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CHEMISTRY

Examination Papers
2008–2014

CONTENT

CBSE EXAMINATION PAPERS

DELHI—2008

Time allowed: 3 hours **Maximum marks: 70**

General Instructions:

(*i*) *All questions are compulsory.*
(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*
(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*
(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*
(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*
(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (Delhi) SET–I

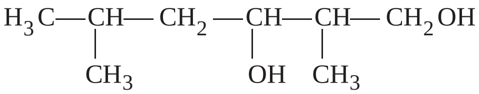
1. What is the coordination number of each type of ions in a rock-salt type crystal structure?

2. Define the term ‘order of reaction’ for chemical reactions.

3. What causes Brownian movement in a colloidal solution?

4. In which one of the two structures, NO_2^+ and NO_2^-, the bond angle has a higher value?

5. Write the IUPAC name of the following compound:



$$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH_2-\underset{OH}{\underset{|}{CH}}-\underset{CH_3}{\underset{|}{CH}}-CH_2OH$$

6. Arrange the following compounds in an increasing order of their acid strengths:

$(CH_3)_2CHCOOH$, $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$

7. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt.

8. Name a substance that can be used as an antiseptic as well as a disinfectant.

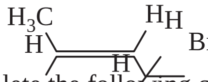
9. Explain as to why haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions.

OR

Which compound in each of the following pairs will react faster in S_N2 reaction with —OH? Why?

(*i*) CH_3Br or CH_3I (*ii*) $(CH_3)_3CCl$ or CH_3Cl

10. (*a*) State the IUPAC name of the following compound:



(*b*) Complete the following chemical equation:

$$CH_3CH_2CH=CH_2 + HBr \xrightarrow{\text{peroxide}} \ldots\ldots$$

11. State Henry’s law correlating the pressure of a gas and its solubility in a solvent and mention two applications of the law.

12. A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its $t_{1/2}$ value.

13. What is meant by the 'rate constant, *k*' of a reaction? If the concentration is expressed in mol L^{-1} units and time in seconds, what would be the units for *k* (i) for a zero order reaction and (ii) for a first order reaction?

14. Define the following terms in relation to proteins:

(*i*) Peptide linkage (*ii*) Denaturation

15. List the reactions of glucose which cannot be explained by its open chain structure.

16. Assign a reason for each of the following statements:

(*i*) Ammonia is a stronger base than phosphine.

(*ii*) Sulphur in vapour state exhibits a paramagnetic behaviour.

17. Draw the structure of the following molecules:

(*i*) SF_4 (*ii*) XeF_4

18. What are biodegradable and non-biodegradable detergents? Give one example of each class.

19. What is a semiconductor? Describe the two main types of semiconductors and explain mechanisms for their conduction.

20. Calculate the temperature at which a solution containing 54 g of glucose, ($C_6H_{12}O_6$), in 250 g of water will freeze. (K_f for water $= 1.86$ K mol^{-1} kg)

21. What are lyophilic and lyophobic sols? Give one example of each type. Which one of these two types of sols is easily coagulated and why?

22. State briefly the principles which serve as basis for the following operations in metallurgy:

(*i*) Froth floatation process

(*ii*) Zone refining

(*iii*) Refining by liquation

23. Write chemical equations for the following processes:

(*i*) Chlorine reacts with a hot concentrated solution of sodium hydroxide.

(*ii*) Orthophosphorous acid is heated

(*iii*) PtF_6 and xenon are mixed together.

OR

Complete the following chemical equations:

(*i*) $Ca_3P_2(s) + H_2O(l) \longrightarrow \ldots$

(*ii*) $Cu^{2+}(aq) + NH_3(aq) \longrightarrow \ldots$ (excess)

(*iii*) $F_2(g) + H_2O(l) \longrightarrow \ldots$

24. (*a*) What is a ligand? Give an example of a bidentate ligand.

(*b*) Explain as to how the two complexes of nickel, $[Ni(CN)_4]^{2-}$ and $Ni(CO)_4$, have different structures but do not differ in their magnetic behaviour. (Ni = 28)

25. Name the reagents which are used in the following conversions:

(*i*) A primary alcohol to an aldehyde

(*ii*) Butan-2-one to butan-2-ol

(*iii*) Phenol to 2, 4, 6-tribromophenol

26. Account for the following observations:

(*i*) pK_b for aniline is more than that for methylamine.

(*ii*) Methylamine solution in water reacts with ferric chloride solution to give a precipitate of ferric hydroxide.

(*iii*) Aniline does not undergo Friedel-Crafts reaction.

27. Write the names and structure of the monomers of the following polymers:
(*i*) Buna-S (*ii*) Neoprene (*iii*) Nylon-6

28. Conductivity of 0.00241 M acetic acid solution is 7.896×10^{-5} S cm^{-1}. Calculate its molar conductivity in this solution. If Λ_m° for acetic acid is 390.5 S cm^2 mol^{-1}, what would be its dissociation constant?

OR

Three electrolytic cells *A*, *B* and *C* containing solutions of zinc sulphate, silver nitrate and copper sulphate, respectively are connected in series. A steady current of 1.5 ampere was passed through them until 1.45 g of silver were deposited at the cathode of cell *B*. How long did the current flow? What mass of copper and what mass of zinc were deposited in the concerned cells? (Atomic masses of Ag = 108, Zn = 65.4, Cu = 63.5)

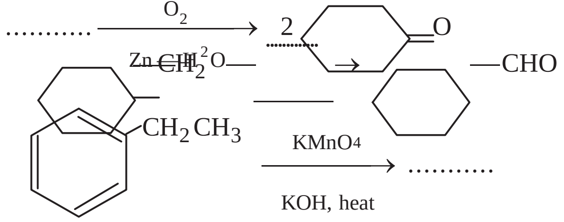
29. Assign reasons for the following:
(*i*) The enthalpies of atomisation of transition elements are high.
(*ii*) The transition metals and many of their compounds act as good catalysts.
(*iii*) From element to element the actinoid contraction is greater than the lanthanoid contraction.
(*iv*) The *E*° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that of Cr^{3+}/Cr^{2+}.
(*v*) Scandium ($Z = 21$) does not exhibit variable oxidation states and yet it is regarded as a transition element.

OR

(*a*) What may be the possible oxidation states of the transition metals with the following *d* electronic configurations in the ground state of their atoms:
$3d^3 4s^2$, $3d^5 4s^2$ and $3d^6 4s^2$. Indicate relative stability of oxidation states in each case.
(*b*) Write steps involved in the preparation of (i) Na_2CrO_4 from chromite ore and (ii) K_2MnO_4 from pyrolusite ore.

30. (*a*) Complete the following reaction statements by giving the missing starting material, reagent or product as required:

(*i*)
(*ii*)
(*iii*)



(*b*) Describe the following reactions:
(*i*) Cannizaro reaction (*ii*) Cross aldol condensation

OR

(*a*) How would you account for the following:
(*i*) Aldehydes are more reactive than ketones towards nucelophiles.
(*ii*) The boiling points of aldehydes and ketones are lower than of the corresponding acids.
(*iii*) The aldehydes and ketones undergo a number of addition reactions.
(*b*) Give chemical tests to distinguish between:
(*i*) Acetaldehyde and benzaldehyde
(*ii*) Propanone and propanol.

CBSE (Delhi) SET–II

Questions Uncommon to Set-I

1. What is the total number of atoms per unit cell in a face-centred cubic (fcc) structure?

2. What is primary cell? Give an example.

6. Write the IUPAC name of the following compound:

$CH_3COCH_2COCH_3$

9. State Raoult's law for solutions of volatile liquids. Taking suitable examples explain the meaning of positive and negative deviations from Raoult's law.

OR

Define the term osmotic pressure. Describe how the molecular mass of a substance can be determined by a method based on measurement of osmotic pressure?

10. The conductivity of a 0.20 M solution of KCl at 298 K is 0.0248 $S\,cm^{-1}$. Calculate its molar conductivity.

11. Formulate the galvanic cell in which the following reaction takes place:

$$Zn(s) + 2Ag^{+}(aq) \longrightarrow Zn^{2+}(aq) + 2Ag(s)$$

State:

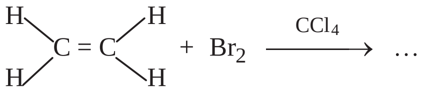
(*i*) Which one of its electrodes is negatively charged?

(*ii*) The reaction taking place at each of its electrode.

(*iii*) The carriers of current within this cell.

14. Complete the following reaction equations:

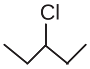
(*i*) $C_6H_5N_2Cl + KI \longrightarrow \ldots$

(*ii*) 

$$H_2C=CH_2 + Br_2 \xrightarrow{CCl_4} \ldots$$

15. (*i*) Why is it that haloalkanes are more reactive than haloarenes towards nucleophiles.

(*ii*) Which one of the following reacts faster in an S_N1 reaction and why?



Or

28. (*a*) Derive the general form of the expression for the half-life of a first order reaction.

(*b*) The decomposition of NH_3 on platinum surface is a zero order reaction. What are the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4}$ mol^{-1} L s^{-1} ?

OR

(*a*) List the factors on which the rate of a chemical reaction depends.

(*b*) The half-life for decay of radioactive ^{14}C is 5730 years. An archaeological artefact containing wood has only 80% of the ^{14}C activity as found in living trees. Calculate the age of the artefact.

29. (*a*) How will you bring about the following conversions?

(*i*) Ethanol to acetone (*ii*) Benzene to acetophenone

(*iii*) Benzoic acid to benzaldehyde

(*b*) Describe the following giving a suitable example in each case:

(*i*) Decarboxylation (*ii*) Cannizaro's reaction

OR

(*a*) An organic compound contains 69.77% carbon, 11.63% hydrogen and the rest is oxygen. The molecular mass of the compound is 86. It does not reduce Tollens' reagent but forms an addition compound with sodium hydrogen sulphite and gives positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acids. Deduce the possible structure of the organic compound.

(*b*) State reasons for the following:

(*i*) Monochloroethanoic acid has a higher *pKa* value than dichloroethanoic acid.

(*ii*) Ethanoic acid is a weaker acid than benzoic acid.

CBSE (Delhi) SET–III

Questions Uncommon to Set-I and Set–II

1. What type of substances exhibit antiferromagnetism?

2. Express the relation between conductivity and molar conductivity of a solution.

3. Which has a higher enthalpy of adsorption, physisorption or chemisorption?

10. The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is $1500\ \Omega$. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3}\ \text{S cm}^{-1}$?

19. How would you account for the following?

(*i*) Frenkel defects are not found in alkali metal halides.

(*ii*) Schottky defects lower the density of related solids.

(*iii*) Impurity doped silicon is a semiconductor.

OR

Explain the following properties giving suitable examples:

(*i*) Ferromagnetism

(*ii*) Paramagnetism

(*iii*) Ferrimagnetism

21. Explain the basic principles of following metallurgical operations:

(*i*) Zone refining

(*ii*) Vapour phase refining

(*iii*) Electrolytic refining

22. Explain what is observed when

(*i*) an electrolyte, KCl, is added to a hydrated ferric oxide sol.

(*ii*) an electric current is passed through a colloidal solution.

(*iii*) a beam of strong light is passed through a colloidal solution.

SOLUTIONS

CBSE (Delhi) SET–I

1. Coordination number of Na^+ ion = 6

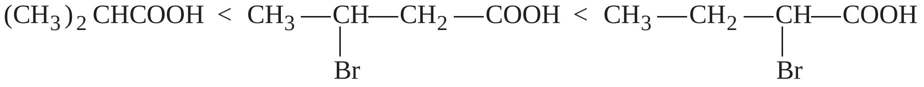
Coordination number of Cl^- ion = 6

2. The sum of powers of the concentrations of the reactants in the rate law expression is called the order of reaction.

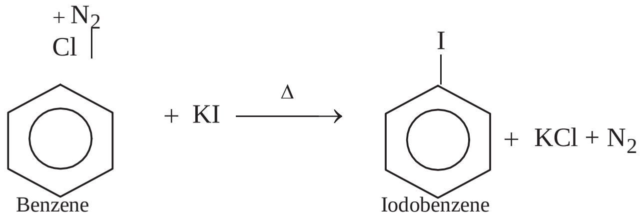
3. This is due to the unequal bombardment of colloidal particles by the molecules of dispersion medium.

4. NO_2^+ has higher bond angle as the central atom nitrogen in NO_2^- has a lone pair of electrons.

5. 2, 5-Dimethyl hexane-1, 3-diol.

6. 

$$(CH_3)_2CHCOOH < CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_2-COOH < CH_3-CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-COOH$$

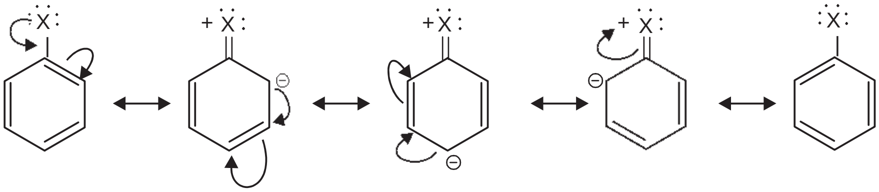
7. 

Benzene diazonium chloride

Iodobenzene

8. Phenol, 0.2% solution of phenol acts as antiseptic where as 1% solution acts as disinfectant.

9. In haloarenes C—X bond acquires a partial double bond character due to resonance. As a result the bond cleavage in haloarenes is difficult than haloalkanes and therefore, they are less reactive towards nucleophilic substitution reaction.



OR

(*i*) CH_3–I reacts faster than CH_3–Br as iodine is a better leaving group because of its larger size.

(*ii*) CH_3–Cl (1° halide) reacts faster than $(CH_3)_3CCl$ (3° halide) since in case tertiary butyl chloride three bulky methyl group hinder the approaching nucleophile.

10. (*a*) 1-Bromo but-2-ene.

(*b*) $$\underset{\text{But-1-ene}}{CH_3-CH_2-CH=CH_2} + H-Br \xrightarrow{\text{Peroxide}} \underset{\text{1-bromo butane}}{CH_3-CH_2-CH_2-CH_2-Br}$$

11. It states that at constant temperature the mass of a gas(m) dissolved in a given volume of the liquid is directly proportional to the pressure of the gas (P) present in equilibrium with the liquid.

Mathematically, $m \propto P$

or $m = K_H P$

where K_H is the Henry's law constant.

Applications of Henry's law are

(*i*) To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.

(*ii*) To minimize the painful effects accompanying the decompression of deep sea divers, oxygen diluted with less soluble helium gas is used as breathing gas.

12. For a first order reaction

$$K = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

when $t = 40$ minutes, $\dfrac{[R]_0}{[R]} = \dfrac{100}{100 - 30} = \dfrac{10}{7}$

$$K = \frac{2.303}{40} \log \frac{10}{7} = \frac{2.303}{40} \log 1.428 = \frac{2.303}{40} \times 0.1548$$

$$K = 8.91 \times 10^{-3} \text{ min}^{-1}$$

$$t_{1/2} = \frac{0.693}{K} = \frac{0.693}{8.91 \times 10^{-3}}$$

$$t_{1/2} = 77.78 \text{ min.}$$

13. Rate constant is the rate of the reaction when the concentration of each reactant is taken as unity.

Q rate $= K[A]^n$

$\therefore$ General unit of $K = \left(\dfrac{\text{mol.}}{\text{lit.}}\right)^{1-n} \text{s}^{-1}$

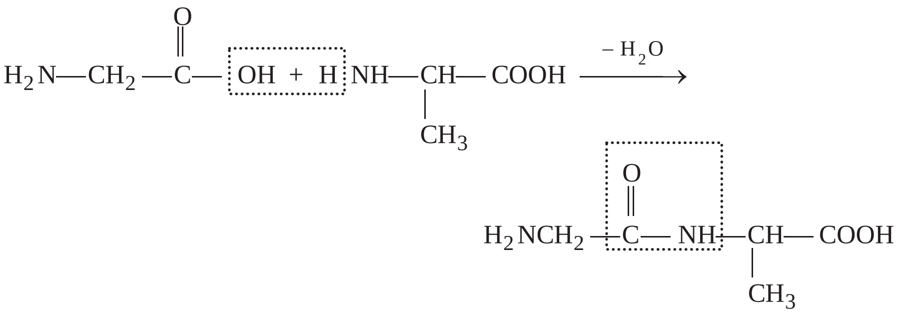
(*i*) For a zero order reaction $n = 0$

$\therefore$ Unit of K = mol lit^{-1} sec^{-1}

(*iii*) For a first order reaction $n = 1$

$\therefore$ Unit of $K = \text{sec}^{-1}$

14. **(*i*) Peptide linkage:** A peptide linkage is an amide linkage (—CONH—) formed between —COOH group of one α-amino acid and NH_2 group of the other amino acid by the elimination of a water molecule.



$$H_2N—CH_2—\overset{\overset{O}{\|}}{C}—\boxed{OH + H}NH—\underset{\underset{CH_3}{|}}{CH}—COOH \xrightarrow{-H_2O} H_2NCH_2—\boxed{\overset{\overset{O}{\|}}{C}—NH}—\underset{\underset{CH_3}{|}}{CH}—COOH$$

Peptide linkage
(Gly-Ala)

(***ii***) **Denaturation:** When a protein in its native form is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and proteins loses its biological activity. During denaturation 2° and 3° structures of proteins are destroyed but 1° structure remains intact, *e.g.*, coagulation of egg white on boiling.

15. The following reactions of glucose cannot be explained by its open chain structure.

(*i*) Despite having the aldehyde group glucose does not give 2, 4-DNP test, Schiffs test and it does not form the hydrogen sulphite addition product with $NaHSO_3$.

(*ii*) The pentacetate of glucose does not react with hydroxylamine indicating the absence of free —CHO group.

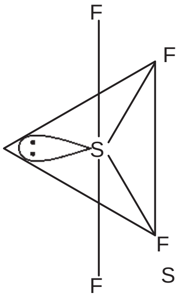
(*iii*) When D-glucose is treated with methanol in the presence of dry hydrogen chloride gas, it gives two isomeric mono methyl derivatives known as α-D glucoside and methyl β-D glucoside. These glucosides do not react with hydrogen cyanide or with hydroxylamine.

16. (*i*) As the atomic size of nitrogen is smaller than phosphorus, therefore electron density on nitrogen atom is higher than that on phosphorus atom. Consequently the tendency of N in NH_3 to donate its lone pair of electrons is much higher than that of P in PH_3. Thus, ammonia is stronger base than phosphine.

(*ii*) In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding π^* orbitals like O_2 and, hence exhibits paramagnetic behaviour.

17. (*i*) sp^3d hybridisation.

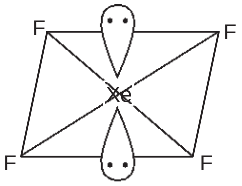
5*e* pairs
b. p. = 4
l. p. = 1



See-saw shape

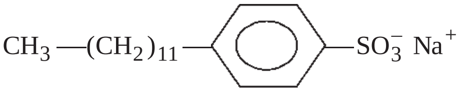
(ii) sp^3d^2 hybridisation

6*e* pairs
b. p. = 4
l. p. = 2

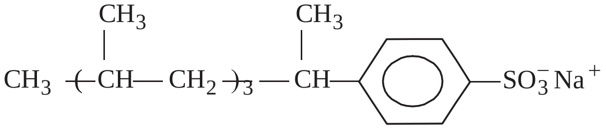


Square planar

18. **Biodegradable detergents:** Detergents having straight hydrocarbon chains are easily degraded by micro-organism and hence called biodegradable detergents, *e.g.*, sodium–4–(1-dodecyl) benzene sulphonate.



Non-biodegradable detergents: Detergents having branched hydrocarbon chains are not easily degraded by micro-organisms and hence are called non-biodegradable detergents, *e.g.*, sodium-4-(1, 3, 5, 7-tetramethyl octyl) benzenesulphonate.



Non-biodegradable detergents accumulate in rivers and waterways thereby causing water pollution.

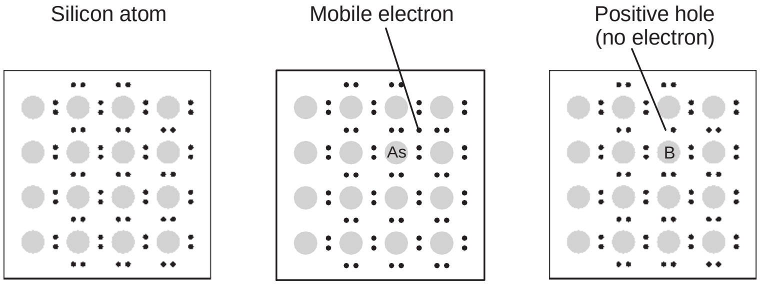
19. **Semiconductor:** These are the solids with conductivities in the intermediate range from 10^{-6} to 10^4 ohm^{-1} m^{-1}.

Semiconductors are of two types

(i) *n*-type of semiconductors (ii) *p*-type of semiconductors

***n*-type semiconductor:** When a silicon or germanium crystal is doped with group 15 element like P or As, the dopant atom forms four covalent bonds like a Si or Ge atom but the fifth electron, not used in bonding, becomes delocalised and contribute its share towards electrical conduction. Thus silicon or germanium doped with P or As is called *n*-type semiconductor, *n* indicative of negative, since it is the electron that conducts electricity.

***p*-type semiconductor:** When silicon or germanium is doped with group 13 element like B or Al, the dopant has only with three, valence electrons. An electron vacancy or a hole is created at the place of the missing fourth electron. Here, this hole moves through the crystal like a positive charge giving rise to electrical conductivity. Thus Si or Ge doped with B or Al is called *p* type of semiconductor, (*P* stands for positive hole) since it is the positive hole that is responsible for conduction.



Perfect crystal n-type p-type

20. Mass of glucose $(W_B) = 54$ g

Molecular mass of glucose $(M_B) = 180$

Mass of water $(W_B) = 250$ g

K_f for water $= 1.86$ k mol^{-1} kg

Applying the formula, $\Delta T_f = \dfrac{K_f \times W_B \times 1000}{M_B \times W_A}$

$$\Delta T_f = \frac{1.86 \times 54 \times 1000}{180 \times 250} = 2.23$$

$$T_f = T^\circ_f - \Delta T_f = 0 - (2.23)$$

$$T_f = -\,2.23^\circ\text{ C}$$

21. **Lyophilic sols:** Lyophilic sols are those sols in which the particles of dispersed phase have great affinity for the dispersion medium, *e.g.*, sols of gum, gelatine, starch, etc.

Lyophobic sols: In this type of sols the particles of dispersed phase have little or no affinity for the dispersion medium, *e.g.*, gold sol, $Fe(OH)_3$ sol, As_2O_3 sol., etc.

Lyophobic sols easily coagulate on the addition of small amount of electrolyte because these are not stable. The stability of Lyophobic sols is only due to the presence of charge on the colloidal particles, on the other hand stability of lyophilic sol. is due to charge as well as solvation of colloidal particles.

22. (*i*) The principle of froth floatation process is that sulphide ore particle are preferentially wetted by pine oil, whereas the gangue particles are wetted by water.

(*ii*) Zone refining is based on the principle that the impurities are more soluble in (liquid state) than in the solid state of the metal.

(*iii*) The principle of refining by liquation is that the impurities whose melting points are higher than the metal are left behind on melting the impure metal. Hence pure metal separates out.

23. (*i*) $$3Cl_2 + \underset{\text{(Hot \& conc.)}}{6NaOH} \longrightarrow 5NaCl + NaClO_3 + 3H_2O$$

(*ii*) $$4H_3PO_3 \xrightarrow{\Delta} 3H_3PO_4 + PH_3$$

(*iii*) $$PtF_6 + Xe \longrightarrow Xe^+[PtF_6]^-$$

OR

(*i*) $$Ca_3P_2(s) + 6H_2O(l) \longrightarrow 2PH_3 + 3Ca(OH)_2$$

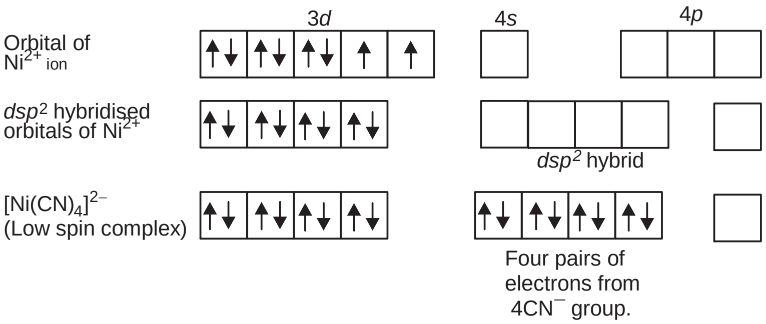
(*ii*) $$\underset{\text{(blue)}}{Cu^{2+}}(aq) + \underset{\text{(excess)}}{4NH_3(aq)} \rightleftharpoons \underset{\text{(deep blue)}}{[Cu(NH_3)_4]^{2+}(aq)}$$

(*iii*) $$2F_2(g) + 2H_2O(l) \longrightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$$

24. **(*a*)** The ion, atom or molecule bound to the central atom/ion in the coordination entity is called ligand. A ligand should have lone pair of electrons in their valence orbital which can be donated to central metal atom/ion.

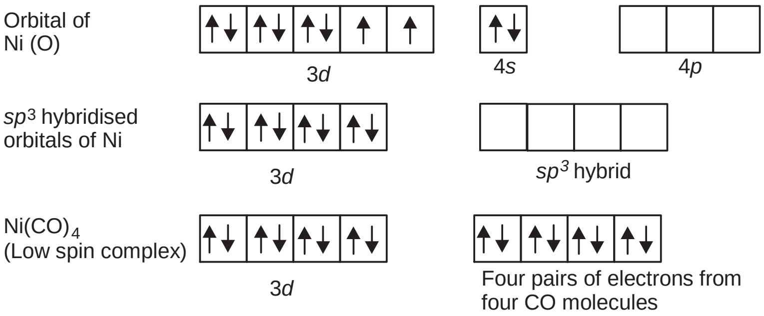
Bidentate ligand: $$\underset{\text{(Ethylene diamine)}}{H_2\overset{\bullet\bullet}{N}{-}CH_2{-}CH_2{-}\overset{\bullet\bullet}{N}H_2}$$

(*b*)



Structure: Square planar.

Magnetic behaviour: Diamagnetic due to the absence of unpaired electrons.



Structure: Tetrahedral

Magnetic behaviour: Diamagnetic due to the absence of unpaired electrons.

25. (*i*) Pyridinium chlorochromate ($C_5H_5\overset{+}{N}HCrO_3Cl^-$) or Cu/573 K

(*ii*) $LiAlH_4$ / ether (*iii*) Br_2 / H_2O

26. (*i*) In aniline due to resonance the lone pair of electrons on the nitrogen atom are delocalized over the benzene ring. As a result, the electron density on the nitrogen decreases. On the other hand, in methyl amine +I effect of CH_3 increases the electron density on the nitrogen atom. Therefore aniline is a weaker base than methyl amine and hence its pK_b value is higher than that of methyl amine.

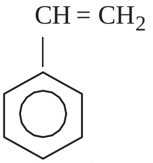
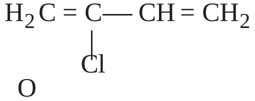
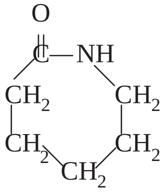
(*ii*)
$$CH_3—NH_2 + H_2O \rightleftharpoons CH_3\overset{+}{N}H_3 + OH^-$$

Due to alkaline nature of solution of methylamine precipitation of $Fe(OH)_3$ occurs.

$$FeCl_3 + 3OH^- \longrightarrow \underset{\substack{\text{Ferric hydroxide}\\\text{(Brown ppt)}}}{Fe(OH)_3\downarrow} + 3Cl^-$$

(*iii*) Aniline being a Lewis base, reacts with lewis acid $AlCl_3$ to form a salt. Due to this N atom of aniline acquires positive charge and hence acts as a strong deactivation group for further reaction.

27.

	Polymer	**Monomer**	**Structure of Monomer**
(i)	Buna-S	Buta-1, 3-diene and styrene	$CH_2 = CH—CH = CH_2$ 
(*ii*)	Neoprene	Chloroprene	 $H_2C = C(Cl)— CH = CH_2$
(*iii*)	Nylon-6	Caprolactum	

28. $c = 0.00241\text{ M}, K = 7.896 \times 10^{-5}\text{ S cm}^{-1}, \lambda_m^\infty = 390.5\text{ S cm}^2\text{ mol}^{-1}$

$$\lambda_m = \frac{K \times 1000}{c}$$

Substituting the values

$$\lambda_m = \frac{7.896 \times 10^{-5} \times 1000}{0.002} = 32.76\text{ S cm}^2\text{ mol}^{-1}$$

$$\alpha = \frac{\lambda^c_m}{\lambda^\infty_m} = \frac{32.76}{390.5} = 0.084$$

$$\alpha = 8.4\%$$

$$\begin{array}{lcll} CH_3\text{—}COOH & \rightleftharpoons & CH_3\text{—}COO^- & + \; H^+ \\ c & & 0 & \quad 0 \\ c(1-\alpha) & & c\alpha & \quad c\alpha \end{array}$$

$$K_a = \frac{[CH_3\text{—}COO^-][H^+]}{[CH_3\text{—}COOH]} = \frac{c\alpha \, . \, c\alpha}{c(1-\alpha)} = \frac{c\alpha^2}{1-\alpha}$$

$$K_a = \frac{0.0241(0.084)^2}{(1-0.084)} = 1.86 \times 10^{-5}$$

OR

$$Ag^+ + e^- \longrightarrow Ag$$

108 g of Ag are deposited by 96500 C

$\therefore$ 1.45 g of Ag will be deposited by $= \frac{96500}{108} \times 1.45\text{ C}$

$= 1295.6\text{ C}$

$$t = \frac{Q}{I} = \frac{1295.6}{1.50} = 863.7\text{ s.}$$

$$Cu^{2+} + 2e^- \longrightarrow Cu$$

2 × 96500 C deposit Cu = 63.5 g

$\therefore$ 1295.6 C deposit Cu $= \frac{63.5}{2 \times 96500} \times 1295.6 = 0.426\text{ g}$

$$Zn^{2+} + 2e^- \longrightarrow Zn$$

2 × 96500 C deposits Zn = 65.3 g

$\therefore$ 1295.6 C deposit Zn $= \frac{65.3}{2 \times 96500} \times 1295.6 = 0.438\text{ g}$

29. (*i*) This is because transition metals have strong metallic bonds as they have a large number of unpaired electrons.

(*ii*) The catalytic activity of transition metals is attributed to the following reasons:

(*a*) Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation energy for the reaction.

(*b*) In some cases, the transition metal provides a suitable large surface area with free valencies on which reactants are adsorbed.

(*iii*) This is due to poorer shielding by 5*f* electrons in actinoids than that by 4*f* electron in the lanthanoids.

(*iv*) This is because half filled *d*-subshell $(3d^5)$ in Mn^{2+} is more stable.

(*v*) This is because scandium has partially filled *d* orbitals in the ground state $(3d^1 4s^2)$.

OR

(*a*)

Electronic Configuration	Element	Possible O.S.	More stable O.S.
$3d^2 4s^2$	Vanadium	+ 2, + 3, + 4, + 5	+ 5
$3d^5 4s^2$	Manganese	+ 2, + 3, + 4, + 5, + 6, + 7	+ 2, + 7
$3d^6 4s^2$	Iron	+ 2, + 3, + 4, + 6	+ 2, + 3

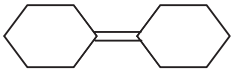
(*b*) (*i*) Chromite ore is fused with sodium carbonate in excess of air.

$$\underset{\text{Chromite ore}}{4FeCr_2O_4} + 8Na_2CO_3 + 7O_2 \longrightarrow \underset{\text{Sod. chromate}}{8Na_2CrO_4} + 2Fe_2O_3 + 8CO_2$$

(*ii*) Pyrolusite ore (MnO_2) is fused with KOH in the presence of O_2 or oxidising agent such as KNO_3.

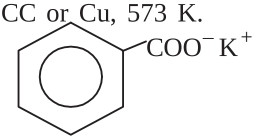
$$\underset{\text{Pyrolusite ore}}{2MnO_2} + 4KOH + O_2 \longrightarrow \underset{\text{Potassium maganate}}{2K_2MnO_4} + 2H_2O$$

30. (*a*) (*i*)



(*ii*) BH_3 / THF, H_2O_2 / OH^-,
PCC or Cu, 573 K.

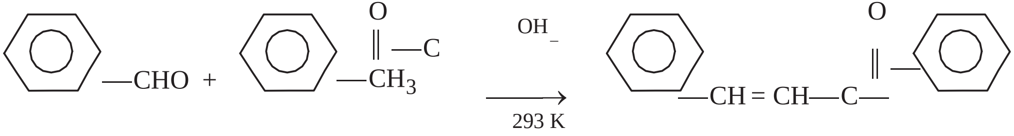
(*iii*)



(*b*) (*i*) **Cannizzaro reaction:** Aldehydes which do not have an α-hydrogen, undergo self oxidation and reduction (disproportionation) reaction on treatment with concentrated alkali. In this reaction one molecule of the aldehyde is reduced to alcohol while another is oxidised to carboxylic acid salt.

$$\underset{\text{Formaldehyde}}{2HCHO} \xrightarrow{\text{conc. KOH}} \underset{\text{Methyl alcohol}}{CH_3—OH} + \underset{\text{Potasium formate}}{HCOO^-K^+}$$

(*ii*) **Cross aldol condensation:** When aldol condensation is carried out between two different aldehydes and/or ketones, it is called cross aldol condensation.



Benzaldehyde Acetophenone Benzal acetophenone

If both of them contain α-hydrogen atoms. It gives a mixture of four products.

OR

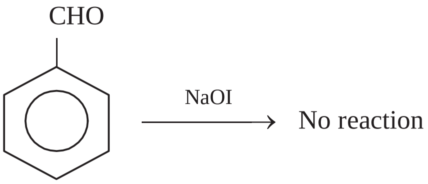
(*a*) (*i*) This is due to steric and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent. Electronically two alkyl groups reduce the positivity of the carbonyl carbon more effectively in ketones than in aldehydes.

(*ii*) This is due to intermolecular hydrogen bonding in carboxylic acids.

(*iii*) Due to greater electronegativity of oxygen than carbon the C atom of the $>C=O$ bond acquires a partial positive charge in aldehydes and ketones and hence readily undergo nucleophilic addition reactions.

(*b*) (*i*) Acetaldehyde reacts with NaOI (I_2 / NaOH) to form yellow ppt of iodoform while benzaldehyde does not give this test.

$$CH_3—CHO + 3NaOI \longrightarrow HCOO^- Na^+ + \underset{\substack{\text{Iodoform} \\ \text{(yellow ppt)}}}{CHI_3} + 2NaOH$$



(*ii*) Propanone give orange-red ppt with 2, 4-DNP reagent and yellow ppt of iodoform with sodium hypoiodite, whereas 1-propanol does not give these tests.

$$CH_3—COCH_3 + 3NaOI \longrightarrow \underset{\substack{\text{Iodoform} \\ \text{yellow ppt.}}}{CHI_3} + CH_3—COO^- Na^+ + 2NaOH$$

$$CH_3—CH_2—CH_2—OH \xrightarrow{NaOI} \text{No yellow ppt. of iodoform}$$

CBSE (Delhi) SET–II

1. 8 (corner atoms) $\times \frac{1}{8}$ atom per unit cell + 6 (face atoms) $\times \frac{1}{2}$ atom per unit cell $= 1 + 3 = 4$

2. A primary cell is one in which the redox reaction occurs only once and the cell becomes dead after some time and cannot be used again, *e.g.*, dry cell.

6. Pentane-2, 4-dione.

9. **Raoult's law:** It states that for a solution of volatile liquids the partial pressure of each component is directly proportional to its mole fraction.

Mathematically

$$P_A \propto x_A \qquad P_B \propto x_B$$
$$P_A = P_A^o x_A \qquad P_B = P_B^o x_B$$

Positive deviation from Raoult's law: In this type of deviation the partial pressure of each component of solution is greater than that calculated from Raoult's law, *i.e.*, $P_A > P_A^o x_A$ & $P_B > P_B^o x_B$. **Example:** A solution of water and ethanol.

Negative deviation from Raoult's: In this type of deviation the partial pressure of each component of solution is less than that expected from Raoult's law, *i.e.*, $P_A < P_A^o x_A$ & $P_B < P_B^o x_B$.

Example: A solution of acetone and chloroform.

OR

Osmotic pressure (π) is defined as the extra pressure that must be applied to the solution side in order to prevent the flow of solvent molecules into it through a semipermeable membrane.

$$\pi = \frac{n_B}{V} RT = CRT$$

where V is the volume of solution in litres containing n_B moles of the solute.
If W_B grams of the solute whose molecular mass M_B is present in the solution then

$$\pi = \frac{W_B RT}{M_B RT}$$

$$M_B = \frac{W_B RT}{\pi V}$$

Thus, knowing W_B, T, π and V molecular mass of the solute, M_B can be calculated.

10. $\kappa = 0.0248 \text{ S cm}^{-1}$, $M = 0.2 \text{ mol L}^{-1}$

Substituting the values

$$\Lambda_m = \frac{\kappa \times 1000}{M} = \frac{0.0248 \times 1000}{0.2}$$

$$\Lambda_m = 1248 \text{ cm}^2 \text{ mol}^{-1}$$

11. $\text{Zn} \left| \text{Zn}^{2+} \text{(conc.)} \right|\left| \text{Ag}^{+} \text{(conc)} \right| \text{Ag}$

(*i*) Zn electrode is negatively charged.

(*ii*) At anode $\qquad \text{Zn} \longrightarrow \text{Zn}^{2+} + 2e^-$

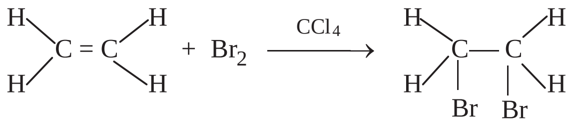
At cathode $\qquad 2\text{Ag}^+ + e^- \longrightarrow 2\text{Ag}$

(*iii*) Current carriers of cell are

- electrons in external wire.
- Zn^{2+} ions in anodic half cell.
- Ag^+ ions in cathodic half cell.
- Ions of salt bridge, *i.e.*, K^+ and Cl^-.

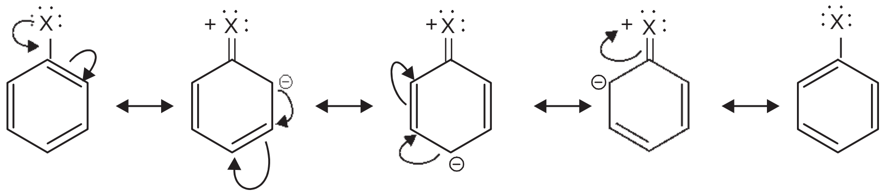
14. (*i*) $$C_6H_5N_2Cl + KI \longrightarrow \underset{\text{Iodobenzene}}{C_6H_5I} + KCl + N_2$$

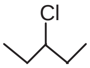
(*ii*)



1, 2-Dibromoethane

15. (*i*) In haloarenes C—X bond acquires a partial double bond character due to resonance. As a result the bond cleavage in haloarenes is difficult than haloalkanes and therefore, they are less reactive towards nucleophilic substitution reaction.



(*ii*)  Or 

I II

Compound (I) reacts faster in S_N1 reaction as it is a 2° alkyl halide.

28. (*a*) Consider the first order reaction

$$R \longrightarrow P$$

$$\text{Rate} = -\frac{d\,[R]}{dt} = K\,[R]$$

or $$\frac{d\,[R]}{[R]} = -\,K\,dt$$

Integrating both the sides we get

$$ln\,[R] = -\,Kt + C \qquad \ldots\text{(i)}$$

when $t = 0$, $R = [R]_0$ where $[R]_0$ is the initial concentration of the reactant.

Therefore equation (i) can be written as

$$ln\,[R]_0 = -\,K \times 0 + C$$

$$ln\,[R]_0 = C$$

Substituting the value of C in equation (i)

$$ln\,[R] = -\,Kt + ln\,[R]_0$$

$$Kt = ln\,[R]_0 - ln\,[R]$$

$$Kt = \frac{ln\,[R]_0}{[R]}$$

$$Kt = 2.303\,\log\frac{[R]_0}{[R]} \qquad \Rightarrow \qquad t = \frac{2.303}{K}\log\frac{[R]_0}{[R]}$$

when $t = t_{1/2}$ $\quad [R] = \dfrac{[R]_0}{2}$

$$\therefore \quad t_{1/2} = \frac{2.303}{K}\log\frac{[R]_0}{\frac{[R]_0}{2}}$$

$$t_{1/2} = \frac{2.303}{K}\log 2 = \frac{2.303}{K} \times 0.3010$$

$$\therefore \quad t_{1/2} = \frac{0.693}{K}$$

(*b*) $$2NH_3 \longrightarrow N_2 + 3H_2$$

For a zero order reaction

$$\text{Rate} = K\,[NH_3]^0$$

$$\text{Rate} = K = 2.5 \times 10^{-4}$$

$$\text{Rate} = -\frac{1}{2}\frac{d\,[NH_3]}{dt} = \frac{d\,[N_2]}{dt} = \frac{1}{3}\frac{d\,[H_2]}{dt}$$

$$\therefore \quad \frac{d\,[N_2]}{dt} = 2.5 \times 10^{-4}\ \text{mol L}^{-1}\ \text{S}^{-1}$$

$$\frac{d\,[H_2]}{dt} = \frac{3d\,[N_2]}{dt} = 3 \times 2.5 \times 10^{-4}\ \text{mol L}^{-1}\ \text{S}^{-1}$$

$$\frac{d\,[H_2]}{dt} = 7.5 \times 10^{-4}\ \text{mol L}^{-1}\ \text{S}^{-1}$$

OR

(*a*) Rate of reaction depends on

(*i*) Concentration
(*ii*) Temperature
(*iii*) Nature of reactant
(*iv*) Pressure of the gaseous reactant
(*v*) Surface area
(*vi*) Catalyst

(*b*) $t_{1/2} = 5730$ years

$$\therefore \quad K = \frac{0.693}{t_{1/2}} = \frac{0.693}{5730} = 1.209 \times 10^{-4}\ \text{year}^{-1}$$

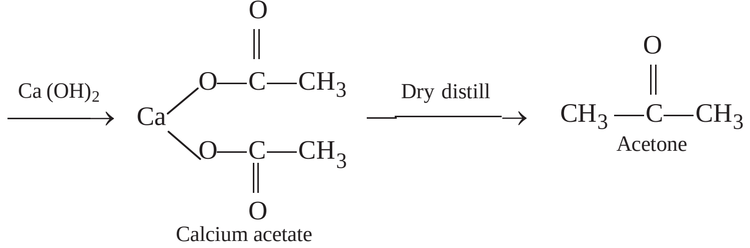
$$t = \frac{2.303}{K} \log \frac{[R]_0}{[R]} = \frac{2.303}{1.2 \times 10^{-4}} \log \frac{100}{80}$$

$$t = \frac{2.303 \times 10^4}{1.2} (\log 10 - \log 8) = \frac{2.303 \times 10^4}{1.2} (1 - 3 \log 2)$$

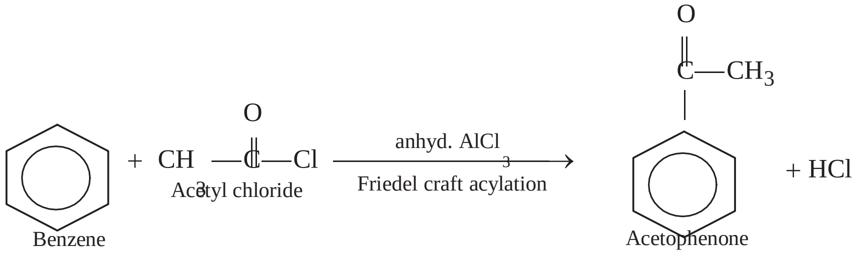
$$t = \frac{2.303}{1.2} \times 10^4 (1 - 3 \times 0.3010) = \frac{2.303 \times 0.097 \times 10^4}{1.209}$$

$$t = 1847.7 \text{ years}$$

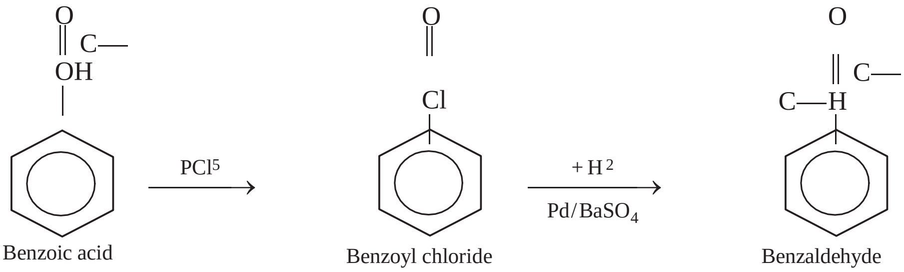
29. (*a*) (*i*) $\underset{\text{Ethyl alcohol}}{CH_3—CH_2—OH} \xrightarrow[(O)]{K_2Cr_2O_7/H_2SO_4} CH_3—CHO \xrightarrow{(O)} \underset{\text{Acetic acid}}{CH_3—COOH}$



(*ii*)

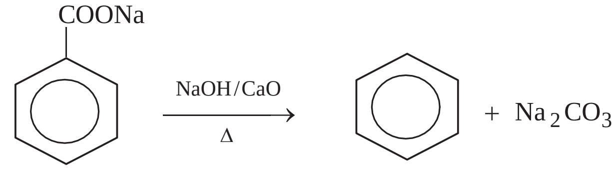


(*iii*)



(*b*) **(*i*) Decarboxylation:** Carboxylic acids lose CO_2 to form hydrocarbons when their sodium salts are heated with soda lime (NaOH and CaO in the ratio 3: 1).

$$R—COONa \xrightarrow[\Delta]{\text{NaOH and CaO}} R—H + Na_2CO_3$$



Sodium benzoate Benzene

(*ii*) Cannizzaro Reaction: Aldehydes which do not have an α-hydrogen atom, undergo disproportionation reaction on treatment. In this reaction, one molecule of the aldehyde is reduced to alcohol while the other is oxidised to carboxylic acid.

$$\underset{\text{Formaldehyde}}{2HCHO} \xrightarrow{\text{conc. NaOH}} \underset{\text{Methyl alcohol}}{CH_3—OH} + \underset{\text{Sodium formate}}{HCO\overset{-}{O}\overset{+}{Na}}$$

OR

(*a*) % C = 69.77%, %H = 11.63%

%O = 100 – (69.77 + 11.63) = 18.6%

$$C:H:O = \frac{69.77}{12} : \frac{11.63}{1} = \frac{18.6}{16} = 5.81 : 11.63 : 1.16$$

$\therefore$ $C:H:O = 5:10:1$

The empirical formula of the given compound is $C_5H_{10}O$.

$$n = \frac{\text{molecular mass}}{\text{Empirical formula mass}}$$

Molecular mass = 86

Empirical formula mass = $5 \times 12 + 10 \times 1 + 1 \times 16 = 86$

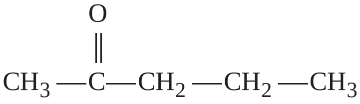
$$n = \frac{86}{81} = 1$$

$\therefore$ Molecular formula = n (Empirical formula)

$= C_5H_{10}O$

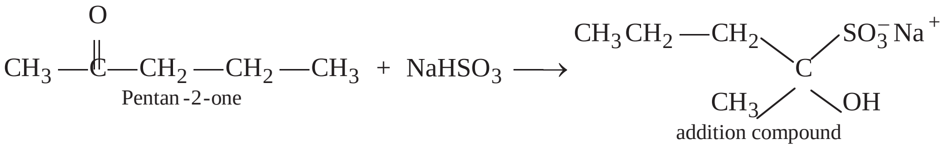
The (forms addition compound with $NaHSO_3$) given organic compound is methyl ketone as it gives positive iodoform test and also does not reduce Tollen's reagent.

Since on oxidation it gives ethanoic and propanoic acid its possible structural formula is



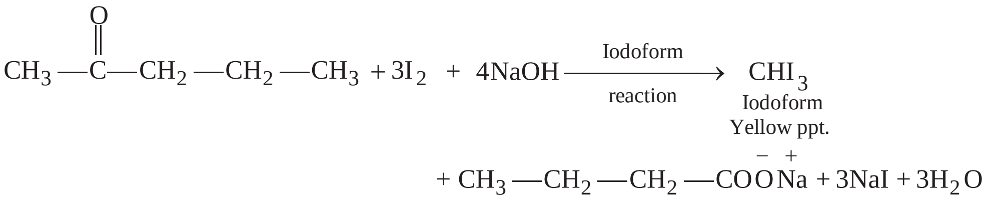
$$CH_3—\overset{\overset{\large O}{\|}}{C}—CH_2—CH_2—CH_3$$

Reactions involved:

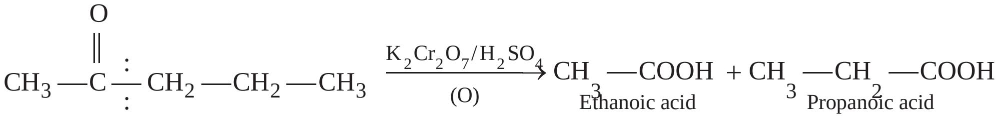


Pentan-2-one

addition compound



$$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3 + 3I_2 + 4NaOH \xrightarrow[\text{reaction}]{\text{Iodoform}} \underset{\substack{\text{Iodoform}\\ \text{Yellow ppt.}}}{CHI_3} + CH_3-CH_2-CH_2-CO\overset{-}{O}\overset{+}{Na} + 3NaI + 3H_2O$$



$$CH_3-\overset{\overset{O}{\|}}{C}\,\vdots\,CH_2-CH_2-CH_3 \xrightarrow[(O)]{K_2Cr_2O_7/H_2SO_4} \underset{\text{Ethanoic acid}}{CH_3-COOH} + \underset{\text{Propanoic acid}}{CH_3-CH_2-COOH}$$

(*b*) (*i*) This is because dichloroethanoic acid is a stronger acid than monochloroethanoic acid.

(*ii*) This is because methyl group due to its positive inductive effect destabilize the acetate anion by intensifying the negative charge.

CBSE (Delhi) SET–III

1. Substance in which domains are oppositely oriented and cancel out each other magnetic moments.

2.

$$\lambda_m = \frac{\kappa \times 1000}{c}$$

where, Λ_m = Molar conductivity

κ = Conductivity

c = Molar concentration

3. Chemisorption

10.

$$\kappa = \frac{1}{R} \times \text{cell constant}$$

$\kappa = 0.146 \times 10^{-3}\ \text{S cm}^{-1}, \quad R = 1500\ \text{ohm}$

$$0.146 \times 10^{-3} = \frac{1}{1500} \times \text{cell constant}$$

$$\text{cell constant} = 0.146 \times 10^{-3} \times 1500 = 219 \times 10^{-3} = 0.219\ \text{cm}^{-1}$$

19. (*i*) This is because alkali metal ions have larger size which cannot fit into interstitial sites.

(*ii*) As the number of ions decreases as a result of Schottky defect, the mass decreases whereas the volume remains the same.

(*iii*) This is due to additional electron or creation of hole on dopping with impurity.
Creation of hole causes *p*-type semiconductor and creation of electron causes *n*-type semiconductor.

OR

(*i*) **Ferromagnetism:** Ferromagnetic substances are those substance which are strongly attracted by external magnetic fielding, *e.g.*, (iron, cobalt, nickle and CrO_2, etc.] Ferromagnetism arises due to spontaneous alignment of magnetic moments in the same direction.

Alignment of magnetic moments in ferromagnetic substance.

(*ii*) **Paramagnetism:** Paramagnetic substances are those substances which are weakly attracted by magnetic field. It is due to the presence of one or more unpaired electrons, *e.g.*,O_2, Fe^{3+}, Cr^{3+}, etc.

(*iii*) **Ferrimagnetism:** Ferrimagnetism is observed when the magnetic moments of the domains in the substance are aligned in parallel and antiparallel directions in unequal number resulting in some net magnetic moment, *e.g.*, Fe_3O_4 (magnetite) and ferrites like $MgFe_2O_4$, etc.

21. (*i*) Zone refining is based on the principle that the impurities are more soluble in the melt in than solid state of metal.

(*ii*) **Vapour phase refining.**

In this, metal is converted into its volatile compound and collected elsewhere. It is the decomposed to give pure metal. So, the two requirements are:

(*a*) the metal should form a volatile compound with an available reagent.

(*b*) the volatile compound should be easily decomposable, so that the recovery is easy.

(*iii*) In electrolytic refining impure metal is made to act as anode. A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal. When electric current is passed, impure metal forms metal ions which are discharged at cathode forming pure metal.

Anode: $M \longrightarrow M^{n+} + ne^-$

Cathode: $M^{n+} + ne^- \longrightarrow M$

22. (*i*) The positively charged colloidal particles of $Fe(OH)_3$ get coagulated by the oppositely charged Cl^- ions provided by KCl.

(*ii*) On passing direct current, colloidal particles move towards the oppositely charged electrode where they lose their charge and get coagulated.

(*iii*) Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

CBSE EXAMINATION PAPERS

ALL INDIA—2008

Time allowed: 3 hours **Maximum marks: 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (All India) SET–I

1. Define the 'forbidden zone' of an insulator.

2. Mention two ways by which lyophilic colloids can be coagulated.

3. Mention all the oxidation states exhibited by chlorine in its compounds.

4. Why are lower members of aldehydes easily miscible with water?

5. Why do amines behave as nucleophiles?

6. What are disaccharides? Give an example.

7. Define the term 'polymerisation'.

8. What is understood by 'chemotherapy'?

9. Define osmotic pressure. How is it that measurement of osmotic pressures is more widely used for determining molar masses of macromolecules than the rise in boiling point or fall in freezing point of their solutions?

OR

Derive an equation to express that relative lowering of vapour pressure for a solution is equal to the mole fraction of the solute in it when the solvent alone is volatile.

10. The conductivity of 0.20 M solution of KCl at 298 K is 0.0248 S cm^{-1}. Calculate its molar conductivity in this solution.

11. Assign reasons for the following :

(*i*) In liquid state, hydrogen chloride is a stronger acid than hydrogen fluoride.

(*ii*) Phosphorus (P_4) is much more reactive than nitrogen (N_2).

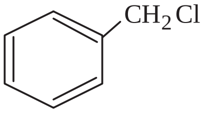
12. Discuss the relative stability in aqueous solutions of +2 oxidation state among the elements : Cr, Mn, Fe and Co. How would you justify this situation?

(At. Nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

13. What happens when bromine reacts with $CH_3 — C \equiv CH$? How would you justify this reaction?

14. Write the IUPAC names of the following compounds :

(*i*) $(CH_3)_3CCH_2Br$

(*ii*) 

15. Alcohols react both as nucleophiles as well as electrophiles. Write one reaction of each type and describe its mechanism.

16. How would you carry out the following conversions?

(*i*) Ethyl magnesium chloride to propan-1-ol

(*ii*) Benzyl chloride to benzyl alcohol

17. Write the structures of the monomers of the following polymers :

(*i*) PVC

(*ii*) Polypropene

18. What are biodegradable and non-biodegradable detergents? Give one example of each type.

19. Niobium (Nb) crystallises in a body-centred cubic (bcc) structure. If its density is 8.55 g cm^{-3}, calculate the atomic radius of niobium.

(Atomic mass of Nb = 93 u; $N_A = 6.02 \times 10^{23}$ mol^{-1})

OR

Explain with suitable examples the following :

(*a*) *n*-type and *p*-type semiconductors

(*b*) F-centres

(*c*) Ferromagnetism

20. Calculate the amount of KCl which must be added to 1 kg of water so that its freezing point is depressed by 2 K.

(K_f for water = 1.86 K kg mol^{-1}, Atomic mass K = 39, Cl = 35.5)

21. In the button cells widely used in watches and other devices the following reaction takes place :

$$Zn(s) + Ag_2O + H_2O(l) \longrightarrow Zn^{2+}(aq) + 2\,Ag(s) + 2OH^-\ (aq)$$

Determine $\Delta_r G°$ for the reaction.

(Given : $E°_{Zn^{2+}/Zn} = -\,0.76$ V and $E°_{Ag^+/Ag} = +\,0.34$ V)

22. Explain what is observed when

(*i*) a beam of light is passed through a colloidal solution.

(*ii*) an electrolyte NaCl, is added to hydrated ferric oxide sol.

(*iii*) an electric current is passed through a colloidal sol.

23. Write the chemical reactions which take place in the following operations :

(*i*) Electrolytic reduction of Al_2O_3.

(*ii*) Isolation of zinc from zinc blende.

(*iii*) Mond's process for refining nickel.

24. Compare actinoids and lanthanoids with reference to their :

(*i*) electronic configurations of atoms

(*ii*) oxidation states of elements

(*iii*) general chemical reactivity of elements.

25. Write the IUPAC name and describe the magnetic behaviour (diamagnetic or paramagnetic) of the following coordination entities:

(*i*) $[Cr(H_2O)_2(C_2O_4)_2]^-$

(*ii*) $[Co(NH_3)_5$

$Cl]^{2+}$ (*iii*) $[NiCl_4]^{2-}$

(At. Nos. : Cr = 24, Co = 27, Ni = 28)

26. Account for the following :

(*i*) pK_b of methylamine is less than that of aniline.

(*ii*) Aniline does not undergo Friedel–Crafts reaction.

(*iii*) Ethylamine is freely soluble in water whereas aniline is only slightly soluble.

27. Define the following in relation to proteins :

(*i*) Primary structure

(*ii*) Denaturation

(*iii*) Peptide linkage

28. (*a*) A reaction is of first order in A and of second order in B. Write the differential rate equation for this reaction.

How will its initial rate be affected if the concentration of both A and B are together doubled?

(*b*) The rate constant k of a reaction increases four fold when the temperature changes from 300 K to 320 K. Calculate the activation energy for the reaction. (R = 8.314 J mol^{-1} K^{-1})

OR

(*a*) List the factor which affect the rate of a chemical reaction.

(*b*) The half-life for radioactive ^{14}C is 5730 years. The wooden part of an archaeological artefact has only 80% of the ^{14}C activity found in fresh wood. Calculate the age of the artefact.

29. (*a*) Assign reasons for the following :

(*i*) Bi (V) is a stronger oxidising agent than Sb (V).

(*ii*) Of the noble gases only xenon is known to form established chemical compounds.

(*b*) Draw the structures of the following molecules :

(i) $H_2S_2O_7$ (ii) BrF_3 (iii) XeF_2

OR

(*a*) Complete the following chemical reaction equations :

(*i*) $Ca_3P_2 + H_2O \longrightarrow$

(*ii*) $XeF_4 + H_2O \longrightarrow$

(*b*) How would you account for the following observations :

(*i*) NH_3 is a stronger base than PH_3.

(*ii*) Sulphur in vapour state exhibits paramagnetism.

(*iii*) Hydrogen fluoride has a higher boiling point than hydrogen chloride.

30. (*a*) Illustrate the following reactions giving one example for each :

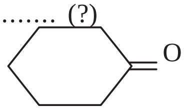
(*i*) Cannizzaro reaction

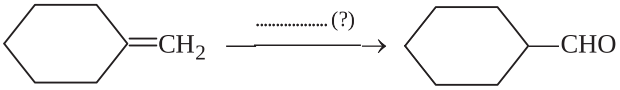
(*ii*) Decarboxylation

(*b*) Complete the following reaction equations by giving the indicated missing substances :

(*i*) $CH_3CHO \xrightarrow{H_2NCONHNH_2}$ .... (?)

(*ii*) (?) .... $\xrightarrow[\text{(ii) Zn}-H^2O]{\text{(i) } O_3}$ 2



(*iii*) 

OR

(*a*) State tests to distinguish between the following pairs of compounds :
  (*i*) Propanal and propanone
  (*ii*) Phenol and benzoic acid

(*b*) How will you bring about the following conversions :
  (*i*) Propanone to propene
  (*ii*) Benzaldehyde to benzophenone
  (*iii*) Ethanol to 3-hydroxybutanal

CBSE (All India) SET–II

Questions Uncommon to Set-I

1. Which crystal defect lowers the density of a solid?

6. What are reducing sugars? Give one example.

8. What is tincture of iodine?

10. Define the following terms giving an example for each:
  (*i*) The order of a reaction
  (*ii*) The molecularity of a reaction

18. Why do soaps not function in hard water, for washing clothes? How are synthetic detergents better than soaps for this purpose?

21. The rate constant for a first order reaction is 60 s^{-1}. How much time will it take to reduce the initial concentration of the reactant to 1/16th of its initial value?

23. Describe the principle involved in the following metallurgical operations:
  (*i*) Zone refining
  (*ii*) Electrolytic refining
  (iii) Froth-floatation process of concentrating sulphide ores

27. What happens when D-glucose is treated with the following reagents?
  (*i*) HNO_3
  (*ii*) Bromine water
  (*iii*) HI

Indicate the products formed.

28. (*a*) Depict the galvanic cell in which the following reaction takes place:

$$\text{Zn (s)} + 2\text{Ag}^{+}\text{(aq)} \longrightarrow \text{Zn}^{2+}\text{(aq)} + 2\text{Ag (s)}$$

Also indicate that in this cell
  (*i*) which electrode is negatively charged.
  (*ii*) what are the carrier of the current in the cell.
  (*iii*) what is the individual reaction at each electrode.

(*b*) Write the Nernst equation and determine the e.m.f. of the following cell at 298 K:

$$\text{Mg (s)} \mid \text{Mg}^{2+}\text{(0.001 M)} \parallel \text{Cu}^{2+}\text{(0.0001 M)} \mid \text{Cu (s)}$$

(Given : $E^\circ_{Mg^{2+}/Mg} = -2.375$ V, $E^\circ_{Cu^{2+}/Cu} = +0.34$ V)

OR

(*a*) Define conductivity and molar conductivity for the solution of an electrolyte. How do they vary when the concentration of electrolyte in the solution increases?

(*b*) Three conductivity cells A, B and C containing solutions of zinc sulphate, silver nitrate and copper sulphate respectively are connected in series. A steady current of 1.5 amperes is passed through them until 1.45 g of silver is deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc got deposited in their respective cells?
(Atomic mass : Zn = 65.4 u, Ag = 108 u, Cu = 63.5 u)

CBSE (All India) SET–III

Questions Uncommon to Set-I and Set–II.

1. Name an element with which silicon may be doped to give a *p*-type semiconductor.

10. What is meant by a pseudo first order reaction? Give an example of a pseudo first order reaction and write the rate equation for the same.

12. Assign a reason for each of the following:

(*i*) The third ionization energy of Mn ($Z = 25$) is higher than that of either Cr ($Z = 24$) or Fe ($Z = 26$).

(*ii*) Simple copper (I) salts are not stable in aqueous solutions.

18. What are artificial sweetening agents? Give two examples.

21. The rate constant for a first order reaction is $60\ \text{s}^{-1}$. How much time will it take to reduce the initial concentration of reactant to $1/10^{\text{th}}$ of its value?

24. Describe the trends in the following properties of the first series of the transition elements :

(*i*) Oxidation states

(*ii*) Atomic sizes

(*iii*) Magnetic behaviour of dipositive gaseous ions (M^{2+})

SOLUTIONS

CBSE (All India) SET–I

1. The difference of energy between conduction band and valence band is called forbidden zone and for insulator its value is averaging between 3–6 eV.
2. This can be done
   (*i*) by adding an electrolyte.
   (*ii*) by adding a suitable solvent.
3. Cl_2 exhibits $-1, +1, +3, +5, +7$ oxidation states in its compounds.
4. Lower members aldehydes are able to form intermolecular hydrogen bonds with water molecules. Hence, they are easily miscible with water.
5. Due to the presence of a lone pair of electrons on nitrogen atom.
6. Carbohydrates that yield two monosaccharide units, on hydrolysis are called disaccharides, *e.g.*, sucrose.
7. The process of formation of polymers from respective monomers is called polymerisation.

$$\underset{\substack{\text{Ethene}\\\text{(monomer)}}}{nCH_2 = CH_2} \xrightarrow[\text{Polymerisation}]{O_2,\ 350K\text{-}570\ K,\ 1000\text{-}2000\ atm} \underset{\substack{\text{Polyethene (LDP)}\\\text{(polymer)}}}{-\!\!(CH_2 - CH_2)\!\!-_n}$$

8. **Chemotherapy:** It is the branch of chemistry which deals with the treatment of diseases using suitable chemicals.
9. Osmotic pressure (π) may be defined as the extra pressure that must be applied to the solution to prevent the flow of solvent molecules into it through a semipermeable membrane.

$$\pi = \frac{n_B}{V} RT = CRT$$

$$\pi = \frac{W_B . R.T}{M_B . V}$$

where V is the volume of solution in litre containing n_B moles of solute of molecular mass M_B.
Thus knowing π, W_B, T and V molecular mass of the solute M_B can be calculated.

The osmotic pressure method has the advantage over rise in boiling point or fall in freezing point for determining molar masses of macromolecules because

(*i*) Osmotic pressure is measured at the room temperature and the molarity of solution is used instead of molality.

(*ii*) Compared to other colligative properties, its magnitude is large even for very dilute solutions.

OR

For a solution of volatile liquids Raoult's law, is given as

$$P = P_A + P_B$$

If solute (component B) is non-volatile then

$$P = P_A = P_A^o x_A$$

$$P = P_A^o (1 - x_B) \qquad (\because\ x_A + x_B = 1)$$

$$P = P_A^o - P_A^o x_B$$

$$P_A^o x_B = P_A^o - P$$

$$\frac{P_A^o - P}{P_A^o} = x_B$$

Thus, relative lowering of vapour pressure is equal to the mole fraction of non-volatile solute.

10. $K = 0.0248 \text{ S cm}^{-1}$

$M = 0.2 \text{ mol L}^{-1}$

$$\lambda_m = \frac{K \times 1000}{M} = \frac{0.0248 \times 1000}{0.2}$$

$$\lambda_m = 124 \text{ S cm}^2 \text{ mol}^{-1}$$

11. (*i*) It is due to

(*a*) Intermolecular hydrogen bonding in HF.

(*b*) Higher H—F bond dissociation enthalpy than H—Cl.

(*ii*) As P—P single bond (213 kJ mol^{-1}) in P_4 is much weaker than $N \equiv N$ triple bond ($941.4 \text{ kJ mol}^{-1}$) in N_2.

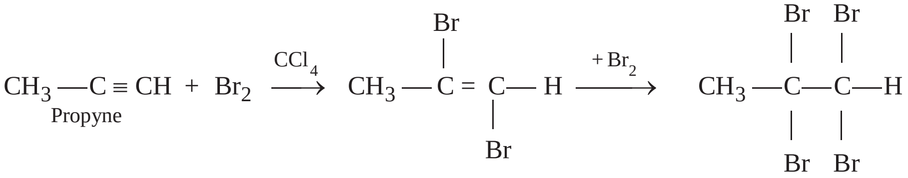
12. On the basis of electrochemical series the standard electrode potential shows the following order

$$E^\circ_{Mn^{2+}/Mn} < E^\circ_{Cr^{2+}/Cr} < E^\circ_{Fe^{2+}/Fe} < E^\circ_{Co^{2+}/Co}$$

Therefore, Co^{2+} gets easily reduced to metallic cobalt while it is difficult to reduce Mn^{2+}. Hence Mn^{2+} will be most stable and the increasing stability order will be

$$Co^{2+} < Fe^{2+} < Cr^{2+} < Mn^{2+}$$

13. When bromine reacts with propyne, the reddish brown colour of bromine is discharged as long as propyne is present in excess.

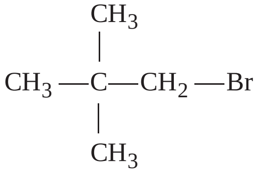


$$\underset{\text{Propyne}}{CH_3—C \equiv CH} + Br_2 \xrightarrow{CCl_4} CH_3—\underset{}{\overset{Br}{C}} = \underset{Br}{C}—H \xrightarrow{+Br_2} CH_3—\overset{Br}{\underset{Br}{C}}—\overset{Br}{\underset{Br}{C}}—H$$

1, 1, 2, 2, Tetra Bromo propane (colourless)

This is due to the formation of 1, 1, 2, 2-tetrabromo propane which is colourless.

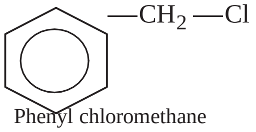
14. (*i*)



$$CH_3—\overset{CH_3}{\underset{CH_3}{C}}—CH_2—Br$$

1-Bromo-2, 2-dimethyl propane

(*ii*)



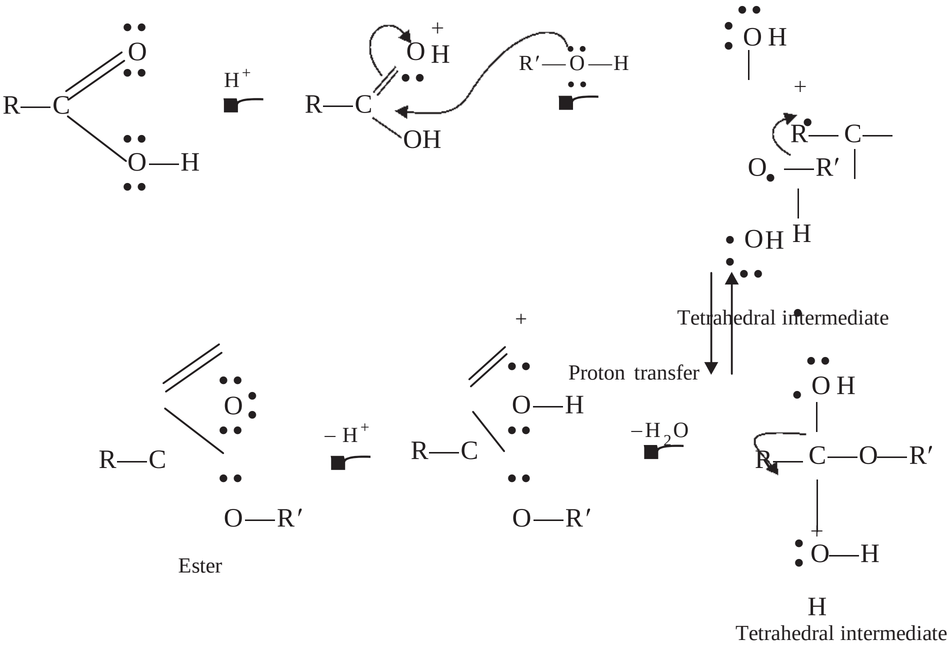
Phenyl chloromethane

15. Alcohols as nucleophile:

The bond between O—H is broken when an alcohol reacts as a nucleophile.

$$\underset{\text{Carboxylic acid}}{R—COOH} + \underset{\text{Alcohol}}{R'—OH} \overset{H^+}{\rightleftharpoons} \underset{\text{Ester}}{R—COOR'} + H_2O$$

Mechanism:



Alcohols as electrophile:

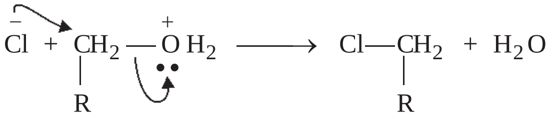
The bond between C—O is broken when alcohols react as electrophiles.

$$R-CH_2-O-H + HCl \longrightarrow R-CH_2-Cl + H_2O$$

Alcohol

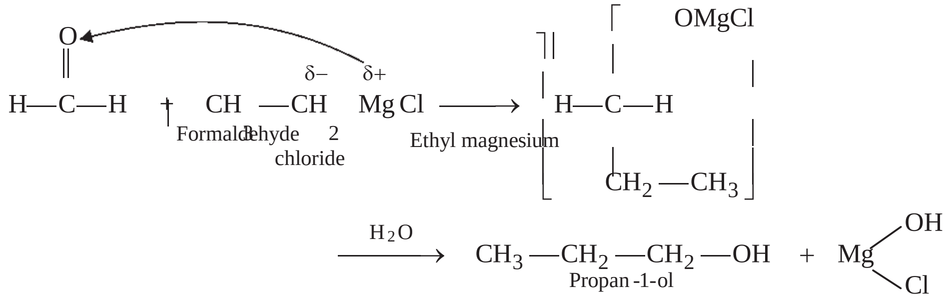
Mechanism

$$R-CH_2-\ddot{\underset{\cdot\cdot}{O}}-H + H^+ \longrightarrow R-CH_2-\overset{+}{\underset{\cdot\cdot}{O}}H_2$$

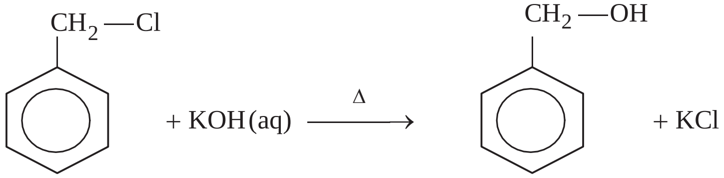


$$\overset{-}{Cl} + \underset{\displaystyle R}{\underset{|}{CH_2}}-\overset{+}{\underset{\cdot\cdot}{O}}H_2 \longrightarrow Cl-\underset{\displaystyle R}{\underset{|}{CH_2}} + H_2O$$

16. (*i*)



(*ii*)



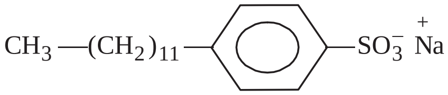
Benzyl chloride

Benzyl alcohol

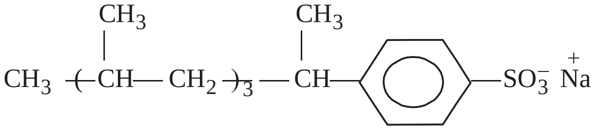
17.

	Polymer	Monomer	Structure of the monomer
(*i*)	PVC	Vinyl chloride	$CH_2 = CH—Cl$
(*ii*)	Polypropene	Propene	$CH_3—CH = CH_2$

18. **Biodegradable detergents:** Detergents having straight hydrocarbon chains are easily degraded by micro-organism and hence called biodegradable detergents, *e.g.*, sodium–4–(1-dodecyl) benzene sulphonate.



Non-biodegradable detergents: Detergents having branched hydrocarbon chains are not easily degraded by the micro-organism and hence are called non-biodegradable detergents, *e.g.*, sodium-4-(1, 3, 5, 7-**tetramethyl octyl**) benzenesulphonate.



Non-biodegradable detergents accumulate in rivers and waterways thereby causing water pollution.

19. $d = 8.55\ g/cm^3$, $M = 93\ g/mol$

For bcc, $z = 2$, $a = ?$ $N_A = 6.02 \times 10^{23}$

$$d = \frac{z \times M}{a^3 \times N_A}$$

Substituting the values

$$8.55 = \frac{2 \times 93}{a^3 \times 6.02 \times 10^{23}}$$

$$a^3 = \frac{2 \times 93}{8.55 \times 6.02 \times 10^{23}}$$

$$a = \left(\frac{8.55 \times 3.01}{930}\right)^{1/3} 10^{-8}$$

$$x = \left(\frac{930}{8.55 \times 3.01}\right)^{1/3}$$

Let

$$\log x = \log\left(\frac{930}{8.55 \times 3.01}\right)^{1/3}$$

∴

$$= \frac{1}{3}(\log 930 - \log 8.55 - \log 3.01)$$

$$= \frac{1}{3}(2.9685 - 0.9320 - 0.4786)$$

$$\log x = \frac{1}{3}(1.5579) = 0.5193$$

$$x = \text{Antilog}\,(0.5193)$$

$$x = 3.306$$

$$a = 3.306 \times 10^{-8}\ \text{cm}$$

∴

Now $$r = \frac{\sqrt{3}}{4} a$$

$\therefore$ $$r = \frac{\sqrt{3}}{4} \times 3.306 \times 10^{-8} = \frac{1.732 \times 3.306 \times 10^{-8}}{4}$$

$$r = 1.4315 \times 10^{-8} \text{ cm} = 143.15 \times 10^{-10} \text{ cm}$$

$$r = 143.15 \text{ pm}$$

OR

(*a*) ***n*-type semiconductor:** When a silicon or germanium crystal is doped with group 15 element like P or As, the dopant atom forms four covalent bonds like a Si or Ge atom but the fifth electron, not used in bonding, becomes delocalised and contribute its share towards electrical conduction. Thus silicon or germanium doped with P or As is called *n*-type semiconductor, *n* indicative of negative, since it is the electron that conducts electricity.

***p*-type semiconductor:** When silicon or germanium is doped with group 13 element like B or Al, the dopant has only with three, valence electrons. An electron vacancy or a hole is created at the place of the missing fourth electron. Here, this hole moves through the crystal like a positive charge giving rise to electrical conductivity. Thus Si or Ge doped with B or Al is called *p* type of semiconductor, (*P* stands for positive hole) since it is the positive hole that is responsible for conduction.

(*b*) **F-centres:** Electrons trapped in anion vacancies are called F-centres. They impart characteristic colour to the compound and increase electrical conductivity.

(*c*) **Ferromagnetism:** Ferromagnetic substances are those substances which are strongly attracted by external magnetic field, *e.g.*, (iron, cobalt, nickle and CrO_2 etc.] Ferromagnetism arises due to spontaneous alignment of magnetic moments in the same direction.

Alignment of magnetic moments in ferromagnetic substance.

20. Assuming 100% dissociation of KCl, $i = 2$, $\Delta T_f = 2$ K, $K_f = 1.86$ K kg mol^{-1}, $W_B = ?$

$M_B = 74.5$ g mol^{-1}, $W_A = 1000$ g

$$\Delta T_f = \frac{i \times K_f \times W_B \times 1000}{M_B \times W_A}$$

Substituting the values

$$2 = \frac{2 \times 1.86 \times W_B \times 1000}{74.5 \times 1000}$$

$\therefore$ $$W_B = \frac{74.5}{1.86} = 40.05 \text{ g}$$

21.

$$\begin{array}{l} \text{Zn} \longrightarrow \text{Zn}^{2+} + 2e^- \\ \underline{\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2e^- \longrightarrow 2\text{Ag}^+ + 2\text{OH}^-} \\ \underline{\text{Zn} + \text{Ag}_2\text{O} + \text{H}_2\text{O} \longrightarrow \text{Zn}^{2+} + 2\text{Ag} + 2\text{OH}^-} \end{array}$$

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$$

$$= E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Zn}^{2+}/\text{Zn}}$$

$$E^\circ_{\text{cell}} = 0.34 - (-0.76)$$

$$= 1.10 \text{ V}$$

also $n = 2$

$$\Delta G^\circ = -nFE^\circ_{cell}$$

$$\Delta G^\circ = -2 \times 96500 \times 1.10$$

$$\Delta G^\circ = 2.123 \times 10^5 \text{ J}$$

22. (*i*) Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

(*ii*) The positively charged colloidal particles of $Fe(OH)_3$ get coagulated by the oppositely charged Cl^- ions provided by NaCl.

(*iii*) On passing direct current, colloidal particles move towards the oppositely charged electrode where they lose their charge and get coagulated.

23. (*i*) **Electrolytic reduction of Al_2O_3 :**

Cathode: $Al^{3+}\text{ (melt)} + 3e^- \longrightarrow Al$

Anode: $C(s) + O^{2-}\text{ (melt)} \longrightarrow CO(g) +$

$2e^- C(s) + 2O^{2-}\text{ (melt)} \longrightarrow CO_2(g) +$

$4e^-$

(*ii*) **Isolation of zinc from zinc blende:**

Roasting: $\underset{\text{Zinc blende}}{2\,ZnS} + 3O_2 \xrightarrow{\Delta} 2\,ZnO + 2\,SO_2$

Reduction: $ZnO + C \xrightarrow{1673\text{ K}} Zn + CO$

(*iii*) **Mond's process for refining nickel:**

$$Ni + 4CO \xrightarrow{330\text{-}350\text{ K}} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450\text{-}470\text{ K}} Ni + 4CO$$

24.

	Characteristics	Lanthanoids	Actinoids
(*i*)	Electronic configuration	$[Xe]\,4f^{1-14}5d^{0-1}6s^2$	$[Rn]\,5f^{1-14}6d^{0-1}7s^2$
(*ii*)	Oxidation states	Besides +3 O.S. lanthanoids show +2 and +3 O.S. only in a few cases.	Besides +3 O.S. actinoids show higher O.S. of +4, +5, +6, +7 also because of smaller energy gap between 5*f*, 6*d* and 7*s* subshell.
(*iii*)	General chemical reactivity of elements	These are less reactive metals Lesser tendency towards complex formation. Do not form oxocation Compounds are less basic.	These are highly reactive metals. Greater tendency towards complex formation. Form oxocation Compounds are more basic.

25. (*i*) $[Cr(H_2O)_2\ (C_2O_4)_2$

$]^-$Diaquadioxalatochromate (III) ion

O.S. of Cr $= x + 0.2 + (-2).2 = -1, x = +3$

Electronic configuration of $Cr^{3+} = 3d^3\ 4s^0 = t_{2g}^3\ e_g^0$

Unpaired electrons (n) = 3, Paramagnetic.

(*ii*) $[Co(NH_3)_5\ Cl]^{2+}$

Pentaamminechloro cobalt (III) ion

O.S. of Co $= x + 0.5 + (-1).1 = 2, x = 3$

Electronic configuration of $Co^{3+} = 3d^6\ 4s^0 = t_{2g}^6\ e_g^0$

Unpaired electrons (n) = 0, Diamagnetic.

(*iii*) $[NiCl_4]^{2-}$

Tetrachloronickelate (II) ion

O.S. of Ni $= x + (-1)\ 4 = -2, x = +2$

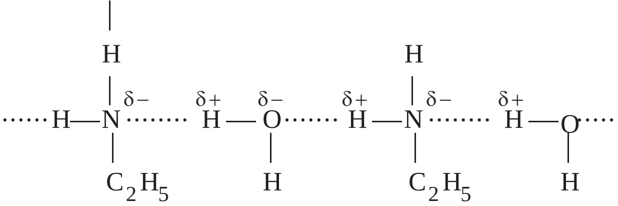
Electronic configuration of $Ni^{2+} = 3d^8\ 4s^0 = t_{2g}^8\ e_g^0$

Unpaired electrons (n) = 2, Paramagnetic.

26. (*i*) In aniline, due to resonance, the lone pair of electrons on the nitrogen atom are delocalized over the benzene ring. As a result, the electron density on the nitrogen decreases. On the other hand, in methyl amine +ve I effect of CH_3 increases the electrondensity on the nitrogen atom. Therefore aniline is a weaker base than methyl amine and hence its pK_b value is higher than that of methyl amine.

(*ii*) Aniline being a Lewis base reacts with lewis acid $AlCl_3$ to form a salt. Due to this, N atom of aniline acquires positive charge and hence acts as a strong deactivation group for further reaction.

(*iii*) Ethyl amine is freely soluble in water because it forms hydrogen bonds with water molecules.

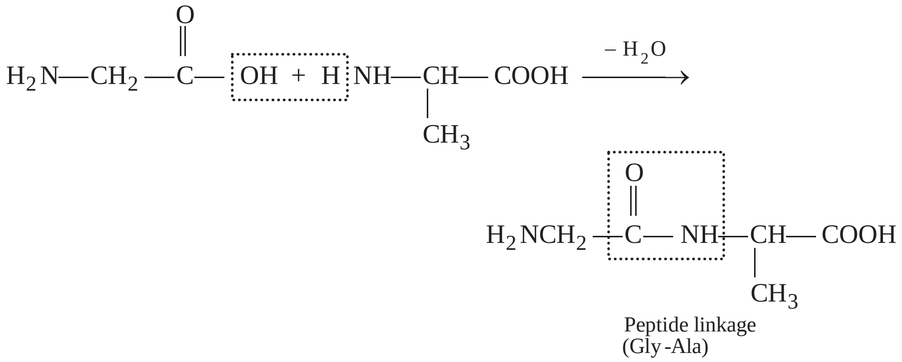


On the other hand in aniline due to large, hydrocarbon part, the extent of hydrogen bonding decreases considerably and hence aniline is slightly soluble.

27. **(*i*)** **Primary structure of proteins:** The sequence in which various amino acids are arranged in a protein is called its primary structure. Any change in the sequence of amino acids creates different protein which alters biological functions.

(*ii*) **Denaturation:** When a protein in its native form is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and proteins lose its biological activity. During denaturation 2° and 3° structures of proteins are destroyed but 1° structure remains intact, *e.g.*, coagulation of egg white on boiling.

(*iii*) **Peptide linkage:** A peptide linkage is an amide linkage (—CONH—) formed between —COOH group of one α-amino acid and NH_2 group of the other amino acid by the elimination of a water molecule.



$$H_2N—CH_2—\overset{O}{\overset{\|}{C}}—OH + H—NH—\underset{CH_3}{\underset{|}{CH}}—COOH \xrightarrow{-H_2O} H_2NCH_2—\overset{O}{\overset{\|}{C}}—NH—\underset{CH_3}{\underset{|}{CH}}—COOH$$

28. (*a*) $\text{Rate} = \frac{dx}{dt} = K[A][B]^2$

If concentration of both A and B are doubled, then

$$\text{Rate} = K[2A][2B]^2$$
$$= 8K[A][B]^2$$

i.e., the rate of reaction becomes 8 times.

(*b*) $K_2 = 4K_1$ *i.e.*, $\frac{K_2}{K_1} = 4$

$T_1 = 300$ K $T_2 = 320$ K

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303\, R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\log 4 = \frac{E_a}{2.303 \times 8.314}\left(\frac{320 - 300}{300 \times 320}\right)$$

$$2 \log 2 = \frac{E_a}{19.147}\left(\frac{20}{300 \times 320}\right)$$

$$E_a = \frac{2 \times 0.3010 \times 19.147 \times 300 \times 320}{20} = 55327 \text{ J}$$

$$E_a = 55.327 \text{ kJ}$$

OR

(*a*) Rate of reaction depends on
- (*i*) Concentration
- (*ii*) Temperature
- (*iii*) Nature of reactant
- (*iv*) Pressure of the gaseous reactant
- (*v*) Surface area
- (*vi*) Catalyst

(*b*) $t_{1/2} = 5730$ years

$$\therefore \quad K = \frac{0.693}{t_{1/2}} = \frac{0.693}{5730} = 1.209 \times 10^{-4} \text{ year}^{-1}$$

$$t = \frac{2.303}{K} \log \frac{[R]_0}{[R]} = \frac{2.303}{1.2 \times 10^{-4}} \log \frac{100}{80}$$

$$t = \frac{2.303 \times 10^4}{1.2}(\log 10 - \log 8) = \frac{2.303 \times 10^4}{1.2}(1 - 3\log 2)$$

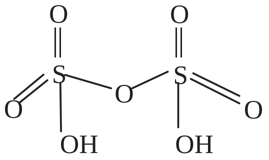
$$t = \frac{2.303}{1.2} \times 10^4\,(1 - 3 \times 0.3010) = \frac{2.303 \times 0.097 \times 10^4}{1.209}$$

$$t = 1847.7 \text{ years}$$

29. **(*a*)** (*i*) Due to stronger inert pair effect Bi (V) gets readily reduced to Bi (III) therefore, Bi (V) is a stronger oxidising agent than Sb (V).

(*ii*) Xe has least ionization enthalpy among noble gases and hence it readily forms chemical compounds particularly with O_2 and F_2.

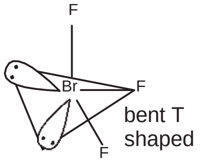
(*b*) (*i*)



$H_2S_2O_7$ (Pyrosulphuric acid)

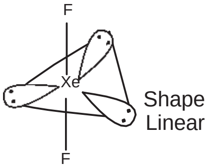
(*ii*) BrF_3
sp^3d
hybridisation

$5e$ ⟨ b. p. = 3, l. p. = 2



(*iii*) XeF_2
sp^3d
hybridisation

$5e$ ⟨ b.p. = 2, l.p. = 3



OR

(*a*) (*i*) $Ca_3P_2 + 6H_2O \longrightarrow \underset{\text{Phosphine}}{PH_3} + 3\,Ca(OH)_2$

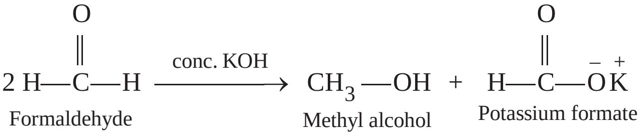
(*ii*) $6XeF_4 + 12H_2O \longrightarrow 2XeO_3 + 24HF + 4Xe + 3O_2$

(*b*) (*i*) As the atomic size of nitrogen is smaller than phosphorus, electron density on nitrogen atom is higher than that on phosphorus atom. Consequently, the tendency of N in NH_3 to denote its lone pair of electrons is much higher than that of P in PH_3. Thus NH_3 is a stronger base than PH_3.

(*ii*) In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding π^* orbital like O_2 and hence exhibits paramagnetic behaviour.

(*iii*) Because of hydrogen bonding HF exists as associated molecules in a liquid and therefore has high boiling point. Due to large size and low electronegativity of chlorine no hydrogen bonding is present in HCl, only Vander Waal forces are present. The boiling of HCl is therefore low.

30. **(*a*)** **(*i*) Cannizzaro reaction:**



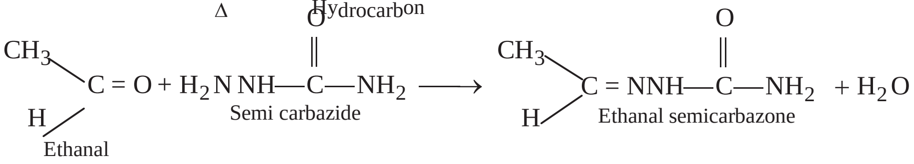
$$\underset{\text{Formaldehyde}}{2\,H{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}H} \xrightarrow{\text{conc. KOH}} \underset{\text{Methyl alcohol}}{CH_3{-}OH} + \underset{\text{Potassium formate}}{H{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}\overset{-}{O}\overset{+}{K}}$$

(*ii*) **Decarboxylation**

$$R—COOH + NaOH \longrightarrow \underset{\text{Sodium carboxylate}}{R—COONa} + H_2O$$

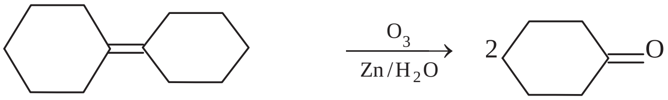
$$R—COONa \xrightarrow[\Delta]{NaOH/CaO} \underset{\text{Hydrocarbon}}{R—H} + Na_2CO_3$$

(*b*) (*i*)

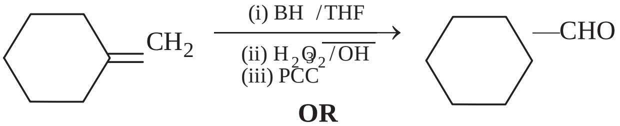


$$\underset{\text{Ethanal}}{CH_3(H)C=O} + \underset{\text{Semi carbazide}}{H_2N\,NH—\overset{\overset{O}{\|}}{C}—NH_2} \longrightarrow \underset{\text{Ethanal semicarbazone}}{CH_3(H)C=NNH—\overset{\overset{O}{\|}}{C}—NH_2} + H_2O$$

(*ii*)



(*iii*)



OR

(*a*) (*i*) Propanone on treatment with I_2 / NaOH (NaOI) undergoes iodoform reaction to give yellow ppt of iodoform but propanal does not.

$$CH_3COCH_3 + 3NaOI \longrightarrow \underset{\substack{\text{Iodoform}\\\text{(Yellow ppt)}}}{CHI_3\downarrow} + CH_3—COONa + 2NaOH$$

$$\underset{\text{Propanal}}{CH_3—CH_2—CHO} \longrightarrow \text{No yellow ppt. of Iodoform}$$

Tollen's test: Propanal being an aldehyde reduces Tollen's reagent to silver mirror but propanone being a ketone does not.

$$CH_3—CH_2—CHO + 2[Ag(NH_3)_2]^+ + 3OH \longrightarrow CH_3—CH_2$$

$$—COO^- \text{Propanal} \quad \text{Tollen's reagent}$$

$$+ \underset{\text{Silver mirror}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

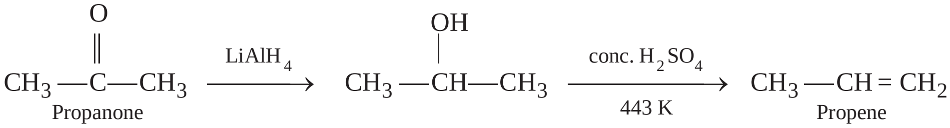
(*ii*) **$FeCl_3$ test:** Phenol gives a violet colouration with neutral $FeCl_3$ solution while benzoic acid gives buff coloured ppt.

$$6C_6H_5OH + FeCl_3 \longrightarrow \underset{\text{Violet complex}}{[Fe(OC_6H_5)_6]^{-3}} + 3H^+ + 3HCl$$

$NaHCO_3$ test: Benzoic acid being a stronger acid than phenol decomposes $NaHCO_3$ to evolve CO_2 but phenol does not.

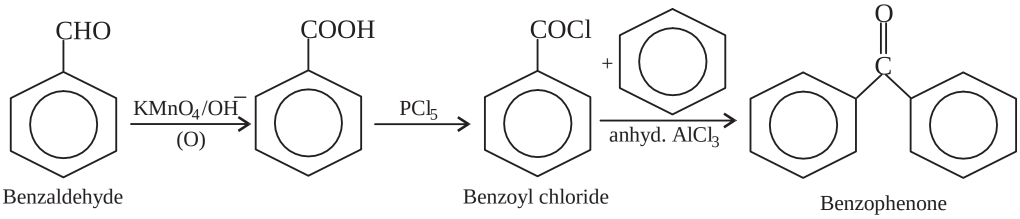
$$\underset{\text{—Benzoic acid}}{C_6H_5—COOH} + NaHCO_3 \longrightarrow \underset{\text{Sodium benzoate}}{C_6H_5—CO\overset{-}{O}\overset{+}{Na}} + H_2O + CO_2$$

(*b*) (*i*)

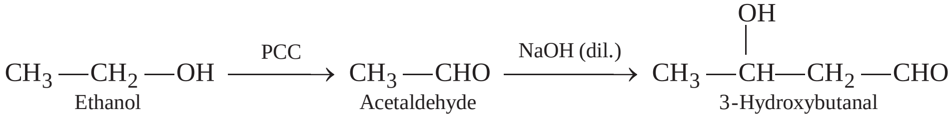


$$\underset{\text{Propanone}}{CH_3—\overset{\overset{O}{\|}}{C}—CH_3} \xrightarrow{LiAlH_4} CH_3—\overset{\overset{OH}{|}}{CH}—CH_3 \xrightarrow[443\text{ K}]{\text{conc. }H_2SO_4} \underset{\text{Propene}}{CH_3—CH=CH_2}$$

(*ii*)



(*iii*)



$$\underset{\text{Ethanol}}{CH_3—CH_2—OH} \xrightarrow{\text{PCC}} \underset{\text{Acetaldehyde}}{CH_3—CHO} \xrightarrow{\text{NaOH (dil.)}} \underset{\text{3-Hydroxybutanal}}{CH_3—\overset{\overset{\large OH}{|}}{C}H—CH_2—CHO}$$

CBSE (All India) SET–II

1. Schottky defect.

6. All carbohydrates which reduce Tollen's reagent and Fehling's solution are referred to as reducing sugars, *e.g.*, glucose.

8. A 2-3 per cent solution of iodine in alcohol water mixture is known as tincture of iodine. It is used as an antiseptic.

10. (*i*) Order of reaction may be defined as the sum of powers of the concentration of the reactants in the rate law expression.

For example consider the reaction

$$NH_4NO_2 \longrightarrow N_2 + 2H_2O$$

Experimentally, it is observed that the rate law for this reaction is

$$\text{Rate} = K\,[NH_4NO_2]$$

Hence, the order of reaction is 1.

(*ii*) Molecularity of a reaction may be defined as the number of reacting species (atoms, ions or molecules) taking part in an elementary reaction which must collide simultaneously in order to bring about a chemical reaction.

For example molecularity of the reaction

$2HI \longrightarrow H_2 + I_2$ is 2 as it involves.

Simultaneous collision between two HI molecules.

18. Hard water contains calcium and magnesium ions. Therefore in hard water soap get precipitated as calcium and magnesium soap which being insoluble stick to the cloth as gummy mass. Hence soap cannot be used with hard water.

$$\underset{\text{Soap}}{2C_{17}H_{35}COO^-Na^+} + CaCl_2 \longrightarrow 2NaCl + \underset{\substack{\text{insoluble calcium}\\ \text{stearate (Soap)}}}{(C_{17}H_{35}COO)_2Ca}$$

On the other hand calcium and magnesium salts of detergents are soluble in water so they easily form lather with hard water.

21. $K = 60\ s^{-1}$, $\quad [R] = \dfrac{[R]_0}{16}$

$t = ?$

$$t = \frac{2.303}{K}\log\frac{[R]_0}{[R]}$$

Substituting the values

$$t = \frac{2.303}{60} \log \frac{[R]_0}{\frac{[R]_0}{16}}$$

$$t = \frac{2.303}{60} \log 16 = \frac{2.303}{60} . 4 \log 2$$

$$t = \frac{2.303}{15} \times 0.3010 = \frac{0.6932}{15}$$

$$t = 4.62 \times 10^{-2} \text{ s.}$$

23. (*i*) Zone refining is based on the principle that the impurities are more soluble in the liquid state than in the solid state of metal.

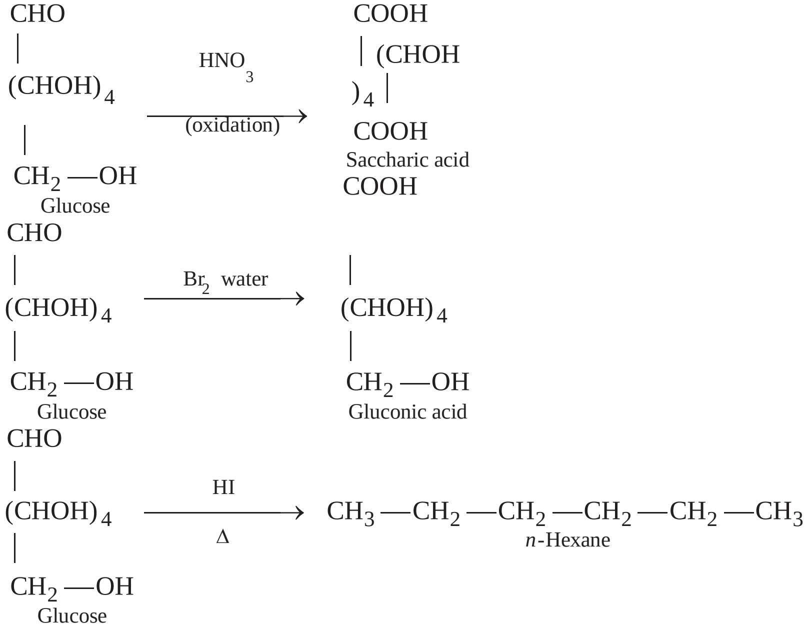
(*ii*) In electrolytic refining the impure metal is made to act as anode. A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal. When electric current is passed, impure metal forms metal ions which are discharged at cathode forming pure metal.

Anode: $\text{M} \longrightarrow \text{M}^{n+} + ne^-$

Cathode: $\text{M}^{n+} + ne^- \longrightarrow \text{M}$

(*iii*) The principle of refining by froth floatation process is that sulphide particles are preferentially wetted by pine oil, whereas the gangue particles are wetted by water.

27. (*i*)



$$\begin{array}{c}\text{CHO}\\ |\\ (\text{CHOH})_4\\ |\\ \text{CH}_2\text{—OH}\\ \text{Glucose}\end{array} \xrightarrow[\text{(oxidation)}]{\text{HNO}_3} \begin{array}{c}\text{COOH}\\ |\\ (\text{CHOH})_4\\ |\\ \text{COOH}\\ \text{Saccharic acid}\end{array}$$

(*ii*)

$$\begin{array}{c}\text{CHO}\\ |\\ (\text{CHOH})_4\\ |\\ \text{CH}_2\text{—OH}\\ \text{Glucose}\end{array} \xrightarrow{\text{Br}_2 \text{ water}} \begin{array}{c}\text{COOH}\\ |\\ (\text{CHOH})_4\\ |\\ \text{CH}_2\text{—OH}\\ \text{Gluconic acid}\end{array}$$

(*iii*)

$$\begin{array}{c}\text{CHO}\\ |\\ (\text{CHOH})_4\\ |\\ \text{CH}_2\text{—OH}\\ \text{Glucose}\end{array} \xrightarrow[\Delta]{\text{HI}} \underset{n\text{-Hexane}}{\text{CH}_3\text{—CH}_2\text{—CH}_2\text{—CH}_2\text{—CH}_2\text{—CH}_3}$$

28. (*a*) $\text{Zn} \,|\, \text{Zn}^{2+} \text{(conc.)} \,||\, \text{Ag}^{+} \text{(conc)} \,|\, \text{Ag}$

(*i*) Zn electrode is negatively charged.

(*ii*) Current carriers of cell are

- electrons in external wire.
- Zn^{2+} ions in anodic half cell.

- Ag^+ ions in cathodic half cell.
- Ions of salt bridge, *i.e.*, K^+ and Cl^-.

(*iii*) At anode $\quad Zn \longrightarrow Zn^{2+}$

$+\ 2e^-$At cathode $\quad 2Ag^+ + e^- \longrightarrow 2Ag$

(*b*)

$$\begin{array}{rcl} Mg & \longrightarrow & Mg^{2+} + 2e^- \\ Cu^{2+} + 2e^- & \longrightarrow & Cu \\ \hline Mg + Cu^{2+} & \longrightarrow & Cu + Mg^{2+} \\ \hline \end{array}$$

$$n = 2$$

According to Nernst equation,

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n} \log \frac{[Cu][Mg^{2+}]}{[Mg][Cu^{2+}]}$$

$$E_{cell} = (E^\circ_{Cu^{2+}/Cu} - E^\circ_{Mg^{2+}/Mg}) - \frac{0.059}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= 0.34 - (-2.375) - \frac{0.059}{2} \log \frac{10^{-3}}{10^{-4}}$$

$$= 0.34 + 2.375 - 0.0295 \log 10$$

$$E_{cell} = 2.6855 \text{ V}$$

$$E_{cell} = 2.685 \text{ V}$$

OR

(*a*) The conductivity of a solution at any given concentration is the conductance of one unit volume of solution kept between two platinum electrodes with unit area of cross section at a distance of unit length.

On increasing the concentration of solution, the number of ions per unit volume of solution increases and thus its conductivity increases.

Molar conductivity (Λ_m) of a solution at a given concentration is the conductance of the volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length. Therefore

$$\Lambda_m = \frac{\kappa A}{} = \kappa$$

Since $l = 1$ and $A = V$ (volume containing 1 gram mole of electrolyte)

$$\Lambda_m = \kappa V$$

Molar conductivity increases with decrease in concentration. This is because the total volume, V of solution containing one mole of electrolyte also increases. It has been found that decrease in K on dilution of solution is more than compensated by increase in its volume.

(*b*) $Ag^+ + e^- \longrightarrow Ag$

108 g of Ag are deposited by 96500 C

$\therefore$ 1.45 g of Ag will be deposited by $= \frac{96500}{108} \times 1.45$ C

$$= 1295.6 \text{ C}$$

$$t = \frac{Q}{I} = \frac{1295.6}{1.50} = 863.7 \text{ s.}$$

$$Cu^{2+} + 2e^- \longrightarrow Cu$$

$$2 \times 96500 \text{ C deposit Cu} = 63.5 \text{ g}$$

$$\therefore \ 1295.6 \text{ C deposit Cu} = \frac{63.5}{2 \times 96500} \times 1295.6 = 0.426 \text{ g}$$

$$Zn^{2+} + 2e^- \longrightarrow Zn$$

$$2 \times 96500 \text{ C deposit Zn} = 65.3 \text{ g}$$

$$\therefore \ 1295.6 \text{ C deposit Zn} = \frac{65.3}{2 \times 96500} \times 1295.6 = 0.438 \text{ g}$$

CBSE (All India) SET–III

1. Boron or Aluminium.

10. A reaction which is of higher order but follows the kinetics of first order under special conditions is called a pseudo first order reaction.

Example, Acid hydrolysis of ethyl acetate.

$$CH_3—COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3—COOH + C_2H_5—OH$$

Here, the rate law is given by expression

$$\text{Rate} = K[CH_3—COOC_2H_5]$$

The concentration of H_2O is so large that it hardly undergoes any change during the reaction, therefore, it does not appear in the rate law.

12. (*i*) This is because Mn^{2+} is more stable as it has exactly half filled configuration $3d^5 4s^0$.

(*ii*) Cu^{2+}(aq) is much more stable than Cu^+(aq). This is because, although second ionization enthalpy of copper is large but for Cu^{2+}(aq) is much more negative than that of Cu^+(aq) and therefore, it more than compensates for the second ionisation enthalpy of copper. Therefore, Cu^+ ion aqueous solution undergoes disproportionation.

$$2Cu^+(aq) \longrightarrow Cu^{2+}(aq) + Cu(s)$$

18. **Artificial sweetening agents:** These are the substances which are non-nutritive in nature and used as substitutes for sugar in foods and beverages.

Examples:

Aspartame: Aspartame is 100 times as sweet as cane sugar. Its use is limited to cold foods and soft drinks because it is unstable at cooking temperature.

Saccharin: It is about 550 times as sweet as cane sugar. Its use is of great value to diabetic persons and people who need to control intake of calories.

21.

$$K = 60 \text{ s}^{-1}$$

$$t = \frac{2.303}{K} \log \frac{[R]_0}{[R]}$$

$$t = \frac{2.303}{60} \log \frac{[R]_0}{\frac{[R]_0}{10}} = \frac{2.303}{60} \log 10 = 0.038 \times 1$$

$$t = 0.038 \text{ s}$$

24. (*i*) As there is very little energy difference between $4s$ and $3d$ orbitals, electrons from both energy levels can be used for chemical bond formation. Therefore all elements except Sc and Zn, of the first transition series show a number of oxidation states as shown in table.

Oxidation states of the first series transition elements (the most common ones are in bold letter)

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
	+2	+2	+2	**+2**	**+2**	**+2**	**+2**	+1	
+3	+3	+3	+3	+3	**+3**	**+3**	+3	**+2**	**+2**
	+4	+4	+4	+4	+4	+4	+4		
		+5	+5	+5					
			+6	+6	+6				
				+7					

(*ii*) Atomic radii of the first transition series decreases from Sc to Cr, then remains almost constant till Ni and then increases from Cu to Zn.

The reason of this variation in atomic radii has been attributed to the increase in nuclear charge in the beginning of the series. But as the electrons continue to be filled in *d*-orbitals, they screen the outer 4*s* electrons from the influence of nuclear charge. When the increased nuclear charge and the increased screening effect balance each other in the middle of transition series, the atomic radii becomes almost constant (Mn to Fe). Towards the end of the series, the repulsive interaction between electrons in *d* orbitals become very dominant. As a result there is an expansion of the electron cloud; consequently, the atomic size increases.

(*iii*) Except Zn^{2+}, all other divalent gaseous ions of the first series of the transition elements contain unpaired electrons in their $3d$ subshell and are therefore paramagnetic in nature.

The magnetic moment (μ) of the elements of the first transition series can be calculated with the unpaired electrons (n) by the spin-only formula

$$\mu = \sqrt{n\,(n+2)}\ \text{B.M.}$$

Ion	Configuration	Unpaired electrons	Magnetic moment (μ) calculated
Mn^{2+}	$3d^5\,4s^0$	5	$\sqrt{5\,(5+2)} = 5.92$ B.M.
Cu^{2+}	$3d^9\,4s^0$	1	$\sqrt{1\,(1+2)} = 1.73$ B.M.
Zn^{2+}	$3d^{10}\,4s^0$	0	$\sqrt{0\,(0+3)} = 0$

CBSE EXAMINATION PAPERS

DELHI–2009

Time allowed : 3 hours **Maximum marks : 70**

General Instructions:

- (*i*) *All questions are compulsory.*
- (*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*
- (*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*
- (*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*
- (*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*
- (*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (Delhi) SET–I

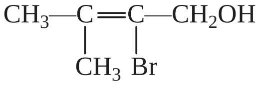
1. Which point defect in crystals does not alter the density of the relevant solid? **1**

2. Define the term ‘Tyndall effect’. **1**

3. Why is the froth floatation method selected for the concentration of sulphide ores? **1**

4. Why is Bi (V) a stronger oxidant than Sb (V)? **1**

5. Give the IUPAC name of the following compound: **1**



$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=\underset{\displaystyle Br}{\underset{|}{C}}-CH_2OH$$

6. Write the structure of 3-oxopentanal. **1**

7. Why is an alkylamine more basic than ammonia? **1**

8. Give an example of elastomers. **1**

9. A reaction is of second order with respect to a reactant. How will the rate of reaction be affected if the concentration of this reactant is **2**

(*i*) doubled (*ii*) reduced to half?

10. Explain the role of **2**

(*i*) Cryolite in the electrolytic reduction of alumina.

(*ii*) Carbon monooxide in the purification of nickel.

11. Draw the structures of the following molecules: **2**

(*i*) XeF_4 (*ii*) BrF_3

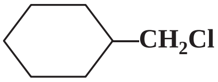
12. Complete the following chemical reaction equations: **2**

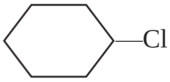
(*i*) $P_{4(s)} + NaOH_{(aq)} + H_2O_{(l)} \longrightarrow$

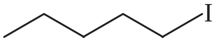
(*ii*) $I^-_{(aq)} + H_2O_{(l)} + O_{3(g)} \longrightarrow$

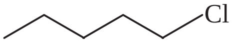
13. Differentiate between molality and molarity of a solution. What is the effect of change in temperature of a solution on its molality and molarity? **2**

14. Which ones in the following pairs of substances undergoes S_N2 substitution reaction faster and why? **2**

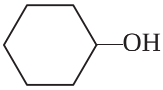
(*i*) 

or 

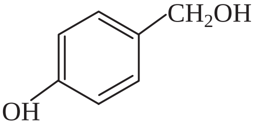
(*ii*) 

or 

15. Complete the following reaction equations: **2**

(*i*) 

$+ SOCl_2 \longrightarrow$

(*ii*) 

$+ HCl \longrightarrow$

16. Explain what is meant by **2**

(*i*) a peptide linkage (*ii*) a glycosidic linkage

17. Name two water soluble vitamins, their sources and the diseases caused due to their deficiency in diet. **2**

18. Draw the structures of the monomers of the following polymers: **2**

(*i*) Teflon (*ii*) Polythene

OR

What is the repeating unit in the condensation polymer obtained by combining $HO_2CCH_2CH_2CO_2H$ (succinic acid) and $H_2NCH_2CH_2NH_2$ (ethylene diamine).

19. Iron has a body-centred cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.87g cm^{-3}. Use this information to calculate Avogadro's number (At. mass of Fe = 56g mol^{-1}). **3**

20. 100 mg of a protein is dissolved in just enough water to make 10.0 mL of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25°C, what is the molar mass of the protein? **3**

(R = 0.0821 L atm mol^{-1} K^{-1} and 760 mm Hg = 1 atm.)

21. A first order reaction has a rate constant of 0.0051 min^{-1}. If we begin with 0.10M concentration of the reactant, what concentration of reactant will remain in solution after 3 hours? **3**

22. How are the following colloids different from each other in respect of dispersion medium and dispersed phase? Give one example of each type. **3**

(*i*) An aerosol

(*ii*) A hydrosol

(*iii*) An emulsion

23. Account for the following: **3**

(*i*) NH_3 is a stronger base than PH_3.

(*ii*) Sulphur has a greater tendency for catenation than oxygen.

(*iii*) Bond dissociation energy of F_2 is less than that of Cl_2.

OR

Explain the following situations:

(*i*) In the structure of HNO_3 molecule, the N—O bond (121 pm) is shorter than N—OH bond (140 pm).

(*ii*) SF_4 is easily hydrolysed whereas SF_6 is not easily hydrolysed.

(*iii*) XeF_2 has a straight linear structure and not a bent angular structure.

24. For the complex $[Fe(en)_2Cl_2]Cl$, (en = ethylene diamine), identify **3**

(*i*) the oxidation number of iron.

(*ii*) the hybrid orbitals and the shape of the complex.

(*iii*) the magnetic behaviour of the complex.

(*iv*) the number of geometrical isomers.

(*v*) whether there is an optical isomer also, and

(*vi*) name of the complex. (At. no. of Fe = 26)

25. Explain the mechanism of the following reactions: **3**

(*i*) Addition of Grignard's reagent to the carbonyl group of a compound forming an adduct followed by hydrolysis.

(*ii*) Acid catalysed dehydration of an alcohol forming an alkene.

(*iii*) Acid catalysed hydration of an alkene forming an alcohol.

26. Giving an example for each, describe the following reactions: **3**

(*i*) Hofmann's bromamide reaction

(*ii*) Gatterman reaction

(*iii*) A coupling reaction

27. Explain the following types of substance with one suitable example, for each case: **3**

(*i*) Cationic detergents

(*ii*) Food preservatives

(*iii*) Analgesics

28. (*a*) Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained? **5**

(*b*) A voltaic cell is set up at 25 °C with the following half cells:

Ag^+ (0.001 M) | Ag and Cu^{2+} (0.10 M) | Cu

What would be the voltage of this cell? (E^o_{cell} = 0.46 V)

OR

(*a*) State the relationship amongst cell constant of a cell, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solute related to conductivity of its solution?

(*b*) A voltaic cell is set up at 25°C with the following half-cells:

$Al \mid Al^{3+}$ (0.001 M) and $Ni \mid Ni^{2+}$ (0.50 M)

Calculate the cell voltage [$E^o_{Ni^{2+}/Ni} = -\ 0.25$ V, $E^o_{Al/Al^{3+}} = -\ 1.66$ V]

29. (*a*) Complete the following chemical reaction equations: **5**

(*i*) $MnO^-_{4(aq)} + C_2O^{2-}_{4\,(aq)} + H^+_{\ (aq)} \longrightarrow$

(*ii*) $Cr_2O^{2-}_{7(aq)} + F^{2+}_{\ (aq)} + H^+_{\ (aq)} \longrightarrow$

(*b*) Explain the following observations about the transition/inner transition elements:

(*i*) There is in general an increase in density of element from titanium (Z = 22) to copper (Z = 29).

(*ii*) There occurs much more frequent metal-metal bonding in compounds of heavy transition elements (3rd series).

(*iii*) The members in the actinoid series exhibit a large number of oxidation states than the corresponding members in the lanthanoid series.

OR

(*a*) Complete the following chemical equations for reactions:

(*i*) $MnO_4{}^-{}_{(aq)} + S_2O_3{}^{2-}{}_{(aq)} + H_2O_{(l)}$

$\longrightarrow$ (*ii*) $CrO_7{}^-{}_{(aq)} + H_2S_{(g)} + H^+{}_{(aq)}$

$\longrightarrow$

(*b*) Give an explanation for each of the following observations:

(*i*) The gradual decrease in size (actinoid contraction) from element to element is greater among the actinoids than that among the lanthanoids (lanthanoid contraction).

(*ii*) The greatest number of oxidation states are exhibited by the members in the middle of a transition series.

(*iii*) With the same *d*-orbital configuration (d^4) Cr^{2+} ion is a reducing agent but Mn^{3+} ion is an oxidising agent.

30. (*a*) Illustrate the following name reactions by giving example: **5**

(*i*) Cannizzaro's reaction

(*ii*) Clemmensen reduction

(*b*) An organic compound A contain 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollen's reagent but forms an addition compound with sodium hydrogen sulphite and gives positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acids. Derive the possible structure of compound 'A'.

OR

(*a*) How are the following obtained?

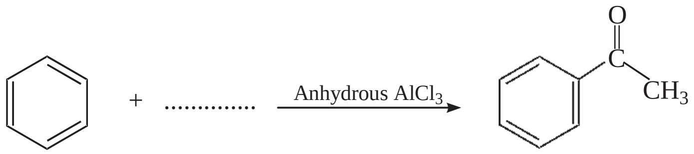
(*i*) Benzoic acid from ethyl benzene.

(*ii*) Benzaldehyde from toluene.

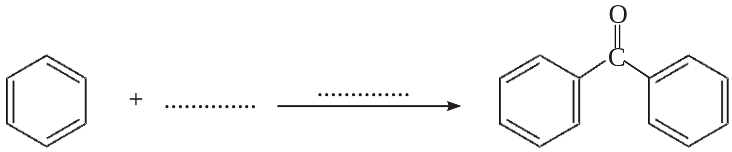
(*b*) Complete each synthesis by giving the missing material, reagent or products:

(*i*) $C_6H_5COCl \xrightarrow[\text{Pd-BaSO}_4]{H_2}$ ....

(*ii*)



(*iii*)



CBSE (Delhi) SET–II

Questions different from Set-I

1. Which point defect in its crystal units alters the density of a solid?

4. Which is a stronger oxidising agent Bi(V) or Sb(V)?

21. What is the difference between multimolecular and macromolecular colloids? Give one example of each. How are associated colloids different from these two types of colloids?

24. Explain the following observations:

(*i*) Fluorine does not exhibit any positive oxidation state.

(*ii*) The majority of known noble gas compounds are those of Xenon.

(*iii*) Phosphorus is much more reactive than nitrogen.

27. How do antisepitcs differ from disinfectants? Give one example of each type.

28. (*a*) Complete the following chemical reaction equations:

(*i*) $Fe^{2+}{}_{(aq)}\ MnO^{-}_{4(aq)} + H^{+}{}_{(aq)} \longrightarrow$ ®

(*ii*) $Cr_2O^{2-}_{7(aq)} + I^{-}{}_{(aq)} + H^{+}{}_{(aq)} \longrightarrow$ ®

(*b*) Explain the following observations:

(*i*) Transition elements are known to form many interstitial compounds.

(*ii*) With the same d^4 *d*-orbital configuration Cr^{2+} ion is reducing while Mn^{3+} ion is oxidising.

(*iii*) The enthalpies of atomisation of the transition elements are quite high.

OR

(*a*) Complete the following chemical reaction equations:

(*i*) $CrO_7{}^{2-}{}_{(aq)} + H_2S_{(g)} + H^+{}_{(aq)} \longrightarrow$

(*ii*) $MnO_{2(s)} + KOH_{(aq)} + O_{(2)}$

$\longrightarrow$ (*b*) Explain the following observations:

(*i*) Transition metals form compounds which are usually coloured.

(*ii*) Transition metals exhibit variable oxidation states.

(*iii*) The actinoids exhibit a greater range of oxidation states than the lanthanoids.

29. (*a*) What type of a cell is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery while operating.

(*b*) A voltaic cell is set up at 25°C with the half-cells Al | Al^{3+} (0.001 M) and Ni | Ni^{2+} (0.50 M). Write the equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

(Given: $E^o_{Ni^{2+}|Ni} = -0.25V,\ E^o_{Al^{3+}|Al} = -1.66V$).

OR

(*a*) Express the relationship amongst cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solute related to conductivity of its solution.

(*b*) Calculate the equilibrium constant for the reaction.

$$Fe_{(s)} + Cd^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cd_{(s)}$$

(Given: $E^o_{Cd^{2+}|Cd} = -\ 0.40\,V,\ E^o_{Fe^{2+}|Fe} = -\ 0.44\,V$).

CBSE (Delhi) SET–III

Questions different from Set-I and Set–II

1. Which point defect in its crystal units increases the density of a solid?

8. What does the part '6, 6' mean in the name nylon-6,6?

19. Calculate the freezing point depression expected for 0.0711m aqueous solution of Na_2SO_4. If this solution actually Freezes at –0.320°C, what would be the value of van't Hoff factor? (K_f for water is 1.86°C mol^{-1}).

24. Compare the following complexes with respect to their shape, magnetic behaviour and the hybrid orbitals involved:

(*i*) $[CoF_4]^{2-}$ (*ii*) $[Cr(H_2O)_2(C_2O_4)_2]^-$

(*iii*) $[Ni(CO)_4]$

(Atomic number: Co = 27, Cr = 24, Ni = 28)

27. What are the following substances? Give one example of each type.

(*i*) Antacid (*ii*) Nonionic detergents (*iii*) Antiseptics

28. (*a*) Complete the following chemical reaction equations:

(*i*) $Cr_2O_7^{2-}{}_{(aq)} + I^-{}_{(aq)} + H^+{}_{(aq)} \longrightarrow$

(*ii*) $MnO_4^-{}_{(aq)} + Fe^{2+}{}_{(aq)} + H^+{}_{(aq)} \longrightarrow$

(*b*) Explain the following observations:

(*i*) In general the atomic radii of transition elements decrease with atomic number in a given series.

(*ii*) The $E^o_{M^{2+}|M}$ for copper is positive (+ 0.34 V). It is the only metal in the first series of transition elements showing this type of behaviour.

(*iii*) The E^o value for $Mn^{3+} | Mn^{2+}$ couple is much more positive than for $Cr^{3+} | Cr^{2+}$ or $Fe^{3+} | Fe^{2+}$ couple.

OR

(*a*) What is meant by the term lanthanoid contraction? What is it due to and what consequences does it have on the chemistry of elements following lanthanoids in the periodic table?

(*b*) Explain the following observations:

(*i*) Cu^+ ion is unstable in aqueous solutions.

(*ii*) Although Co^{2+} ion appears to be stable, it is easily oxidised to Co^{3+} ion in the presence of a strong ligand.

(*iii*) The $E^o_{Mn^{2+}|Mn}$ value for manganese is much more than expected from the trend for other elements in the series.

29. (*a*) Define the term molar conductivity. How is it related to conductivity of the related solution?

(*b*) One half-cell in a voltaic cell is constructed from a silver wire dipped in silver nitrate solution of unknown concentration. Its other half-cell consists of a zinc electrode dipping in 1.0 M solution of $Zn(NO_3)_2$. A voltage of 1.48 V is measured for this cell. Use this information to calculate the concentration of silver nitrate solution used.

$(E^o_{Zn^{2+}/Zn} = -0.76V, \quad E^o_{Ag^{2+}/Ag} = +0.80V)$

OR

(*a*) Corrosion is essentially an electrochemical phenomenon. Explain the reactions occurring during corrosion of iron kept in an open atmosphere.

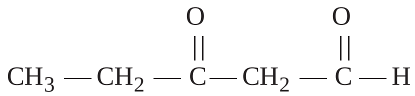
(*b*) Calculate the equilibrium constant for the equilibrium reaction.

$$Fe_{(s)} + Cd^{2+}_{(aq)} \rightleftharpoons Fe^{2+}_{(aq)} + Cd_{(s)}$$

(Given: $E^o_{Cd^{2+}/Cd} = -0.40V, \quad E^o_{Fe^{2+}/Fe} = -0.44V$)

SOLUTIONS

CBSE (Delhi) SET–I

1. Frenkel defect.
2. The scattering of light by colloidal particles is known as Tyndall effect.
3. As only sulphide ore particles are wetted by oil while gangue particles are wet by water.
4. Because Bi (V) is more stable than Sb (V) due to inert pair effect.
5. 2-Bromo-3-methyl but-2-en-1-ol.
6. 3-Oxopentanal: 
$CH_3-CH_2-\overset{\overset{\Large O}{||}}{C}-CH_2-\overset{\overset{\Large O}{||}}{C}-H$
7. Alkyl amine is more basic than ammonia because the + I effect or electron donating nature of alkyl group increases electron density on ‘N’ atom in alkyl amine.
8. Buna–S, neoprene
9. Let the rate law be, $r_1 = k[A]^2$

   (*i*) If $[A]$ is doubled than rate $r_2 = k(2A)^2 = 4k[A]^2 = 4r_1$, *i.e.*, rate becomes 4 times.

   (*ii*) If $[A]$ is reduced to half then rate, $r_3 = k\left[\frac{A}{2}\right]^2 = \frac{1}{4}k[A]^2 = \frac{1}{4}r_1$, *i.e.*, rate becomes $\frac{1}{4}$ times

10. (*i*) Role of cryolite

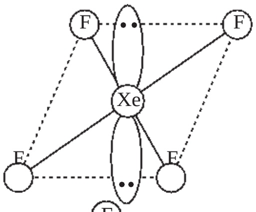
    - It lowers the melting point of the mixture.
    - It makes alumina a good conductor of electricity.

    (*ii*) When nickel is heated with carbon monoxide it forms a volatile complex nickel tetracarbonyl which on further heating at higher temperature decomposes to give pure nickel.

$$\mathrm{Ni} + 4\,\mathrm{CO} \xrightarrow{330-350\,\mathrm{K}} \mathrm{Ni(CO)_4} \xrightarrow{450-470\,\mathrm{K}} \mathrm{Ni} + 4\mathrm{CO}$$

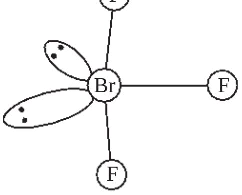
11. (*i*) No. of electron pairs around central atom (Xe) = $6\begin{array}{l} b.p. = 4 \\ l.p. = 2 \end{array}$

    The shape would be square planar.



    (*ii*) No. of electron pairs around central atom (Br) = $5\begin{array}{l} b.p. = 3 \\ l.p. = 2 \end{array}$

    The shape would be slightly bent T.

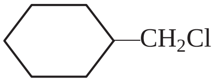


12. (*i*) $P_4 + 3NaOH + 3H_2O \longrightarrow \underset{\text{Phosphine}}{PH_3} + 3NaH_2PO_2$

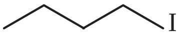
    (*ii*) $2I^-(aq) + H_2O(l) + O_3(g) \longrightarrow 2OH^-(aq) + I_2(s) + O_2(g)$

13. Molality is the number of moles of solute per thousand grams of solvent whereas molarity is the number of moles of solute dissolved in one litre of solution.

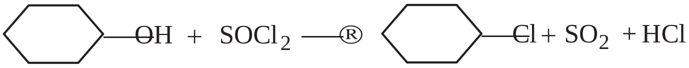
Molality is independent of temperature whereas molarity changes with change in temperature as volume changes with temperature.

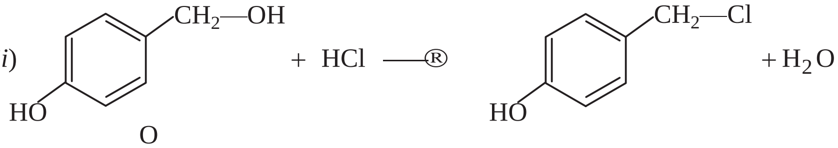
14. **(*i*)** 

: It is primary halide therefore undergoes S_N2 reaction faster.

(*ii*) 

: As iodine is a better leaving group because of its large size, it will be released at a faster rate in the presence of incoming nucleophile

15. (*i*) 

(*ii*) 

16. (*i*) The $-\overset{\overset{\displaystyle O}{\|}}{C}-NH-$ bond formed between two amino acid molecules with loss of water in a polypeptide is called peptide linkage.

(*ii*) The linkage between two monosaccharides molecules through oxygen atom in a disaccharide or polysaccharide is known as glycosidic linkage.

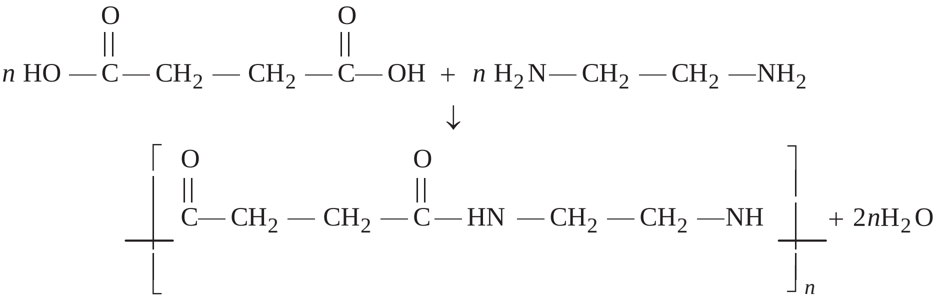
17. B group vitamins and vitamins C are soluble in water.

	Name of Vitamins	**Sources**	**Deficiency diseases**
(*i*)	Vitamin B_{12}	Meat, fish, egg and curd	Pernicious anaemia
(*ii*)	Vitamin C	Citrus fruits and amla	Scurvy

18.

	Polymer	**Monomer**	**Structure**
(i)	Teflon	Tetrafluoroethene	$F-\overset{\overset{\displaystyle F}{\vert}}{C}=\overset{\overset{\displaystyle F}{\vert}}{C}-F$
(ii)	Polyethene	Ethene	$H-\overset{\overset{\displaystyle H}{\vert}}{C}=\overset{\overset{\displaystyle H}{\vert}}{C}-H$

OR



$$n\,HO-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-OH + n\,H_2N-CH_2-CH_2-NH_2$$
$$\downarrow$$
$$\left[\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-HN-CH_2-CH_2-NH\right]_n + 2nH_2O$$

19. $d = 7.87 \text{ g cm}^{-3}$, For *bcc*, z = 2, M = 56 g mol^{-1}

$a = 286.65\text{pm} = 286.65 \times 10^{-10}\text{cm}$, $N_A = ?$

$$d = \frac{z \times M}{a^3 \times N_A}$$

$$7.87\text{g cm}^{-3} = \frac{2 \times 56 \text{ g mol}^{-1}}{(286.65 \times 10^{-3} \text{ cm})^3 \times \text{N}_\text{A}}$$

$$\text{N}_\text{A} = \frac{2 \times 56 \text{ g mol}^{-1}}{(2.8665 \times 10^{-8} \text{ cm})^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= \frac{2 \times 56 \text{ g mol}^{-1}}{23.553 \times 10^{-24} \text{ cm}^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= \frac{112 \text{ mol}^{-1}}{185.366 \times 10^{-24}} = 0.604 \times 10^{24} \text{ mol}^{-1}$$

$$= 6.024 \times 10^{23} \text{ mol}^{-1}$$

20.
$$\pi = \frac{W_B \times R \times T}{M_B \times V}$$

$$M_B = \frac{W_B \times R \times T}{\pi \times V}$$

Here

W_B = 100 mg = 100 × 100^{-3}g

R = 0.0821 L atm K^{-1} mol^{-1}

T = 25°C = (25 + 273) K = 298K

V = 10 mL = 10 × 10^{-3}L

$\pi = 13.3 \text{ mm Hg} = \frac{13.3}{760} \text{ atm}$

$$M_\text{B} = \frac{100 \times 10^{-3} \text{ g} \times 0.0821 \text{ L atm K}^{-1}\text{mol}^{-1} \times 298\text{K}}{\frac{13.3}{760} \text{atm} \times 10 \times 10^{-3} \text{ L}}$$

$$M_\text{B} = \frac{100 \times 10^{-3} \times 0.0821 \times 298 \times 760 \text{ g mol}^{-1}}{13.3 \times 10 \times 10^{-3}} = \frac{18594 \text{ g mol}^{-1}}{133}$$

$$M_\text{B} = 13980.45 \text{ g mol}^{-1}$$

21. For a first order reaction

$$t = \frac{2.303}{k} \log \frac{[\text{R}]_\text{o}}{[\text{R}]}$$

Here

$t = 3\text{ h} = 3 \times 60\text{ min} = 180\text{ min}$

$k = 0.0051\text{min}^{-1}$, $[R]_0 = 0.10\text{ M}$, $[R] = ?$

$$180\text{ min} = \frac{2.303}{0.0051\text{ min}^{-1}} \log \frac{0.10}{[R]}$$

$$\text{Log}\frac{0.1}{[R]} = \frac{180\text{ min} \times 0.0051\text{ min}^{-1}}{2.303} = \frac{918}{2303}$$

$$\log \frac{0.1}{[R]} = 0.3986$$

$$\frac{0.1}{[R]} = \text{Anti log }(0.3986) = 2.503$$

$$[R] = \frac{0.1}{2.503} = 0.03995\text{ M}$$

$$[R] = 0.04\text{M}$$

22.

Type of Colloid	Dispersed Phase	Dispersion medium	Example
Aerosol	Solid or liquid	Gas	Smoke, Fog, Cloud
Hydrosol	Solid	Water	Starch sol, Protein sol
Emulsion	Liquid	Liquid	Milk, hair cream

23. (*i*) NH_3 is stronger base than PH_3. This is because the lone pair of electrons on N atom in NH_3 is directed and not diffused as it is in PH_3 due to larger size of phosphorus and hence more available for donation.

(*ii*) Sulphur has a greater tendency for catenation than oxygen because S-S bond is stronger than O – O bond due to less interelectronic repulsions.

(*iii*) Bond dissociation energy of F_2 is less than Cl_2 this is due to relatively large electron – electron repulsion among the lone pairs in F_2 molecule where they are much closer to each other than in case of Cl_2.

OR

(*i*)

As a result of resonance, N–O bond length is average of single bond and double bond whereas N–OH bond has purely single bond character. Therefore, N–O bond is shorter than N–OH bond in HNO_3.

(*ii*) S atom in SF_4 is not sterically protected as it is surrounded by only four F atoms, so attack of H_2O molecules can take place easily and hence hydrolysis takes place easily. In contract, in SF_6, S is sterically protected by six F atoms. Therefore does not allow H_2O molecules to attack S atoms. As a result of this, SF_6 does not undergo hydrolysis.

(*iii*) In XeF_2, Xe is sp^3d hybridised having 2 bond pair and 3 lone pair of electrons. The presence of 3 lone pair of electrons in Xe F_2 at equidistance to have minimum repulsion is responsible for its linear structure.

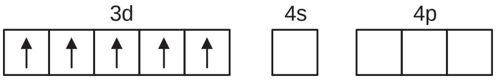
24. Given complex is $[Fe(en)_2 Cl_2]Cl$

(*i*) Let the oxidation number of iron be *x*.

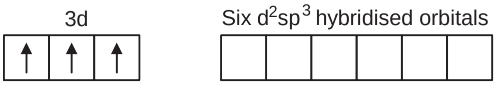
$$\therefore \quad x + 2 \times 0 + 2(-1) + 1(-1) = 0$$

$$\Rightarrow \quad x = 3$$

(*ii*) Orbitals of Fe (III)



$d^2 sp^3$ hybridised orbitals of Fe (III)



Thus, hybridisation: $d^2 sp^3$

Shape of the complex: Octahedral

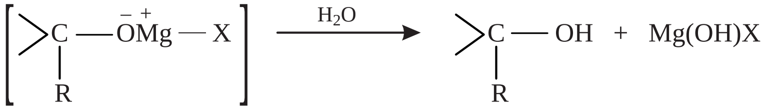
(*iii*) Paramagnetic due to presence of three unpaired electrons

(*iv*) Two, cis and trans isomers

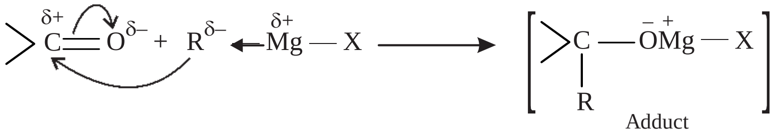
(*v*) Yes, cis isomer will also show optical isomerism

(*vi*) Dichlorido bis (ethane-1, 2 diamine) iron (III) chloride or Dichloro bis (ethylenediamine) iron (III) chloride.

25. **(*i*) Step I:** Nucleophilic addition of Grignard reagent to Carbonyl group.



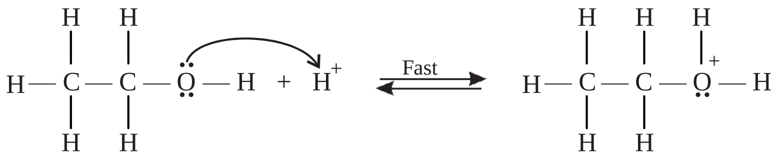
Step II: Hydrolysis



(***ii***) $CH_3-CH_2-OH \xrightarrow[\Delta]{H^+} CH_2=CH_2 + H_2O$

Mechanism

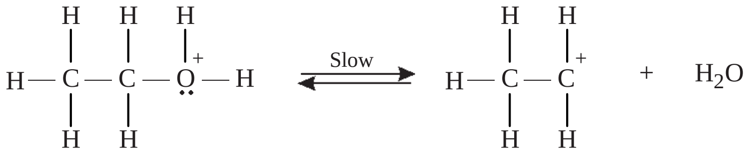
Step I: Formation of protonated alcohols



Ethyl alcohol

Ethyl oxonium ion

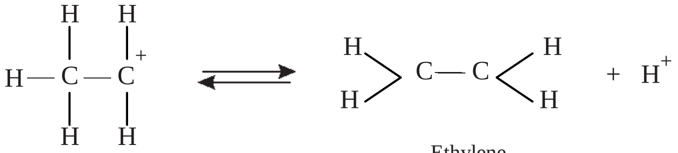
Step II: Formation of carbocation: It is the slowest step and hence, the rate determining step.



Ethyl oxonium ion

Ethyl carbocation

Step III: Formation of ethylene by elimination of a proton

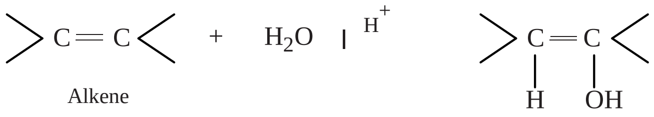


Ethyl carbocation

Ethylene

To drive the equilibrium to the right, ethylene is removed as it is formed.

(*iii*)

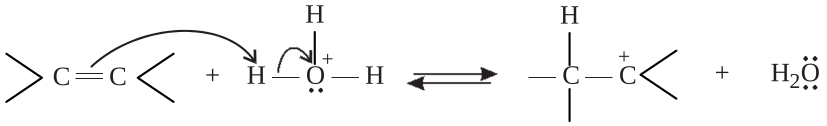


Alkene

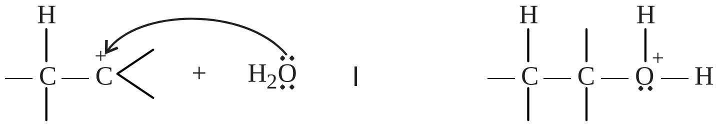
Mechanism

Step I: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.

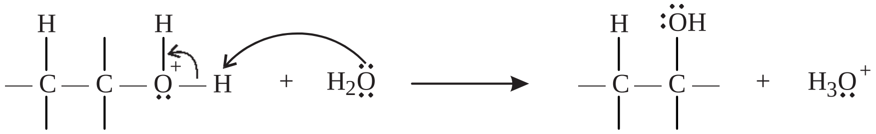
$$H_2\ddot{\underset{\cdot\cdot}{O}} + \overset{+}{H} \longrightarrow H_3\ddot{O}^+$$



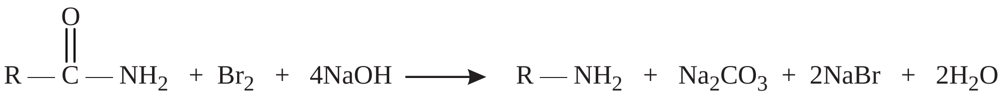
Step II: Nucleophilic attack of water on carbocation.



Step III: Deprotonation to form an alchohol

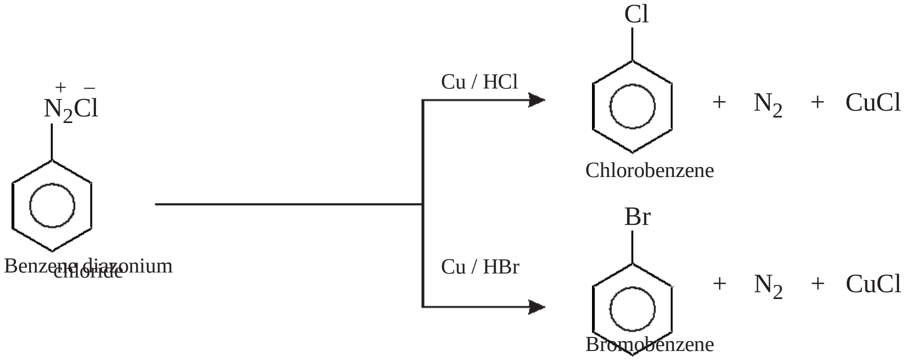


26. (*i*) **Hoffman's bromamide reaction:** When a primary acidamide is heated with bromine in an aqueous or ethanolic solution of sodium hydroxide, it gives a primary amine with one carbon atom less. In this degradation reaction, migration of an alkyl or aryl group takes place from carbonyl carbon of the amide to the nitrogen atom.

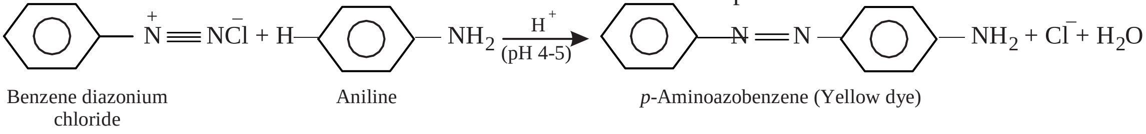


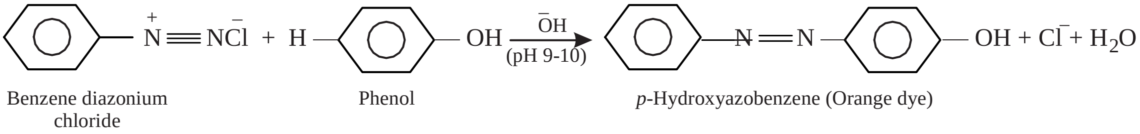
$$\underset{\text{1° acid amide}}{R-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2} + Br_2 + 4NaOH \longrightarrow \underset{\text{1° amine}}{R-NH_2} + Na_2CO_3 + 2NaBr + 2H_2O$$

(*ii*) **Gattermann reaction:** Chlorine or bromine can be introduced in benzene ring by treating the diazonium salt solution with corresponding halogen acid in the presence of copper powder.

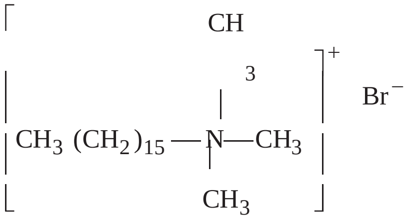


(*iii*) **Coupling reaction:** Diazonium salts react with aromatic amines in weakly acidic medium and with phenols in weakly alkaline medium to form coloured compounds called azo dyes by coupling at para position of amines or phenols. The mechanism is basically that of electrophilic aromatic substitution where the diazonium ion is electrophile.





27. (*i*) **Cationic Detergents :** Cationic detergents are quarternary ammonium salts of amines with acetates, chlorides or bromides as anions. Cationic part possess a long hydrocarbon chain and a positive charge on nitrogen atom. Hence, these are called cationic detergents. Cetyltrimethylammonium bromide is a popular cationic detergent and is used in hair conditioners.



$$\left[CH_3(CH_2)_{15}-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{N}}}}-CH_3\right]^+ Br^-$$

Cetyltrimethyl ammonium bromide

Cationic detergents have germicidal properties and are expensive, therefore, these are of limited use.

(*ii*) **Food Preservatives:** These are the chemical substances which are added to the food materials to prevent their spoilage due to microbial growth and to retain their nutritive value for long periods.

Preservatives prevent the rancidity of food and inhibit growth or kill the microganisms.

The most-common preservations used are, sugar table salt, sodium benzoate, Sodium metabisulphite sorbic acid and propanoic acid.

(*iii*) **Analgesics:** Drugs which reduce or abolish pain without causing impairment of consciousness, mental confusion, incoordination or paralysis or some other disturbances of nervous system. These are classified as follow.

(*a*) **Non-narcotic (non-addictive) analgesics:** Aspirin, paracetamol etc.

(*b*) **Narcotic drugs:** These are known to be habit forming, *e.g.*, morphine, Codeine, Heroin etc.

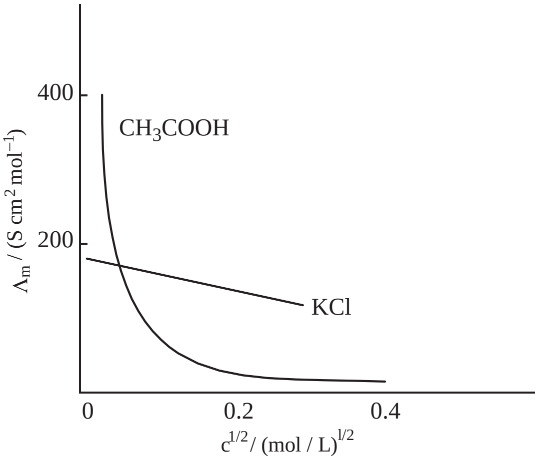
28. (*a*) Molar Conductivity (Λ_m): It may be defined as the conductance of a solution containing 1 mole of electrolyte such that the entire solution is placed is between two electrodes one centimeter apart.

$$\Lambda_m = k \times v$$

or

$$\Lambda_m = \frac{k \times 1000}{M}$$

Molar conductivity increases with decrease in concentration or increase in dilution as number of ions as well as mobility of ions increased with dilution.



For strong electrolytes the number of ions do not increase appreciably on dilution and only mobility of ions increases due to decrease in inter-ionic attractions. Therefore Λ_m increases a little as shown in graph by a straight line.

For weak electrolyte the number of ions as well as mobility of ions increases on dilution as shown by curve in the figure.

(*b*) At anode: $Cu(s) \longrightarrow Cu^{2+}(aq) + 2\bar{e}$

At cathode: $2Ag^{+}(aq) + 2\bar{e} \longrightarrow 2Ag(s)$

$$\overline{Cu(s) + 2Ag^{+}(aq) \longrightarrow Cu^{2+}(aq) + 2Ag(s)}$$

Here $E_{cell} = E^{o}_{cell} - \frac{0.0591}{n} \log \frac{[Cu^{2+}]}{[Ag^{+}]^2}$

Here $E^{o}_{cell} = 0.46$ V, $n = 2$

$[Ag^{+}] = 0.001M = 1\times10^{-3}$ M, $[Cu^{2+}] = 0.1M$

$$E_{cell} = 0.46 - \frac{0.0591}{2} \log \frac{0.1}{(10^{-3})^2}$$

$$E_{cell} = 0.46 - \frac{0.0591}{2} \log 10^5 = 0.46 - \frac{0.0591}{2} \times 5 \log 10$$

$$E_{cell} = 0.46 - 0.0591 \times 2.5 \times 1 = 0.46 - 0.14775 = 0.31225\text{V}$$

$$E_{cell} = 0.312\text{ V}$$

OR

(*a*) $\kappa = \dfrac{1}{R} \times \left(\dfrac{l}{A}\right)$

Where κ = Conductivity

$\dfrac{l}{A}$ = Cell Constant

R = Resistance

$$\Lambda_m = \frac{\kappa \times 1000}{\text{M}}$$

Where Λ_m = Molar conductivity

κ = Conductivity

M = Molarity of Solution

(*b*) At anode: $\text{Al}(s) \longrightarrow \text{Al}^{3+}(aq) + 3\bar{e}\,] \times 2$

At cathode: $\text{Ni}^{2+}(aq) + 2\bar{\text{e}} \longrightarrow \text{Ni}(s)] \times 3$

$$2\text{Al}(s) + 3\text{Ni}^{2+}(aq) \longrightarrow 2\text{Al}^{3+}(aq) + \text{Ni}(s)$$

$$E_{cell} = E^{o}_{cell} - \frac{0.0591}{n} \log \frac{[\text{Al}^{3+}]^2}{[\text{Ni}^{2+}]^3}$$

Here n = 6, $[\text{Al}^{3+}] = 0.001\text{M} = 1 \times 10^{-3}\text{M}$, $[\text{Ni}^{2+}] = 0.5\text{M}$

$$E^{o}_{cell} = E^{o}_{Ni^{2+}/Ni} - E^{o}_{Al^{3+}/Al} = -0.25V - (-1.66V)$$

$$E^{o}_{cell} = 1.41\text{V}$$

$$E^{o}_{cell} = 1.41 - \frac{0.0591}{6} \log \frac{(10^{-3})^2}{(0.5)^3} = 1.41 - \frac{0.0591}{6} \log \frac{10^{-6}}{0.125}$$

$$= 1.41 - \frac{0.0591}{6} \log (10^{-6} \times 8) = 1.41 - \frac{0.0591}{6} (\log 10^{-6} + \log 2^3)$$

$$= 1.41 - \frac{0.0591}{6} \log (-6 \log 10 + 3 \log 2) = 1.41 - \frac{0.0591}{6} (-6 + 3 \times 0.3010)$$

$$= 1.41 - \frac{0.0591}{6} (-5.097) = 1.41 + \frac{0.3012}{6}$$

$$= 1.41 + 0.0502 \quad = 1.4602\text{V}$$

$$E_{cell} = 1.46\text{ V}$$

29. (*a*) (*i*) In acidic medium:

$$MnO_4^- + 8H^+ + 5\bar{e} \longrightarrow Mn^{2+} + 4H_2O] \times 2$$

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2\bar{e}] \times 5$$

$$\underline{\overline{2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O}}$$

(*ii*) In acidic medium:

$$Cr_2O_7^{2-} + 14H^+ + 6\bar{e} \longrightarrow 2Cr^{3+} + 7H_2O$$

$$Fe^{2+} \longrightarrow Fe^{3+} + \bar{e}] \times 6$$

$$\underline{\overline{Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O}}$$

(*b*) (*i*) On moving from titanium to copper in general atomic mass increases where as atomic size decreases, therefore density increases in general.

(*ii*) The frequent metal-metal bonding in compounds of heavy transition elements is due to their high enthalpy of atomization.

(*iii*) This is due to very small energy gap between $5f$, $6d$ and 7s orbitals in the actinoid series.

OR

(*a*) (*i*) In neutral or faintly alkaline solutions

$$MnO_4^- + 2H_2O + 3e^- \longrightarrow MnO_2 + 4OH^-]\times 8$$

$$S_2O_3^{2-} + 10\bar{O}H \longrightarrow 2SO_4^{2-} + 5H_2O + 8e^-]\times 3$$

$$\underline{\overline{8MnO_4^- + 3S_2O_3^{2-} + H_2O \longrightarrow 8MnO_2 + 6SO_4^{2-} + 2\bar{O}H}}$$

(*ii*) In acidic solutions

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$

$$H_2S \longrightarrow S + 2H^+ + 2e^-]\times 3$$

$$\underline{\overline{Cr_2O_7^{2-} + 3H_2S + 8H^+ \longrightarrow 2Cr^{3+} + 3S + 7H_2O}}$$

(*b*) $Fe(s) + Cd^{2+}(aq) \rightleftharpoons Fe^{2+}(aq) + Cd(s)$

$$\log k_c = n\frac{E^o_{cell}}{0.059}$$

Here, $n = 2$

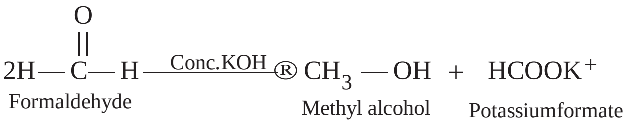
$$E^o_{cell} = E^o_{cathode} - E^o_{anode} = E^o_{Cd^{2+}/Cd} - E^o_{Fe^{2+}/Fe}$$

$$= -40 - (-0.44) = 0.04V$$

$$\log k_c = \frac{2\times 0.04}{0.059} = \frac{0.08}{0.059}$$

$$\log k_c = 1.3536 \quad \Rightarrow \quad k_c = \text{Antilog } 1.3536 = 22.57$$

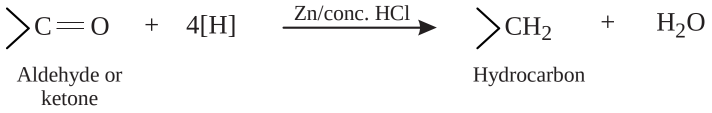
30. (*a*) (*i*) **Cannizzaro reaction:** Aldehyde which do not have an $\alpha-$ hydrogen atom, undergo disproportionation reaction on treatment with concentrated alkali, In this reaction, one molecule of aldehyde is reduced to alcohol while other is oxidised to carboxylic acid salt.



$$2H-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{\text{Conc.KOH}} CH_3-OH + HCOOK^+$$

Formaldehyde Methyl alcohol Potassiumformate

(*ii*) **Clemmensen reduction:** The carbonyl group of aldehyde and ketones is reduced to CH_2 group on treatment with zinc amalgam and concentrated hydrochloric acid.



$$>C=O + 4[H] \xrightarrow{\text{Zn/conc. HCl}} >CH_2 + H_2O$$

Aldehyde or ketone Hydrocarbon

(*b*)

Element	Percentage	Atomic mass	No. of moles	Simplest molar ratio
C	69.77	12	$\frac{69\text{x}77}{12}=5\text{x}81$	$\frac{5\text{x}81}{1\text{x}16}=5$
H	11.63	1	$\frac{11\text{x}63}{1}=11\text{x}63$	$\frac{11\text{x}63}{1\text{x}16}=10$
O	(100 – 81.4) = 18.60	16	$\frac{18\text{x}60}{16}=1\text{x}16$	$\frac{1\text{x}16}{1\text{x}16}=1$

Empirical formula of the compound *A* = $C_5H_{10}O$

Molecular formula of the compound *A* = *n* (Empirical formula)

$$n = \frac{\text{Molecular mass of compound } A}{\text{Empirical formula mass of compound } A}$$

Molecular mass of compound *A* = 86

Empirical formula mass of compound *A* = $5\times12+1\times10+1\times16$

$$= 60 + 10 + 16$$

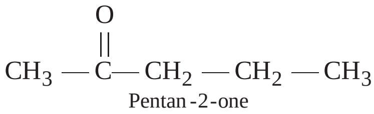
$$= 86$$

$$n = \frac{86}{86} = 1$$

Molecular formula of the compound *A* = $1(C_5H_{10}O)$

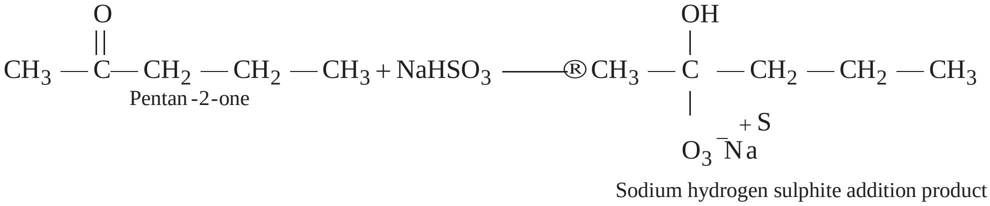
$$= C_5H_{10}O$$

- As the compound *A* forms addition compound with $NaHSO_3$ therefore it must be either an aldehyde or ketone.
- As it does not reduce Tollens reagent and give positive Iodoform test therefore it must be a methyl ketone.
- As on oxidation the compound A gives a mixture of ethanoic acid and propanoic acid, therefore compound *A* is

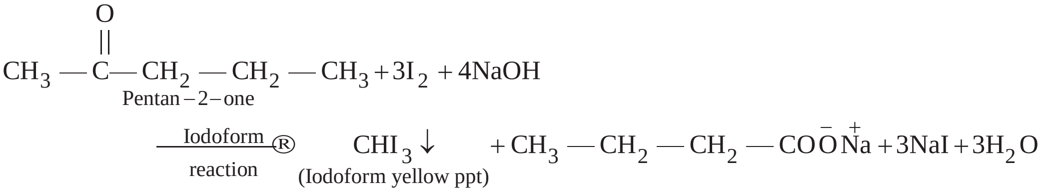


$$\underset{\text{Pentan-2-one}}{\mathrm{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-CH_3}}$$

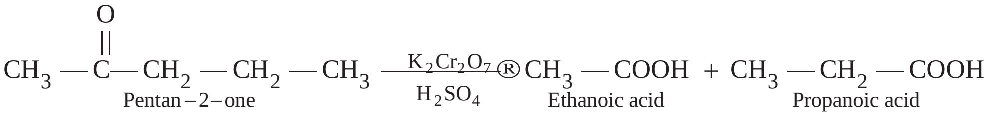
The chemical reactions are:



$$\underset{\text{Pentan-2-one}}{\mathrm{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-CH_3}} + \mathrm{NaHSO_3} \longrightarrow \underset{\text{Sodium hydrogen sulphite addition product}}{\mathrm{CH_3-\overset{\overset{\displaystyle OH}{|}}{\underset{\underset{\displaystyle O_3\overset{-}{S}\overset{+}{Na}}{|}}{C}}-CH_2-CH_2-CH_3}}$$



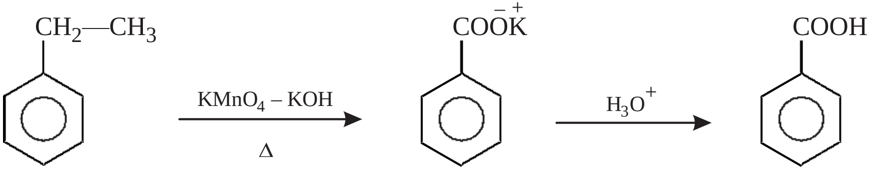
$$\underset{\text{Pentan-2-one}}{\mathrm{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-CH_3}} + 3\mathrm{I_2} + 4\mathrm{NaOH} \xrightarrow[\text{reaction}]{\text{Iodoform}} \underset{\text{(Iodoform yellow ppt)}}{\mathrm{CHI_3}\downarrow} + \mathrm{CH_3-CH_2-CH_2-CO\overset{-}{O}\overset{+}{Na}} + 3\mathrm{NaI} + 3\mathrm{H_2O}$$



$$\underset{\text{Pentan-2-one}}{\mathrm{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-CH_3}} \xrightarrow[\mathrm{H_2SO_4}]{\mathrm{K_2Cr_2O_7}} \underset{\text{Ethanoic acid}}{\mathrm{CH_3-COOH}} + \underset{\text{Propanoic acid}}{\mathrm{CH_3-CH_2-COOH}}$$

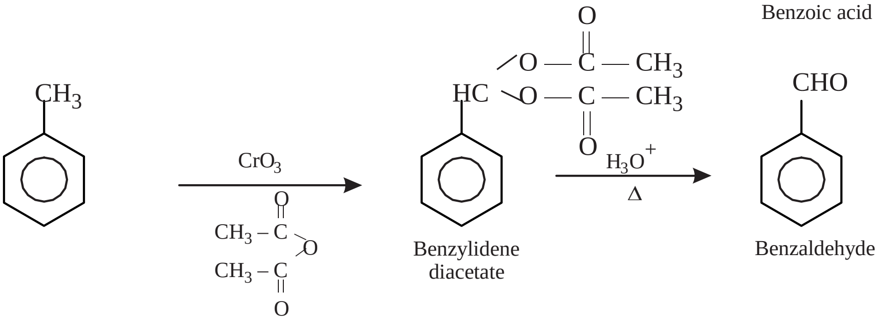
OR

(*a*) (*i*)

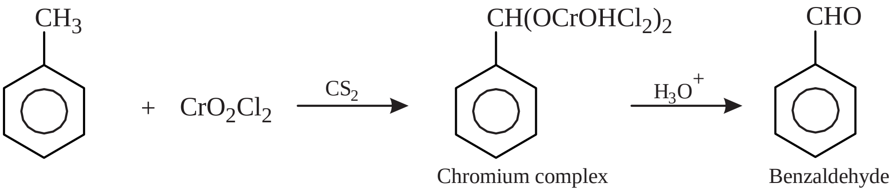


Benzoic acid

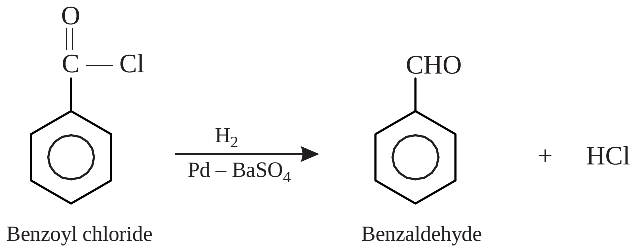
(*ii*)



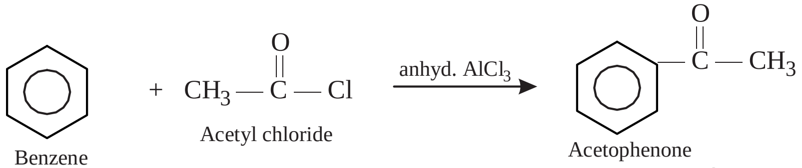
OR



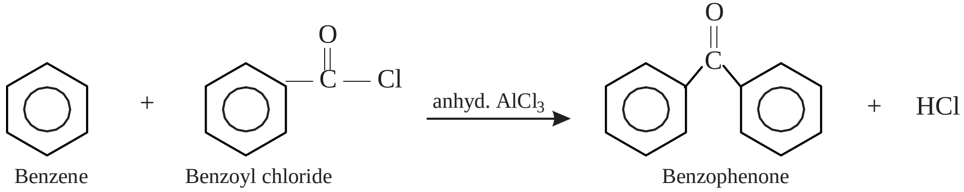
(*b*) (*i*)



(*ii*)



(*iii*)



CBSE (Delhi) SET–II

1. Schottky defect

21. **Multimolecular colloids:** In this type of colloids, colloidal particles are aggregates of atoms or molecules each having size less than 1nm, e.g., sulphur sol, gold sol.

Macromolecular colloids: In this type of colloids, colloidal particles are themselves large molecules of colloidal dimensions, e.g., starch, proteins, polyethene, etc.

Associated colloids: There are certain substances which at low concentrations behave as normal electrolyte, but at higher concentrations exhibit colloidal behaviour due to the formation of aggregates. Such colloids are known as associated colloids, e.g., soaps and detergents.

24. (*i*) Fluorine does not exhibit any positive oxidation state as it is the most electro-negative element and does not have *d* orbitals in its valance shell.

(*ii*) This is due to low ionization enthalpy of xenon.

(*iii*) Phosphorus is much more reactive than nitrogen as the P–P single bond (213 kJ mol^{-1}) is much weaker than $N \equiv N$ triple bond (941.4 kJ mol^{-1}).

27. Difference between antiseptics and disinfectants.

- Antiseptics are chemical substances which prevent the growth of micro-organisms and may even kill them but are not harmful to living tissues.
- Antiseptics are generally applied to living tissues such as wounds, cuts, ulcers and diseased skin surfaces.
- Dettol, furacine, soframicine are antiseptics.

- Disinfectants are chemical substances which kill micro-organisms or stop their growth but are harmful to human tissues.
- Disinfectants are applied to inanimate objects such as floor, drainage system, instrument, etc.
- Chlorine in the concentration of 0.2 to 0.4 ppm in aqueous solution and SO_2 in very low concentration are disinfectants.

28. (*a*) (*i*)

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$
$$\left. Fe^{2+} \longrightarrow Fe^{3+} + e^- \right] \times 5$$
$$\overline{\underline{MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O}}$$

(*ii*)

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$
$$\left. 2I^- \longrightarrow I_2 + 2e^- \right] \times 3$$
$$\overline{\underline{Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O}}$$

(*b*) (*i*) Transition elements form many interstitial compounds as they are capable of entrapping small atoms like H, C or N in the interstitial sites in their crystal lattice.

(*ii*) Cr^{2+} is reducing as its configuration changes from d^4 to d^3, the latter having a half filled t_{2g} configuration. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled d^5 configuration which has extra stability therefore Mn^{3+} is oxidising.

(*iii*) This is because transition metals have strong metallic bonds as they have a large number of unpaired electrons.

OR

(*a*) (*i*)

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$
$$\left. H_2S \longrightarrow S + 2H^+ + 2e^- \right] \times 3$$
$$\overline{\underline{Cr_2O_7^{2-} + 3H_2S + 8H^+ \longrightarrow 2Cr^{3+} + 3S + 7H_2O}}$$

(*ii*) $2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

(*b*) (*i*) This is due to $d - d$ transition as the energy of excitation of d orbital electrons from lower energy to higher energy level lies in the visible region.

(*ii*) The variable oxidation states of transition metals are due to the participation of *ns* and $(n-1)d$ electrons in bonding as energy difference between ns and $(n-1)d$ orbitals is small.

(*iii*) This is due to comparable energies of $5f$, $6d$ and $7s$ orbitals of actinoids.

29. (*a*) The lead storage battery is a secondary cell

The cell reactions when the battery is in use are given below

At anode : $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

At cathode : $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$

Overall cell reaction : $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$

(*b*) At anode: $\mathrm{Al}(s) \longrightarrow \mathrm{Al}^{3+}(aq) + 3\bar{e}\,] \times 2$

At cathode: $\mathrm{Ni}^{2+}(aq) + 2\bar{\mathrm{e}} \longrightarrow Ni(s)] \times 3$

$$2\mathrm{Al}(s) + 3\mathrm{Ni}^{2+}(aq) \longrightarrow 2\mathrm{Al}^{3+}(aq) + \mathrm{Ni}(s)$$

$$E_{\text{cell}} = E^{o}_{\text{cell}} - \frac{0.0591}{n}\log\frac{[\mathrm{Al}^{3+}]^2}{[\mathrm{Ni}^{2+}]^3}$$

Here $n = 6$, $[\mathrm{Al}^{3+}] = 0.001\mathrm{M} = 1\times 10^{-3}\mathrm{M}$, $[\mathrm{Ni}^{2+}] = 0.5\mathrm{M}$

$$E^{o}_{\text{cell}} = E^{o}_{\mathrm{Ni}^{2+}/\mathrm{Ni}} - E^{o}_{\mathrm{Al}^{3+}/\mathrm{Al}} = -0.25V - (-1.66V)$$

$$E^{o}_{\text{cell}} = 1.41\mathrm{V}$$

$$E^{o}_{\text{cell}} = 1.41 - \frac{0.0591}{6}\log\frac{\left(10^{-3}\right)^2}{(0.5)^3} = 1.41 - \frac{0.0591}{6}\log\frac{10^{-6}}{0.125}$$

$$= 1.41 - \frac{0.0591}{6}\log\left(10^{-6}\times 8\right) = 1.41 - \frac{0.0591}{6}\left(\log 10^{-6} + \log 2^3\right)$$

$$= 1.41 - \frac{0.0591}{6}\log\left(-6\log 10 + 3\log 2\right) = 1.41 - \frac{0.0591}{6}\left(-6 + 3\times 0.3010\right)$$

$$= 1.41 - \frac{0.0591}{6}(-5.097) = 1.41 + \frac{0.3012}{6}$$

$$= 1.41 + 0.0502 = 1.4602\mathrm{V}$$

$$E_{\text{cell}} = 1.46\ \mathrm{V}$$

OR

(*a*) $$\kappa = \frac{1}{R}\times\left(\frac{l}{A}\right)$$

Where κ = Conductivity

$\frac{l}{A}$ = Cell Constant

R = Resistance

$$\Lambda_m = \frac{\kappa\times 1000}{\mathrm{M}}$$

Where Λ_m = Molar conductivity

κ = Conductivity

M = Molarity of Solution

(*b*) $\mathrm{Fe}(s) + \mathrm{Cd}^{2+}(aq) \rightleftharpoons \mathrm{Fe}^{2+}(aq) + \mathrm{Cd}(s)$

$$\log k_c = n\frac{E^\circ\text{cell}}{0.059}$$

Here, $n = 2$

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$$
$$= E^\circ_{Cd^{2+}/Cd} - E^\circ_{Fe^{2+}/Fe} = -\ 0.40 - (-\ 0.44)$$
$$E^\circ_{\text{cell}} = 0.04\ \text{V}$$
$$\log k_c = \frac{2 \times 0.04}{0.059} = \frac{0.08}{0.059}$$
$$\log k_c = 1.3536$$
$$k_c = \text{Antilog } 1.3536$$
$$k_c = 22.57$$

CBSE (Delhi) SET–III

1. Interstitial defect increases the density of a solid.

8. It means the two monomers combine to make nylon 6,6, contain six carbon atoms each.

19.
$$\Delta T_f = [273.15 - (-0.320 + 273.15)]\text{K} = 0.320\ \text{K}$$
$$\Delta T_f = K_f\ .m$$
$$= 1.86\ \text{K kg mol}^{-1} \times 0.0711\ \text{mol kg}^{-1}$$
$$= 0.132\ \text{K}$$
$$i = \frac{\text{Observed value of } \Delta T_f}{\text{Calculated value of } \Delta T_f} = \frac{0.320\text{K}}{0.132\text{K}}$$
$$i = 2.42$$

24.

S. No.	Complex	Central metal ion	Configuration of metal ion	Hybridisation of metal ion	Geometry of the complex	Number of unpaired electrons	Magnetic behaviour
(*i*)	$[CoF_4]^{2-}$	Co^{2+}	d^7	sp^3	Tetrahedral	3	Paramagnetic
(*ii*)	$[Cr(H_2O)_2(C_2O_4)_2]$	Cr^{3+}	$3d^3$	d^2sp^3	Octahedral	3	Paramagnetic
(*iii*)	$Ni(CO)_4$	Ni	$3d^8\ 4s^2$	sp^3	Tetrahedral	0	Diamagnetic

27. **(*i*) Antacids:** Chemical substances which removes the excess acid in the stomach & raise the pH to appropriate level, *e.g.*, sodium hydrogen carbonate, a mixture of aluminium and magnesium hydroxide, ranitidine, etc.

(*ii*) Non-ionic Detergents: Non-ionic detergents do not contain any ion in their constitution. One such detergent is formed when stearic acid reacts with polyethylene glycol.

(*iii*) Antiseptics: These are the chemical substances which prevent the growth of micro-organisms and may even kill them but are not harmful to living tissues. Antiseptics are applied to living tissues such as wounds, cuts, ulcers. Dettol, soframicine are antiseptics.

28. (*a*) (*i*)

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$

$$2I^- \longrightarrow I_2 + 2e^-] \times 3$$

$$\overline{Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O}$$

(*ii*)

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

$$Fe^{2+} \longrightarrow Fe^{3+} + e^-] \times 5$$

$$\overline{MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O}$$

(*b*) (*i*) The atomic radii of transition metals decreases with atomic number in a series as the nuclear charge increases due to poor shielding effect of d orbitals.

(*ii*) This is due to its high enthalpy of atomization and low hydration enthalpy.

(*iii*) This is due to much large third ionisation energy of Mn as Mn^{2+} is very stable on account of stable d^5 configuration.

OR

(*a*) **Lanthanoid contraction:** The steady decrease in the atomic and ionic radii of lanthanoids with increase in atomic number is known as lanthanoid contraction.

Cause of lanthanoid contraction: As we move along the lanthanoid series, for every additional proton in the nucleus, the corresponding electron goes into 4*f*-subshell, there is poor shielding of one electron by another in this subshell due to the shapes of these *f*-orbitals. The imperfect shielding is not able to counterbalance the effect of the increased nuclear charge. Thus the net result is decrease in size with increase in atomic number.

Consequences:

(*i*) 5*d* series elements have nearly same radii as that of 4*d*-series.

(*ii*) The basic strength of hydroxides decreases from $La(OH)_3$ to $Lu(OH)_3$.

(*b*) (*i*) Because the high hydration enthalpy of Cu^{2+} easily compensates the second ionization enthalpy of Cu.

(*ii*) Because strong ligand cause spin pairing giving rise to diamagnetic octahedral complex which are very stable and have very large crystalfield stabilization energy. This splitting energy overcomes the ionization enthalpy.

(*iii*) This is due to stability of Mn^{2+} as it has half filled d^5 configuration.

29. **(*a*) Molar conductivity (Λ_m)**: It may be defined as the conductivity of one molar electrolytic solution placed between two electrodes one centimeter apart and have enough area of cross section to hold entire volume.

$$\Lambda_m = \frac{\kappa}{c}$$

Where κ = Conductivity

c = Concentration of solution in mol L^{-1}

(*b*) At anode : $Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$

At cathode : $Ag^+(aq) + e^- \longrightarrow Ag(s)] \times 2$

$$\mathrm{Zn}(s) + 2\mathrm{Ag}^{+}(aq) \longrightarrow \mathrm{Zn}^{2+} + 2\mathrm{Ag}(s)$$

$$\mathrm{E_{cell}} = \mathrm{E°_{cell}} - \frac{0.0591}{n}\log\frac{[Zn^{2+}]}{[Ag^{+}]^{2}}$$

Here, $n = 2,\ [Zn^{2+}] = 1\ \mathrm{M}$

$$\mathrm{E°_{cell}} = E°_{Ag^{+}/Ag} - E°_{zn^{2+}/zn} = 0.80\,V - (-0.76\,V)$$

$$\mathrm{E°_{cell}} = 1.56\,V$$

$$1.48 = 1.56 - \frac{0.0591}{2}\log\frac{1}{[Ag^{+}]^{2}}$$

$$-0.08 = -\frac{0.0591}{2}\log\frac{1}{[Ag^{+}]^{2}}$$

$$\log\frac{1}{[Ag^{+}]^{2}} = \frac{0.16}{0.0591} = 2.7072$$

$$\log 1 - \log[Ag^{+}]^{2} = 2.7072$$

$$0 - 2\log[Ag^{+}] = 2.7072$$

$$\log[Ag^{+}] = -1.3536 = \bar{2}.6464$$

$$[\mathrm{Ag}^{+}] = \mathrm{Anti\,log}(\bar{2}.6464) = 4.43\times10^{-2}\ \mathrm{M}$$

$$[\mathrm{Ag}^{+}] = 0.044\ \mathrm{M}$$

OR

(*a*) **At anode** : Oxidation of Fe atoms takes place

$$\mathrm{Fe} \longrightarrow \mathrm{Fe}^{2+} + 2\mathrm{e}^{-} \qquad E°_{Fe^{2+}/Fe} = -0.44\,V$$

At cathode : Reduction of oxygen in the presence of H^{+} ions. The H^{+} ions are produced by either $\mathrm{H_2O}$ or $\mathrm{H_2CO_3}$ (formed by dissolution of $\mathrm{CO_2}$ in moisture)

$$2\mathrm{H}^{+}(aq) + 2\mathrm{e}^{-} \longrightarrow 2\mathrm{H}$$

$$2\mathrm{H} + \frac{1}{2}\mathrm{O_2}(g) \longrightarrow \mathrm{H_2O}$$

Net reaction at cathodic area

$$2\mathrm{H}^{+}(aq) + \frac{1}{2}\mathrm{O_2} + 2\mathrm{e}^{-} \longrightarrow \mathrm{H_2O} \qquad \mathrm{E°_{H^{+}/O_2/H_2O}} = 1.23\mathrm{V}$$

The overall reaction

$$\mathrm{Fe}(s) + 2\mathrm{H}^{+}(aq) + \frac{1}{2}\mathrm{O_2}(g) \longrightarrow \mathrm{Fe}^{2+}(aq) + \mathrm{H_2O}(l) \qquad \mathrm{E°_{cell}} = 1.67\,V$$

The ferrous ions are further oxidised by atmospheric oxygen to ferric ions which come out as rust in the form of hydrated ferric oxide ($\mathrm{Fe_2O_3}.x\mathrm{H_2O}$).

(*b*) At anode: $\mathrm{Al}(s) \longrightarrow \mathrm{Al}^{3+}(aq) + 3\bar{e}\,]\times 2$

At cathode: $\mathrm{Ni}^{2+}(aq) + 2\bar{\mathrm{e}} \longrightarrow \mathrm{Ni}(s)]\times 3$

$$2\mathrm{Al}(s) + 3\mathrm{Ni}^{2+}(aq) \longrightarrow 2\mathrm{Al}^{3+}(aq) + \mathrm{Ni}(s)$$

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log\frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

Here n = 6, $[Al^{3+}] = 0.001M = 1\times 10^{-3}M$, $[Ni^{2+}] = 0.5M$

$$E^o_{cell} = E^o{}_{Ni^{2+}/Ni} - E^o{}_{Al^{3+}/Al} = -0.25V - (-1.66V)$$

$$E^o_{cell} = 1.41V$$

$$E^o_{cell} = 1.41 - \frac{0.0591}{6}\log\frac{\left(10^{-3}\right)^2}{(0.5)^3} = 1.41 - \frac{0.0591}{6}\log\frac{10^{-6}}{0.125}$$

$$= 1.41 - \frac{0.0591}{6}\log\left(10^{-6}\times 8\right) = 1.41 - \frac{0.0591}{6}\left(\log 10^{-6} + \log 2^3\right)$$

$$= 1.41 - \frac{0.0591}{6}\log\left(-6\log 10 + 3\log 2\right) = 1.41 - \frac{0.0591}{6}\left(-6 + 3\times 0.3010\right)$$

$$= 1.41 - \frac{0.0591}{6}(-5.097) = 1.41 + \frac{0.3012}{6}$$

$$= 1.41 + 0.0502 = 1.4602V$$

$$E_{cell} = 1.46\ V$$

CBSE EXAMINATION PAPERS

ALL INDIA–2009

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (All India) SET–I

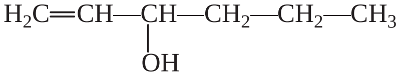
1. How do metallic and ionic substances differ in conducting electricity? **1**

2. What is the 'coagulation' process? **1**

3. What is meant by the term 'pyrometallurgy'? **1**

4. Why is red phosphorus less reactive than white phosphorus? **1**

5. Give the IUPAC name of the following compound: **1**



$$H_2C{=}CH{-}\underset{\displaystyle OH}{\underset{|}{CH}}{-}CH_2{-}CH_2{-}CH_3$$

6. Write the structural formula of 1-phenylpentan-1-one. **1**

7. Arrange the following compounds in an increasing order of basic strengths in their aqueous solutions: **1**

$NH_3,\ CH_3NH_2,\ (CH_3)_2NH,\ (CH_3)_3N$

8. What does '6, 6' indicate in the name nylon-6,6? **1**

9. What type of cell is a lead storage battery? Write the anode and the cathode reactions and the overall cell reaction occurring in the use of a lead storage battery. **2**

OR

Two half cell reactions of an electrochemical cell are given below:

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \circledR\ Mn^{2+}(aq) + 4H_2O(l),\ E° = 1.51V$$

$$Sn^{2+}(aq) \circledR\ Sn^{4+}(aq) + 2e^-,\ E° = +0.15\ V$$

Construct the redox equation from the two half cell reactions and predict if this reaction favours formation of reactants or product shown in the equation.

10. Define the following: **2**

(*i*) Elementary step in a reaction

(*ii*) Rate of a reaction

11. Describe the underlying principle of each of the following metal refining methods: **2**

(*i*) Electrolytic refining of metals

(*ii*) Vapour phase refining of metals.

12. Complete the following chemical reaction equations: **2**

(*i*) $XeF_2 + H_2O$ ——®

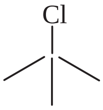
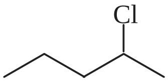
(*ii*) $PH_3 + HgCl_2$ ——®

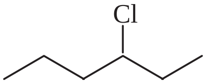
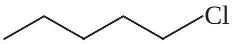
13. Complete the following chemical reaction equations: **2**

(*i*) $MnO_4^-(aq) + C_2O_4^{2-}(aq) + H^+(aq)$ ——®

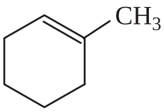
(*ii*) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq)$ ——®

14. Which one in the following pairs undergoes S_N1 substitution reaction faster and why? **2**

(*i*)  or 

(*ii*)  or 

15. Complete the following reaction equations: **2**

(*i*)  + HI ⟶

(*ii*) $CH_3CH_2CH=CH_2 + HBr$ ®

16. Name the four bases present in DNA. Which one of these is not present in RNA? **2**

17. Name two fat soluble vitamins, their sources and the diseases caused due to their deficiency in diet. **2**

18. Differentiate between molecular structures and behaviours of thermoplastic and thermosetting polymers. Give one example of each type. **2**

19. A first order reaction has a rate constant of $0.0051\ min^{-1}$. If we begin with 0.10 M concentration of the reactant, what concentration of the reactant will be left after 3 hours? **3**

20. Silver crystallises with face-centred cubic unit cells. Each side of the unit cell has a length of 409 pm. What is the radius of an atom of silver? (Assume that each face atom is touching the four corner atoms.) **3**

21. A copper-silver cell is set up. The copper ion concentration in it is 0.10 M. The concentration of silver ion is not known. The cell potential measured 0.422 V. Determine the concentration of silver ion in the cell. **3**

(Given: $E^o_{Ag^+/Ag} = +0.80V$, $E^o_{Cu^{2+}/Cu} = +0.34\ V$)

22. What happens in the following activities and why? **3**

(*i*) An electrolyte is added to a hydrated ferric oxide sol in water.

(*ii*) A beam of light is passed through a colloidal solution.

(*iii*) An electric current is passed through a colloidal solution.

23. Giving a suitable example for each, explain the following: **3**

(*i*) Crystal field splitting

(*ii*) Linkage isomerism

(*iii*) Ambidentate ligand.

OR

Compare the following complexes with respect to structural shapes of units, magnetic behaviour and hybrid orbitals involved in units:

$[Co(NH_3)_6]^{3+}, [Cr(NH_3)_6]^{3+}, Ni(CO)_4$

(At No.: Co = 27, Cr = 24, Ni = 28)

24. Explain the following observations: **3**

(*i*) The boiling point of ethanol is higher than that of methoxymethane.

(*ii*) Phenol is more acidic than ethanol.

(*iii*) o-and p-nitrophenols are more acidic than phenol.

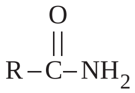
25. How would you account for the following: **3**

(*i*) Many of the transition elements and their compounds can act as good catalysts.

(*ii*) The metallic radii of the third (5*d*) series of transition elements are virtually the same as those of the corresponding members of the second series.

(*iii*) There is a greater range of oxidation states among the actinoids than among the lanthanoids.

26. Complete the following reaction equations: **3**

(*i*) 

$R-\overset{\overset{O}{||}}{C}-NH_2$ $LiAlH_4$

———

—® H_2

O

(*ii*) $C_6H_5N_2Cl + H_3PO_2 + H_2O$

—® (*iii*) $C_6H_5NH_2 + Br_2$ (*aq*)

—®

27. Describe the following substances with one suitable example of each type: **3**

(*i*) Non-ionic detergents

(*ii*) Food preservatives

(*iii*) Disinfectants

28. (*a*) Define the following terms: **5**

(*i*) Mole fraction

(*ii*) Van’t Hoff factor

(*b*) 100 mg of a protein is dissolved in enough water to make 100 mL of a solution. If this solution has an osmotic pressure 13.3 mm Hg at 25° C, what is the molar mass of protein?
(R = 0.0821 L atm mol^{-1} K^{-1} and 760 mm Hg = 1 atm.)

OR

What is meant by:

(*i*) Colligative properties

(*ii*) Molality of a solution.

(*b*) What concentration of nitrogen should be present in a glass of water at room temperature? Assume a temperature of 25° C, total pressure of 1 atmosphere and mole fraction of nitrogen in air of 0.78. [K_H for nitrogen = 8.42×10^{-7} M/mm Hg] **5**

29. (*a*) Draw the structures of the following:

(*i*) $H_2S_2O_8$

(*ii*) $HClO_4$

(*b*) How would you account for the following:

(*i*) NH_3 is a stronger base than PH_3.

(*ii*) Sulphur has a greater tendency for catenation than oxygen.

(*iii*) F_2 is a stronger oxidising agent than Cl_2. **5**

OR

(*a*) Draw the structures of the following:

(*i*) $H_2S_2O_7$

(*ii*) $HClO_3$

(*b*) Give an explanation for each of the following observations:

(*i*) In the structure of HNO_3, the N – O bond
(121 pm) is shorter than the N – OH bond (140 pm)

(*ii*) All the P – Cl bonds in PCl_5 are not equivalent.

(*iii*) ICI is more reactive than I_2.

30. (*a*) Write chemical equations to illustrate the following name bearing reactions:

(*i*) Cannizzaro’s reaction

(*ii*) Hell-Volhard-Zelinsky reaction

(*b*) Give chemical tests to distinguish between the following pairs of compounds: **5**

(*i*) Propanal and Propanone

(*ii*) Acetophenone and Benzophenone

(*iii*) Phenol and Benzoic acid

OR

(*a*) How will you bring about the following conversions:

(*i*) Ethanol to 3-hydroxybutanal

(*ii*) Benzaldehyde to Benzophenone.

(*b*) An organic compound A has the molecular formula $C_8H_{16}O_2$. It gets hydrolysed with dilute sulphuric acid and gives a carboxylic acid B and an alcohol C. Oxidation of C with chromic acid also produced B. C on dehydration reaction gives but-1-ene. Write equations for the reactions involved.

CBSE (All India) SET–II

[Questions different from Set–I]

1. Which point defect of its crystals decrease the density of a solid? **1**

8. What is the primary structural feature necessary for a molecule to make it useful in a condensation polymerisation reaction? **1**

20. For a decomposition reaction the values of rate constant *k* at two different temperatures are given below: **3**

$k_1 = 2.15 \times 10^{-8}$ L mol^{-1} s^{-1} at 650 K

$k_2 = 2.39 \times 10^{-7}$ L mol^{-1} s^{-1} at 700 K

Calculate the value of activation energy for this reaction.

($R = 8.314$ J K^{-1} mol^{-1})

27. Complete the following reaction equations: **3**

(*i*) $C_6H_5N_2Cl + CH_3COCl \longrightarrow$

(*ii*) $C_2H_5NH_2 + C_6H_5SO_2Cl \longrightarrow$

(*iii*) $C_2H_5NH_2 + HNO_2 \longrightarrow$

28. (*a*) Give chemical tests to distinguish between compounds in the following pairs of substances:

(*i*) Ethanal and Propanal

(*ii*) Benzoic acid and Ethyl benzoate

(*b*) An organic compound contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollen's reagent but forms an addition compound with sodium hydrogensulphite and gives positive iodoform test. On vigorous addition, it gives ethanoic and propanoic acids. Derive the structure of the compound 'A'. **5**

OR

(*a*) Arrange the following compounds in an increasing order of their indicated property:

(*i*) Benzoic acid, 4-Nitrobenzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxybenzoic acid (acid strength)

(*ii*) $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)\ CH_2COOH$,

$(CH_3)_2CHCOOH$, $CH_3CH_2CH_2COOH$ (acid strength) (*b*) How would you bring about the following conversions:

(*i*) Propanone to Propene

(*ii*) Benzoic acid to Benzaldehyde

(*iii*) Bromobenzene to 1-phenylethanol

29. (*a*) Draw the structure of the following:

(*i*) H_3PO_2

(*ii*) BrF_3

(*b*) How would you account for the following observations:

(*i*) Phosphorus has a greater tendency for catenation than nitrogen.

(*ii*) Bond dissociation energy of fluorine is less than that of chlorine.

(*iii*) No chemical compound of helium is known. **5**

OR

(*a*) Draw the structures of the following:

(*i*) N_2O_5

(*ii*) $XeOF_4$

(*b*) Explain the following observations:

(*i*) The electron gain enthalpy of sulphur atom has a greater negative value than that of oxygen atom.

(*ii*) Nitrogen does not form pentahalides.

(*iii*) In aqueous solutions HI is a stronger acid than HCl.

CBSE (All India) SET–III

[Questions different from Set–I and Set–II]

1. What is the number of atoms in a unit cell of a face-centred cubic crystal? **1**

13. Describe the role of the following: **2**

(*i*) NaCN in the extraction of silver from a silver ore.

(*ii*) Cryolite in the extraction of aluminium from pure alumina.

14. Define the following: **2**

(*i*) Order of a reaction

(*ii*) Activation energy of a reaction

17. Differentiate between condensation and addition polymerisations. Give one example each of the resulting polymers. **2**

21. A voltaic cell is set up 25° C with the following half-cells: **3**

$Al \mid Al^{3+}$ (0.0010 M) and $Ni \mid Ni^{2+}$ (0.50 M).

Write the equation for the cell reaction that occurs when the cell generates an electric current and determine the cell potential.

(Given : $E^o_{Ni^{2+}/Ni} = -0.25V$, $E^o_{Al^{3+}/Al} = -1.66V$)

23. Explain the following: **3**

(*i*) Low spin octahedral complexes of nickel are not known.

(*ii*) The π–complexes are known for transition elements only.

(*iii*) CO is a stronger ligand than NH_3 for many metals.

OR

Compare the following complexes with respect to structural shapes of units, magnetic behaviour and hybrid orbitals involved in units:

(*i*) $[Ni(CN)_4$

$]^{2-}$(*ii*) $[NiCl_4$

$]^{2-}$

(*iii*) $[CoFe_6]^{3-}$

[At. Nos,: Ni = 28; Co = 27]

27. What are the following substances? Give one example of each of them. **3**

(*i*) Cationic detergents

(*ii*) Enzymes

(*iii*) Sweetening agents

30. (*a*) Draw the structures of the following:

(*i*) XeF_4

(*ii*) $H_2S_2O_7$

(*b*) Explain the following observations:

(*i*) Phosphorus has a greater tendency for catenation than nitrogen.

(*ii*) The negative value of electron gain enthalpy is less for fluorine than that for chlorine.

(*iii*) Hydrogen fluoride has a much higher boiling point than hydrogen chloride. **5**

OR

(*a*) Draw the structures of the following:

(*i*) $PCl_5(s)$

(*ii*) SO_3^{2-}

(*b*) Explain the following observations:

(*i*) Ammonia has a higher boiling point than phosphine.

(*ii*) Helium does not form any chemical compound.

(*iii*) Bi(V) is a stronger oxidising agent than Sb(V).

SOLUTIONS

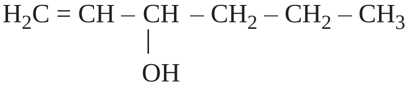
CBSE (All India) SET–I

1. Metallic substances conduct electricity through electrons while ionic substances conduct electricity in molten state or in solution through ions.

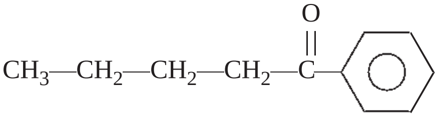
2. The process of settling of colloidal particles is called coagulation.

3. It is a thermal process of extracting a metal from its ore.

4. This is due to polymeric structure of red phosphorus or angular strain in P_4 molecule of white phosphorus where the angle is only 60°.

5. 

$H_2C = CH - \underset{\underset{OH}{|}}{CH} - CH_2 - CH_2 - CH_3$ Hex-l-en-3-ol.

6. 1-Phenyl pentan-1-one 

7. $NH_3 < (CH_3)_3N < CH_3—NH_2 < (CH_3)_2 NH$.

8. The two monomers (adipic acid and hexamethylene diamine) contain 6 carbon atoms each.

9. Lead storage battery is a secondary cell.

At anode: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

At cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$

Overall reactions: $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$

OR

At cathode: $MnO_4^-(aq) + 8H^+ + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)] \times 2$ $E° = +1.51\ V$

At anode: $Sn^{2+} \longrightarrow Sn^{4+}(aq) + 2e^-] \times 5$ $E° = +0.15\ V$

Overall reaction: $2MnO_4^-(aq) + 5Sn^{2+}(aq) + 16H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 5Sn^{4+}(aq) + 8H_2O(l)$

$$E^o_{Sn^{4+}/Sn^{2+}} = -E^o_{Sn^{2+}/Sn^{4+}} = -0.15\ V$$

$$E^o_{cell} = E^o_{cathode} - E^o_{anode} = E^o_{MnO_4^-/Mn^{2+}} - E^o_{Sn^{4+}/Sn^{2+}}$$

$$= 1.51 - (-0.15)$$

$$E^o_{Cell} = 1.66V$$

As E^o_{cell} is +ve therefore the reaction will take place in forward direction, *i.e.*, favours the formation of products.

10. (*i*) **Elementary step:** Each step of a complex reaction is called an elementary step.

(*ii*) **Rate of reaction:** It is the change in the concentration of any of the reactants or products per unit time.

11. (*i*) **Electrolytic refining:** In this method, the impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of same metal. When electric current is passed, the metal from the anode goes into solution as ions due to oxidation while pure metal gets deposited at the cathode due to reduction of metal ions. The less electropositive impurities settle down below the anode as anode mud.

At anode: $M \longrightarrow M^{n+} + ne^{-}$At

cathode: $M^{n+} + ne^{-} \longrightarrow M$

(*ii*) **Vapour phase refining of metals:** In this method, crude metal is freed from impurities by first converting it into volatile compound and collected elsewhere. It is then decomposed to give pure metal. For example refining of nickel by Mond process.

$$\underset{\text{impure}}{Ni} + 4CO \xrightarrow{330-350K} \underset{\text{Tetracarbonyl nickel (volatile)}}{Ni(CO)_4}$$

$$Ni(CO)_4 \xrightarrow{450-470K} \underset{\text{Pure}}{Ni} + 4CO$$

12. (*i*) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

(*ii*) $2PH_3 + \underset{\text{Mercuric chloride}}{3HgCl_2} \longrightarrow \underset{\text{Mercuric phosphide}}{Hg_3P_2\downarrow} + 6HCl$

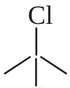
13. (*i*)

$$\begin{array}{ll} MnO_4^- + 8H^+ + 5e^- & \longrightarrow Mn^{2+} + 4H_2O] \times 2 \\ C_2O_4^{2-} & \longrightarrow 2CO_2 + 2e^-] \times 5 \\ \hline 2MnO_4^- + 5C_2O_4^{2-} + 16H^+ & \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O \\ \hline \end{array}$$

(*ii*)

$$\begin{array}{ll} Cr_2O_7^{2-} + 14H^+ + 6e^- & \longrightarrow 2Cr^{3+} + 7H_2O \\ Fe^{2+} & \longrightarrow Fe^{3+} + e^-] \times 6 \\ \hline Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ & \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O \\ \hline \end{array}$$

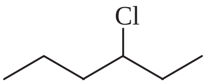
14. (*i*)



tert-Butyl chloride

3° halide reacts faster than 2° halide because of the greater stability of tertiary carbocation.

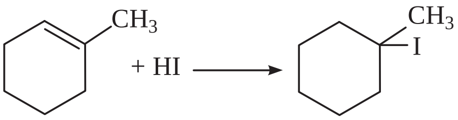
(*ii*)



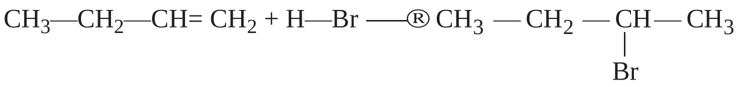
sec-Hexyl chloride

2° halide reacts faster than 1° halide because of the greater stability of secondary carbocation than primary.

15. (*i*)



I–lodo–1–methyl cyclohexane

(*ii*) 

$$CH_3—CH_2—CH{=}CH_2 + H—Br \longrightarrow CH_3—CH_2—\underset{\large Br}{\underset{|}{CH}}—CH_3$$

2–Bromo butane

16. The four bases present in DNA are adenine (A), guanine (G), cytosine(C) and thymine (T). Thymine(T) is not present in RNA.

17.

Fat soluble vitamins	Sources	Deficiency diseases
Vitamin A	Fish liver oil, carrots, milk	Xerophthalmia, Night blindness.
Vitamin D	Exposure to sunlight, fish and egg.	Rickets and osteomalacia.
Vitamin E	Vegetable oils like wheat germ oil, sunflower oil, etc.	Sterility and muscular atrophy
Vitamin K	Green leafy vegetables	Haemorrhages and increased blood clotting time.

18.

Thermoplastics	Thermosetting plastics
(*i*) These polymer are linear or slightly branched chain molecules	(*i*) These polymers are cross linked or heavily branched molecules
(*ii*) Soften on heating and harden on cooling and can be remoulded.	(*ii*) On heating undergo extensive cross linking in moulds and become infusible.
(*iii*) Some common examples are polyethene, PVC, polystyrene, etc.	(*iii*) Some common examples are bakelite, urea-formaldehyde resins, terylene, etc.

19. For a first order reaction

$$t = \frac{2.303}{k} \log \frac{[R]_o}{[R]}$$

Here

$t = 3\text{ h} = 3 \times 60\text{ min} = 180\text{ min}$

$k = 0.0051\text{min}^{-1}, [R]_o = 0.10\text{ M}, [R] = ?$

$$180\text{ min} = \frac{2.303}{0.0051\text{ min}^{-1}} \log \frac{0.10}{[R]}$$

$$\text{Log}\frac{0.1}{[R]} = \frac{180\text{ min} \times 0.0051\text{ min}^{-1}}{2.303} = \frac{918}{2303}$$

$$\log \frac{0.1}{[R]} = 0.3986$$

$$\frac{0.1}{[R]} = \text{Anti log }(0.3986) = 2.503$$

$$[R] = \frac{0.1}{2.503} = 0.03995\text{ M}$$

$$[R] = 0.04\text{M}$$

20. For *fcc* unit cell

$$r = \frac{a}{2\sqrt{2}}$$

Given $a = 409$ pm

$$\therefore \quad r = \frac{409}{2\sqrt{2}} = \frac{409\sqrt{2}}{4}$$

$$r = 144.58 \text{ pm}$$

21. At anode: $\text{Cu}(s) \longrightarrow \text{Cu}^{2+}(aq) + 2\text{e}^-$

At cathode: $2\text{Ag}^+(aq) + \text{e}^- \longrightarrow 2\text{Ag}(s)$

Overall reaction: $\text{Cu}(s) + 2\text{Ag}^+(aq) \longrightarrow \text{Cu}^{2+}(aq) + 2\text{Ag}(s)$

$n = 2,$ $\qquad [Ag^+] = ?$

Given, $\text{E}_{\text{cell}} = 4.22 \text{ V}$ $\qquad [\text{Cu}^{2+}] = 0.1 \text{ M}$

$\text{E}^{\text{o}}_{\text{Ag}^+/\text{Ag}} = 0.80 \text{ V}$ $\qquad \text{E}^{\text{o}}_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$

$$\text{E}^{\text{o}}_{\text{cell}} = \text{E}^{\text{o}}_{\text{cathode}} - \text{E}^{\text{o}}_{\text{anode}} = \text{E}^{\text{o}}_{\text{Ag}^+/\text{Ag}} - \text{E}^{\text{o}}_{\text{Cu}^{2+}/\text{Cu}}$$

$$\text{E}^{\text{o}}_{\text{cell}} = 0.80 - 0.34 = 0.46 \text{ V}$$

$$\text{E}_{\text{cell}} = \text{E}^{\text{o}}_{\text{cell}} - \frac{0.0591}{n} \log \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]}$$

$$0.422 = 0.46 - \frac{0.0591}{2} \log \frac{0.1}{[\text{Ag}^+]^2}$$

$$0.422 - 0.46 = -\,0.0295 \log \frac{10^{-1}}{[Ag^+]^2}$$

$$-\,0.038 = -\,0.0295 \log \frac{10^{-1}}{[Ag^+]^2}$$

$$\frac{0.038}{0.0295} = \log 10^{-1} - \log [Ag^+]^2$$

$$1.2881 = -\log 10 - 2 \log [\text{Ag}^+]$$

$$1.2881 = -\,1 - 2 \log [\text{Ag}^+]$$

$$2 \log [\text{Ag}^+] = 2.2881$$

$$\log [\text{Ag}^+] = -\,1.144$$

$$[\text{Ag}^+] = \text{Antilog } \bar{2}.856$$

$$[\text{Ag}^+] = 7.178 \times 10^{-2} \text{ M}$$

22. (*i*) The positively charged colloidal particles of $Fe(OH)_3$ get coagulated by the negatively charged ions provided by electrolyte.

(*ii*) The path of light becomes visible due to scattering of light by colloidal particles (Tyndall effect).

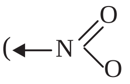
(*iii*) Electrophoresis takes place in which colloidal particles move towards the oppositely charged electrode where they lose their charge and get coagulated.

23. **(*i*) Crystal field spliting:** When the ligands approach the central metal ion, the electrons in the d-orbitals of central metal ion will be repelled by the lone pairs of the ligands. Because of these interactions the degeneracy of d orbitals of the metal ion is lost and these split into two sets of orbitals having different energies. This is known as crystal field splitting, *e.g.*, for d^4, configuration is $t^3_{2g}\, e^1_g$ in the presence of weak field ligand.

(*ii*) Linkage isomerism: The isomers which have same molecular formula but differ in the linkage of ligand atom to the central metal atom are called linkage isomers, *e.g.*,

$[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$

Pentaamminenitrito–N–Cobalt (III) chloride, pentaamminenitrito–O–Cobalt(III) chloride

(*iii*) Ambidentate ligand: A ligand which can bind to the central metal atom through any of the two donor atoms present in it is called ambidentate ligand, *e.g.*, NO_2 can bind to metal either through nitrogen, *i.e.*, as nitrito-N ( $\leftarrow N\begin{matrix} \diagup\!\!\diagup O \\ \diagdown O \end{matrix}$) or through oxygen atom, *i.e.*, as nitrito –O (¬ O—N=O)

OR

Complex/Ion	Central metal ion/atom	Configu-ration of metal ion	Hybri-disation of metal ion involved	Geometry of the complex	Number of unpaired electrons	Magnetic behaviour
$[Co(NH_3)_6]^{3+}$	Co^{3+}	$d^6 4s^0$	d^2sp^3	octahedral	0	Diamagnetic
$[Cr(NH_3)_6]^{3+}$	Cr^{3+}	$3d^3 4s^0$	d^2sp^3	octahedral	3	Paramagnetic
$[Ni(CO)_4]$	Ni	$3d^3 4s^2$	sp^3	Tetrahedral	0	Diamagnetic

24. (*i*) Ethanol undergoes intermolecular hydrogen bonding due to the presence of a hydrogen attached to oxygen atom. As a result, ethanol exist as associated molecules and hence it has higher boiling point than methoxy ethane which does not form hydrogen bonds.

(*ii*) Phenol is stronger acid than ethanol because the phenoxide ion left after the release of proton is stabilized by resonance but ethoxide ion is not. Moreover, ethoxide ion is destabilised by +I effect of ethyl group.

(*iii*) Due to –I effect or –R effect of $–NO_2$ group, the resulting phenolate ion is more stable than phenoxide ion. Therefore o- and p--nitrophenols are more acidic than phenol.

25. (*i*) The catalytic activity of transition metals is attributed to the following reasons:

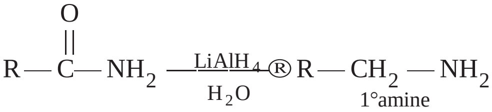
(a) Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation energy for the reaction.

(*b*) In some cases, the transition metal provides a suitable large surface area with free vacancies on which reactants are adsorbed.

(*ii*) This due to filling of 4*f* orbitals which have poor shielding effect or due to lanthanoid contraction.

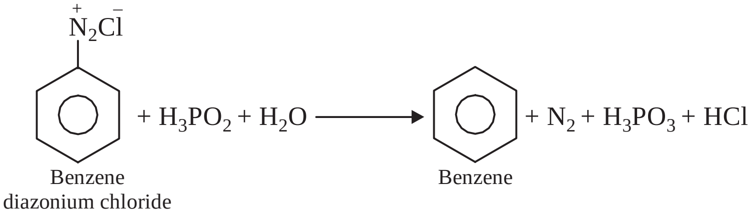
(*iii*) This is due to comparable energies of 5*f*, 6*d* and 7*s* orbital in actinoids.

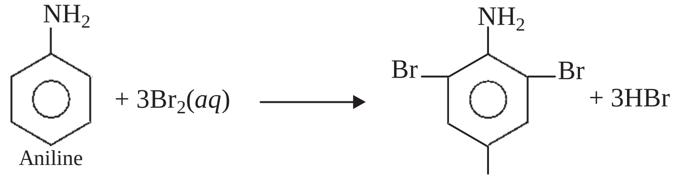
26. (*i*)



$$R-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2 \xrightarrow[H_2O]{LiAlH_4} \underset{1^\circ\text{amine}}{R-CH_2-NH_2}$$

(*ii*)





2, 4, 6 – Tribromo aniline

27. (***i***) **Non-ionic detergents:** These are the esters of high molecular mass alcohols with fatty acids. These are named so because they do not contain any ion in their constitution, e.g., polyethylene glycol stearate.

(***ii***) **Food preservatives:** These are the substances which prevent spoilage of food due to microbial growth, *e.g.*, sodium benzoate, potassium metabisulphite, salts of sorbic acid and propanoic acid, etc.

(***iii***) **Disinfectants:** These are the chemical substances which kill micro-organisms or stop their growth but are harmful to human tissues, *e.g.*, phenol (1%), chlorine in concentration of 0.2 to 0.4 pm in aqueous solution, SO_2, etc.

28. (***a***) (***i***) **Mole fraction:** It may be defined as the ratio of number of moles of one component to the total number of moles of all the components present in the solution.

(***ii***) **Van’t Hoff factor (*i*):** It may be defined as the ratio of normal molar mass to the observed molar mass, *i.e.*, Van’t Hoff factor

$$i = \frac{\text{Normal molar mass}}{\text{Observed molar mass}}$$

OR

$$i = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$$

(*b*)

$$\pi = \frac{W_B \times R \times T}{M_B \times V}$$

$$M_B = \frac{W_B \times R \times T}{\pi \times V}$$

Here

W_B = 100 mg = 100×10^{-3} g

R = 0.0821 L atm K^{-1} mol^{-1}

T = 25°C = (25 + 273) K = 298K

V = 100 mL = 10×10^{-3} L

π = 13.3 mm Hg $= \frac{13.3}{760}$ atm

$$M_B = \frac{100 \times 10^{-3}\ g \times 0.0821\ L\ atm\ K^{-1} mol^{-1} \times 298K}{\frac{13.3}{760}\ atm \times 100 \times 10^{-3}\ L}$$

$$M_B = \frac{100 \times 10^{-3} \times 0.0821 \times 298 \times 760\ g\ mol^{-1}}{13.3 \times 10 \times 10^{-3}} = \frac{18594\ g\ mol^{-1}}{133}$$

$$M_B = 1398.286\ g\ mol^{-1}$$

OR

(*i*) **Colligative properties:** Those properties which depend on the number of solute particles irrespective of their nature relative to the total number of particles present in the solution are called colligative properties of solutions.

(*ii*) **Molality (*m*):** It is the number of moles of the solute per kilogram of the solvent and is expressed as

$$\text{Molality} = \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$$

(*b*) P_{N_2} = 0.78 atm = 0.78 × 760 mm Hg

= 592.8 mm Hg

$K_H = 8.42 \times 10^{-7}$ M/mmHg

X_{N_2} = ?

$X_{N_2} = K_H \times P_{N_2}$

$= 8.42 \times 10^{-7}$ M/mmHg × 592.8 mmHg = 4991.376×10^{-7}

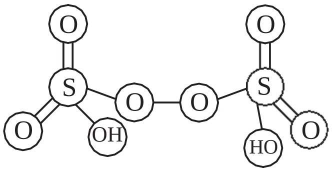
$X_{N_2} = 4.99 \times 10^{-4}$

$$X_{N_2} = \frac{X_{N_2}}{X_{N_2} + X_{H_2O}} = \frac{X_{N_2}}{X_{H_2O}}$$

$$X_{N_2} = X_{H_2O} \times X_{N_2} = \frac{1000}{18} \times 4.99 \times 10^{-4} = 0.0277$$

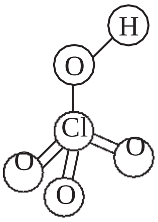
$X_{N_2} = 2.77 \times 10^{-2} = 2.77 \times 10^{-2}$M

29. (*a*) (*i*)



Peroxodisulphuric acid
($H_2S_2O_8$)

(*ii*)



Perchloric acid
($HClO_4$)

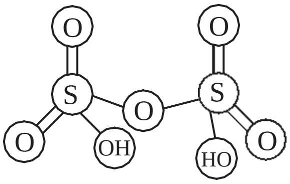
(*b*) (*i*) This is because the lone pair of electrons on N atom in NH_3 is directed and not delocalised as it in PH_3 due to larger size of *P*.

(*ii*) This is because S-S single bond is stronger O—O single bond.

(*iii*) Due to small size of fluorine atom there are strong interelectric repulsions in the relatively small size 2p orbitals of fluorine and thus, the incoming electron does not experience much attraction.

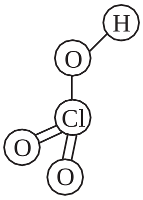
OR

(*a*) (*i*)



Pyrosulphuric acid (Oleum)
($H_2S_2O_7$)

(*ii*)



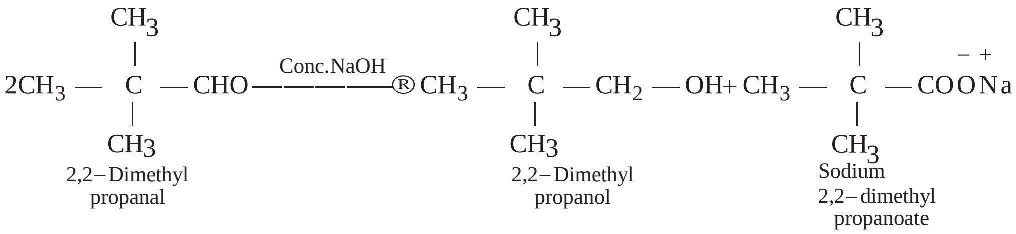
Chloric acid
($HClO_4$)

(*i*) Due to resonance, N—O bond length is the average of single and double bond whereas N—OH bond is purely single bond.

(*ii*) PCl_5 has trigonal bipyramidal structure in which the three equatorial P—Cl bonds are equivalent, while the two axial bonds are longer than equational bonds. This is due to the fact that axial bond pairs suffer more repulsion as compared to equatorial bond pairs.

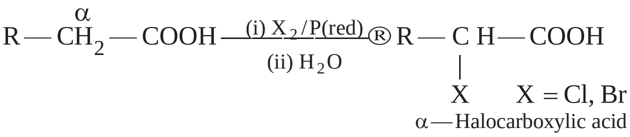
(*iii*) This is because I—Cl bond has lower bond dissociation enthalpy than Cl—Cl bond.

30. (*a*) (*i*) Cannizzaro Reaction:



$$2CH_3-\underset{\underset{\text{2,2-Dimethyl propanal}}{CH_3}}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}}-CHO\xrightarrow{\text{Conc.NaOH}}\underset{\underset{\text{2,2-Dimethyl propanol}}{CH_3}}{CH_3-\overset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-OH+\underset{\underset{\text{Sodium 2,2-dimethyl propanoate}}{CH_3}}{CH_3-\overset{CH_3}{\overset{|}{\underset{|}{C}}}}-CO\overset{-}{O}\overset{+}{Na}$$

(*ii*) **Hell-Volhald-Zelinsky reaction:**



$$R-\overset{\alpha}{CH_2}-COOH\xrightarrow[\text{(ii) }H_2O]{\text{(i) }X_2/P(\text{red})}\underset{\alpha-\text{Halocarboxylic acid}}{R-\underset{\underset{X}{|}}{C}H-COOH}\quad X=Cl, Br$$

(*b*) (*i*) **Propanal and Propanone:**

Tollen's reagent test: Propanal being an aldehyde reduces Tollens reagent to silver mirror but propanone being a ketone does not.

$$CH_3-CH_2-CHO+\underset{\text{Tollens reagent}}{2[Ag(NH_3)_2]^+}+3\overset{-}{O}H$$

$$\longrightarrow CH_3-CH_2-\underset{\text{Propanoate ion}}{CO\overset{-}{O}}+2Ag+4NH_3+2H_2O$$

$$\underset{\text{Propanone}}{CH_3-COCH_3}\xrightarrow{\text{Tollens reagent}}\text{No silver mirror}$$

(*ii*) **Benzophenone and Acetophenone:**

Iodoform test: Acetophenone being a methyl ketone on treatment with NaOI (I_2/NaOH) gives yellow ppt of iodoform but benzophenone does not.

$$\underset{\text{Aceto phenone}}{C_6H_5COCH_3}+3NaOI\longrightarrow C_6H_5-COONa+\underset{\substack{\text{iodoform}\\\text{(Yellow ppt.)}}}{CHI_3\downarrow}+2NaOH$$

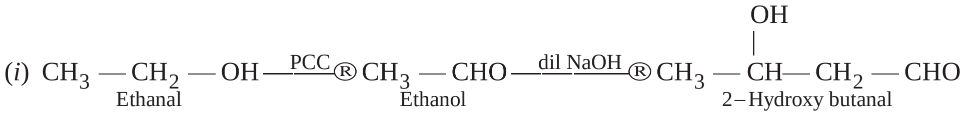
(*iii*) **Phenol and Benzoic acid:**

$FeCl_3$ test: Phenol gives a violet colouration with neutral $FeCl_3$ solution while benzoic acid gives buff coloured ppt ferric benzoate.

$$6C_6H_5-OH+FeCl_3\longrightarrow\underset{\text{Violet colouration}}{[Fe(OC_6H_5)_6]^{3-}}+3H^++3HCl$$

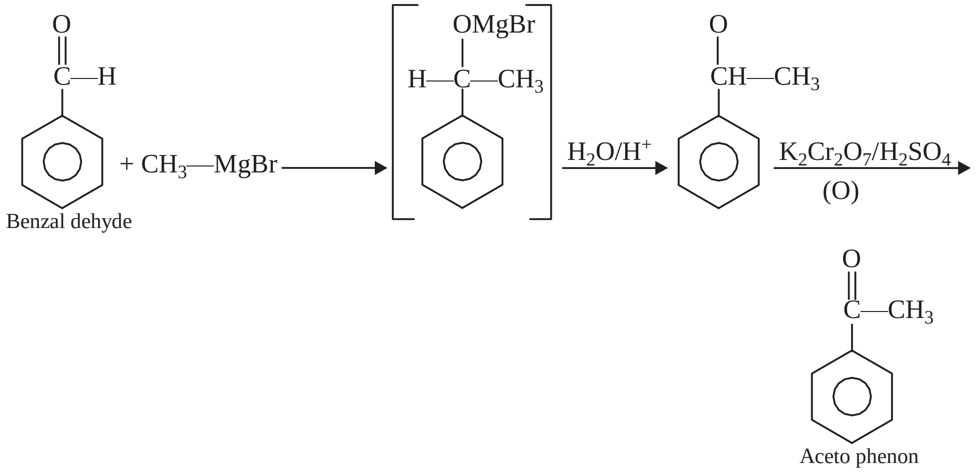
$$3C_6H_5COOH+FeCl_3\longrightarrow\underset{\substack{\text{Ferric benzoate}\\\text{(Buff coloured ppt)}}}{(C_6H_5-COO)_3Fe}+3HCl$$

OR



(*i*) $$\underset{\text{Ethanal}}{CH_3-CH_2-OH}\xrightarrow{\text{PCC}}\underset{\text{Ethanol}}{CH_3-CHO}\xrightarrow{\text{dil NaOH}}\underset{\text{2-Hydroxy butanal}}{CH_3-\overset{\overset{OH}{|}}{C}H-CH_2-CHO}$$

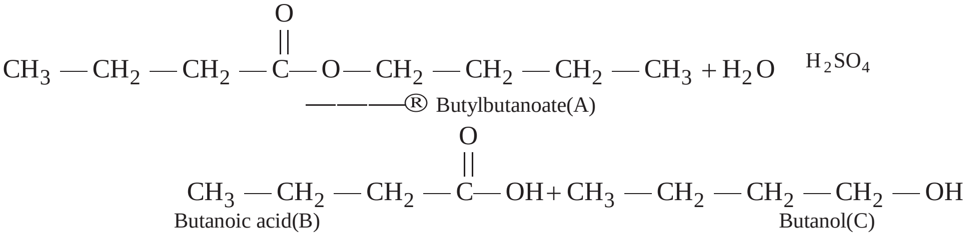
(*ii*)



(*b*) A = Butyl butanoate B = Butanoic acid

C = Butanol D = But–1–ene

Reactions involved:



$$CH_3—CH_2—CH_2—\overset{\overset{\Large O}{||}}{C}—O—CH_2—CH_2—CH_2—CH_3 + H_2O \xrightarrow{H_2SO_4}_{\text{Butylbutanoate(A)}}$$

$$\underset{\text{Butanoic acid(B)}}{CH_3—CH_2—CH_2—\overset{\overset{\Large O}{||}}{C}—OH} + \underset{\text{Butanol(C)}}{CH_3—CH_2—CH_2—CH_2—OH}$$

$$\underset{\text{Butanol(C)}}{CH_3—CH_2—CH_2—CH_2—OH} \xrightarrow[H_2CrO_4]{(O)} CH_3—CH_2—CH_2—CHO \xrightarrow{(O)} \underset{\text{Butanolic acid (B)}}{CH_3—CH_2—CH_2—COOH}$$

$$\underset{\text{Butan}-1-\text{ol}}{CH_3—CH_2—CH_2—CH_2—OH} \xrightarrow[\text{Heat}]{\text{conc.}H_2SO_4} \underset{\text{But}-1-\text{ene.}}{CH_3—CH_2—CH=CH_2} + H_2O$$

CBSE (All India) SET–II

1. Schottky defect.

8. The monomers must be bifunctional.

19. Here, $z = 2$, M = 56 g mol^{-1}, $d = 7.87$ g cm^{-3}

a = 286.65 pm = 286 .65 × 10^{-10} cm = 2.8

Substituting the values in the expression,

$$N_A = \frac{z \times M}{a^3 \times d}, \text{ we get}$$

$$N_A = \frac{2 \times 56 \text{ g mol}^{-1}}{(286.65 \times 10^{-10} \text{ cm})^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= 6.042 \times 10^{23} \text{ mol}^{-1}$$

20. $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$

$$E_a = \frac{2.303 \times R \times T_1 \times T_2}{T_2 - T_1} \log \frac{k_2}{k_1}$$

$$E_a = \frac{2.303 \times 8.314 \text{ J mol}^{-1}\text{K}^{-1} \times 650 \text{ K} \times 700 \text{ K}}{700 \text{ K} - 650 \text{ K}} \log \frac{2.39 \times 10^{-7}}{2.15 \times 10^{-8}}$$

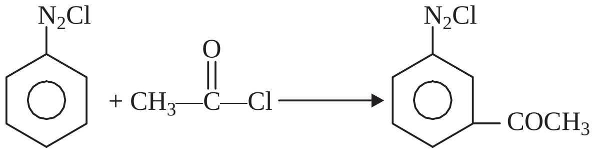
$$E_a = \frac{19.147 \times 650 \times 700}{50} \log (23.9 - \log 2.15) \text{J mol}^{-1}$$

$$E_a = 174237.7(1.3783 - 0.3324) \text{J mol}^{-1}$$

$$E_a = 174237.7 \times 1.0459 \text{ J mol}^{-1} = 182235.2 \text{ J mol}^{-1}$$

$$E_a = 182.24 \text{ kJ mol}^{-1}.$$

27. (*i*)



(*ii*) $C_2H_5NH_2 + C_6H_5SO_2Cl \longrightarrow C_6H_5SO_2NHC_2H_5$

(*iii*) $C_2H_5 - NH_2 + HNO_2 \longrightarrow C_2H_5 - OH + H_2O + N_2$

28. (*i*) Ethanol, when warmed with NaOI (I_2/NaOH) gives yellow ppt of Iodoform while propanal does not

$$\underset{\text{Ethanol}}{CH_3 - CHO} + 3I_2 + 4NaOH \xrightarrow{\text{Heat}} HCOO\overset{+}{N}a + \underset{\text{Iodoform (yellow ppt)}}{CHI_3 \downarrow} + 3NaI + 3H_2O$$

(*ii*) Benzoic acid being an acid, decomposes $NaHCO_3$ to produce brisk effervescence due to evolution of CO_2 while ethyl benzoate does not.

$$\underset{\text{Benzoic acid}}{C_6H_5 - COOH} + NaHCO_3 \longrightarrow \underset{\text{Sodium benzoate}}{C_6H_5 - CO\overset{-}{O}\overset{+}{N}a} + CO_2 \uparrow + H_2O$$

$$\underset{\text{Ethyl benzoate}}{C_6H_5 - COOC_2H_5} + NaHCO_3 \longrightarrow \text{No evolution of } CO_2 \text{ gas}$$

(*b*)

Element	**Percentage**	**Atomic mass**	**No. of moles**	**Simplest molar ratio**
C	69.77	12	$\frac{69x77}{12} = 5x81$	$\frac{5x81}{1x16} = 5$
H	11.63	1	$\frac{11x63}{1} = 11x63$	$\frac{11x63}{1x16} = 10$
O	(100 – 81.4) = 18.60	16	$\frac{18x60}{16} = 1x16$	$\frac{1x16}{1x16} = 1$

Empirical formula of the compound $A = C_5H_{10}O$

Molecular formula of the compound $A = n$ (Empirical formula)

$$n = \frac{\text{Molecular mass of compound } A}{\text{Empirical formula mass of compound } A}$$

Molecular mass of compound $A = 86$

Empirical formula mass of compound $A = 5\times12 + 1\times10 + 1\times16$

$$= 60 + 10 + 16$$

$$= 86$$

$$n = \frac{86}{86} = 1$$

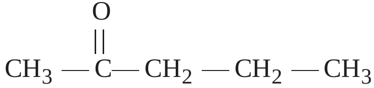
Molecular formula of the compound $A = 1(C_5H_{10}O)$

$$= C_5H_{10}O$$

As the compound *A* forms addition compound with $NaHSO_3$ therefore it must be either an aldehyde or ketone.

As it does not reduce Tollens reagent and give positive Iodoform test therefore it must be a methyl ketone.

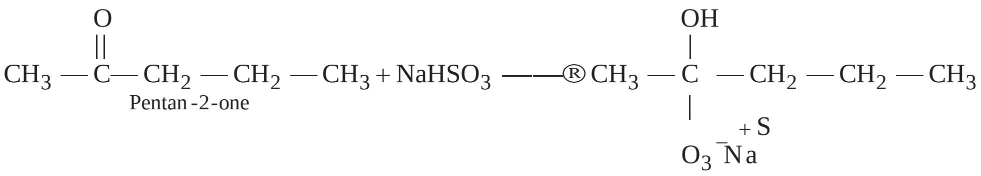
As on oxidation the compound A gives a mixture of ethanoic acid and propanoic acid, therefore compound *A* is



$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-CH_3$$

Pentan-2-one

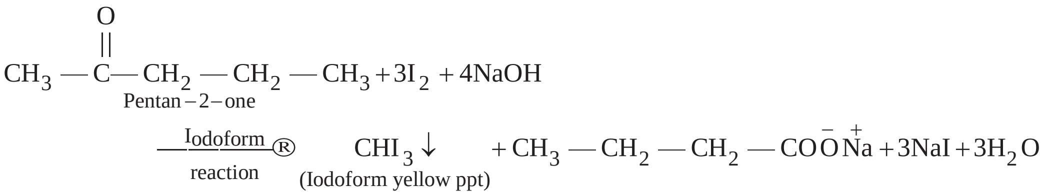
The chemical reactions are:



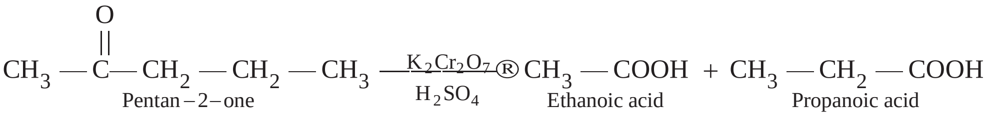
$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_2-CH_3 + NaHSO_3 \longrightarrow CH_3-\underset{\underset{\displaystyle SO_3^-Na^+}{|}}{\overset{\overset{\displaystyle OH}{|}}{C}}-CH_2-CH_2-CH_3$$

Pentan-2-one

Sodium hydrogen sulphite addition product



$$\underset{\text{Pentan-2-one}}{CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3}+3I_2+4NaOH\xrightarrow[\text{reaction}]{\text{Iodoform}}\underset{\text{(Iodoform yellow ppt)}}{CHI_3\downarrow}+CH_3-CH_2-CH_2-CO\overset{-}{O}\overset{+}{Na}+3NaI+3H_2O$$



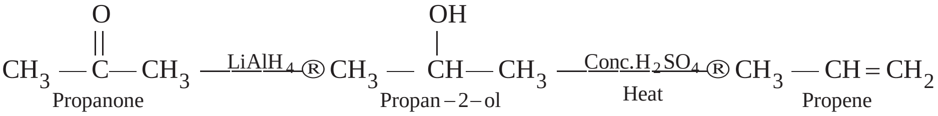
$$\underset{\text{Pentan-2-one}}{CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3}\xrightarrow[H_2SO_4]{K_2Cr_2O_7}\underset{\text{Ethanoic acid}}{CH_3-COOH}+\underset{\text{Propanoic acid}}{CH_3-CH_2-COOH}$$

OR

(*a*) (*i*) Acid strength: 4-Methoxy benzoic acid <Benzoic acid < 4-Nitrobenzoic acid < 3, 4-Dinitrobenzoic acid.

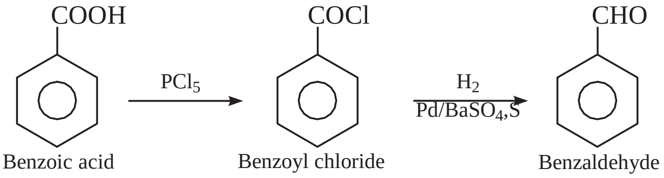
(*ii*) Acid strength: $(CH_3)_2CHCOOH < CH_3CH_2CH_2COOH < CH_3CH(Br)CH_2COOH < CH_3CH_2CH(Br)COOH$

(*b*) (*i*)

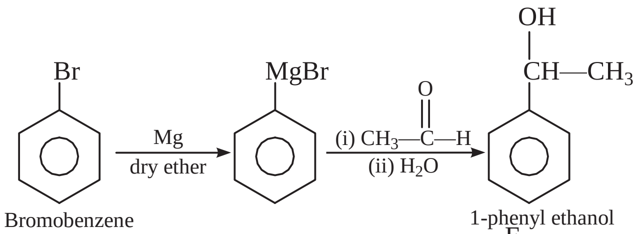


$$\underset{\text{Propanone}}{CH_3-\overset{\overset{O}{\|}}{C}-CH_3}\xrightarrow{LiAlH_4}\underset{\text{Propan-2-ol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3}\xrightarrow[\text{Heat}]{\text{Conc.}H_2SO_4}\underset{\text{Propene}}{CH_3-CH=CH_2}$$

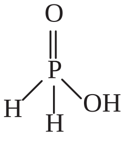
(*ii*)



(*iii*)

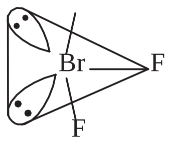


29. (*a*) (*i*)



H_3PO_2

(*ii*)



BrF_3: Bent "T"

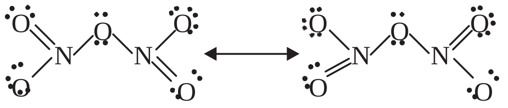
(*b*) (*i*) Due to greater bond strength of P—P single than N—N single bond.

(*ii*) Due to large electron-electron repulsion among the lone pairs in F_2 as fluorine has very small size.

(*iii*) Due to very high ionization enthalpy of helium.

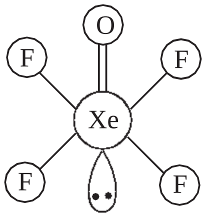
OR

(*a*) (*i*)



(N_2O_5)

(*ii*) $XeOF_4$:



Square pyramidal

(*b*) (*i*) Due to small size of oxygen atom there will be greater interelectronic repulsions in oxygen.

(*ii*) Due to non-availability of d orbitals in valence shell nitrogen does not form pentahalide.

(*iii*) Due to low bond dissociation enthalpy of H-I as compared to H—Cl.

CBSE (All India) SET–III

1. $(8 \text{ corner atoms}) \times \frac{1}{8} + (6 \text{ face centre atoms}) \times \frac{1}{2} = 1 + 3 = 4$

13. (*i*) Dilute NaCN forms a soluble complex with Ag or Ag_2S while the impurities remain unaffected which are filtered off.

$$4Ag + 8NaCN + O_2 + 2H_2O \longrightarrow 4Na[Ag(CN_2)] + 4NaOH$$

Or $$Ag_2S + 4NaCN \longrightarrow \underset{\substack{\text{Sodium dicyanoargentate(I)} \\ \text{(Soluble complex)}}}{2Na[Ag(CN)_2]} + Na_2S$$

(*ii*) The role of cryolite is two fold.

- It lowers the melting point of the mixture to about 1140K.
- It increase the electrical conductivity of the mixture.

14. **(*i*) Order of a reaction:** It may be defined as the sum of exponents of the concentration terms in the rate law expression.

(*ii*) Activation energy of a reaction: It may be defined as the extra amount of energy over and above the average energy of reactants which must be supplied to them to undergo a chemical reaction.

17.

Addition Polymerisation		**Condensation Polymerisation**	
(*i*)	Monomers are unsaturated molecules	(*i*)	Monomers have di or polyfunctional groups.
(*ii*)	Involves chain reaction	(*ii*)	Does not involve chain reaction.
(*iii*)	Formed by adding monomers to a growing chain without loss of any molecules. Examples: Polyethene, Polystyrene, Teflon etc.	(*iii*)	Monomers combine together with the loss of molecules like H_2O, NH_3, etc. Examples: Terylene, Bakelite, Nylon-66, etc.

21. At anode: $\mathrm{Al}(s) \longrightarrow \mathrm{Al}^{3+}(aq) + 3\bar{e}\,] \times 2$

At cathode: $\mathrm{Ni}^{2+}(aq) + 2\bar{\mathrm{e}} \longrightarrow Ni(s)] \times 3$

$$2\mathrm{Al}(s) + 3\mathrm{Ni}^{2+}(aq) \longrightarrow 2\mathrm{Al}^{3+}(aq) + \mathrm{Ni}(s)$$

$$\mathrm{E_{cell}} = \mathrm{E^o_{cell}} - \frac{0.0591}{n} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

Here n = 6, $[\mathrm{Al}^{3+}] = 0.001\mathrm{M} = 1\times 10^{-3}\mathrm{M}$, $[\mathrm{Ni}^{2+}] = 0.5\mathrm{M}$

$$\mathrm{E^o_{cell}} = E^o{}_{Ni^{2+}/Ni} - E^o{}_{Al^{3+}/Al} = -0.25V - (-1.66V)$$

$$\mathrm{E^o_{cell}} = 1.41\mathrm{V}$$

$$\mathrm{E^o_{cell}} = 1.41 - \frac{0.0591}{6} \log \frac{\left(10^{-3}\right)^2}{(0.5)^3} = 1.41 - \frac{0.0591}{6} \log \frac{10^{-6}}{0.125}$$

$$= 1.41 - \frac{0.0591}{6} \log \left(10^{-6} \times 8\right) = 1.41 - \frac{0.0591}{6} \left(\log 10^{-6} + \log 2^3\right)$$

$$= 1.41 - \frac{0.0591}{6} \log \left(-6 \log 10 + 3 \log 2\right) = 1.41 - \frac{0.0591}{6} \left(-6 + 3 \times 0.3010\right)$$

$$= 1.41 - \frac{0.0591}{6} (-5.097) = 1.41 + \frac{0.3012}{6}$$

$$= 1.41 + 0.0502 = 1.4602\mathrm{V}$$

$$\mathrm{E_{cell}} = 1.46\ \mathrm{V}$$

23. (*i*) Ni in its atomic ionic state can not afford two vacant 3d orbitals hence d^2sp^3 hybridisation is not possible.

(*ii*) Transition metals have vacant d orbitals in their atoms or ions into which the electron pairs can be donated by ligands containing π electrons, *e.g.*, C_6H_6, $CH_2 = CH_2$, etc. Thus $d\pi - P\pi$ bonding is possible.

(*iii*) Because in case of CO back bonding takes place in which the central metal uses its filled d orbital with empty anti bonding π^* molecular orbital of CO.

OR

Complex ion	**Central metal ion**	**Configuration of metal ion**	**Hybridisation of metal ion involved**	**Geometry of complex ion**	**Number of unpaired electrons**	**Magnetic behaviour**
$[Ni(CN)_4]^2$	Ni^{2+}	d^8	dsp^2	Square planar	0	Diamagnetic
$[Ni(Cl)_4]^{2-}$	Ni^{2+}	d^8	sp^3	Tetrahedral	2	Paramagnetic
$[CoF_6]^{3-}$	Co^{3+}	d^6	sp^3d^2	Octahedral	4	Paramagnetic

27. (***i***) **Cationic detergents:** These are quarternary ammonium salts of amines with acetates, chlorides or bromides as anions, *e.g.*, cetyltrimethylammonium bromide.

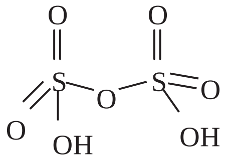
(***ii***) **Enzymes:** Enzymes are globular proteins with high molecular mass ranging from 15,000 to 1,000,000 g mol^{-1}, and form colloidal solution in water. A number of reactions that occur in the body of animals and plants to maintain the life process are catalysed by enzymes therefore enzymes are termed as biochemical catalysts.

(***b***) **Sweetening agents:** These are non-nutritive substances which are used as substitute of sugar in food and beverages, *e.g.*, ortho-sulphobenzimide (saccharin), sucrolose, aspartame, etc.

30. (*a*) (*i*)

Square planar
(XeF_4)

(*ii*)



Pyrosulphuric acid
($H_2S_2O_7$)

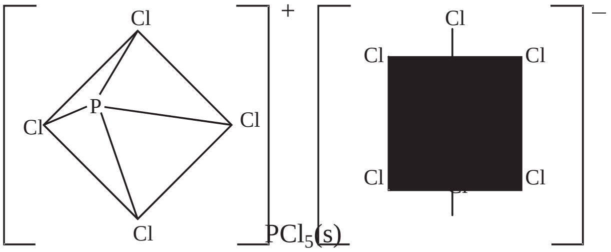
(*b*) (*i*) This is because P–P single bond is stronger than the N–N single bond.

(*ii*) Due to extremely small size of F atom, interelectronic repulsions are more in fluorine.

(*iii*) There is H-bonding in HF molecules due to high electronegativity and small size of fluorine atom but there is no H-bonding in HCl.

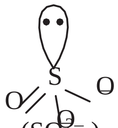
OR

(*a*) (*i*)



$PCl_5(s)$

(*ii*)



(SO_3^{2-})

(*b*) (*i*) Due to small size and high electronegativity of nitrogen, molecules of ammonia are highly associated through hydrogen bonding.

(*ii*) This is due to small size and high ionization enthalpy of helium.

(*iii*) As Bi(V) is more stable than Sb(V) due to inert pair effect.

CBSE EXAMINATION PAPERS

FOREIGN–2009

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*
(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*
(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*
(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*
(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*
(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

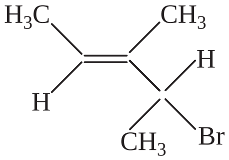
CBSE (Foreign) SET–I

1. What is the number of atoms in a body-centred cubic unit cell of a crystal? **1**

2. What is an emulsion? **1**

3. Which one has higher electron gain enthalpy with negative sign, sulphur or oxygen? **1**

4. Give the IUPAC name of the following compound: **1**



5. Write the structural formula of 3-oxopentanal. **1**

6. Name two metals which occur in nature as oxides. **1**

7. Arrange the following compounds in an increasing order of their basic strength in aqueous solutions:

NH_3, RNH_2, R_2NH, R_3N **1**

8. Write the name of an antacid which is often used as a medicine. **1**

9. Differentiate between molality and molarity of a solution. What is the effect of rise in temperature on molality and molarity of the solution? **2**

10. Describe the role of the following: **2**

(*i*) NaCN in the extraction of silver
(*ii*) CO in the purification of nickel

11. Corrosion is essentially an electrochemical phenomenon. With the help of a diagram explain the reactions occurring during the corrosion of iron kept in open atmosphere. **2**

OR

Define the term molar conductivity and indicate how molar conductivity of a substance changes with change in concentration of a weak electrolyte and a strong electrolyte in its solution. 2

12. Draw the structures of the following molecules: **2**

(*i*) BrF_3 (*ii*) $H_2S_2O_7$

13. State reasons for the following observations: **2**

(*i*) The enthalpies of atomisation of transition elements are quite high.

(*ii*) There is a greater horizontal similarity in the properties of the transition elements than of the main group elements.

14. Give a chemical equation for each of the following reactions: **2**

(*i*) Williamson's synthesis

(*ii*) Reimer-Tiemann reaction

15. Explain the mechanism of each of the following processes: **2**

(*i*) Acid catalysed dehydration of an alcohol

(*ii*) Hydration of ethene to yield ethanol.

16. Name two water soluble vitamins, state their sources and the diseases caused due to their deficiency in diet. **2**

17. What are the following substances? **2**

(*i*) Invert sugar (*ii*) Polypeptides

18. State reasons for the following occurrences: **2**

(*i*) Soaps do not do the cleansing in hard water.

(*ii*) Synthetic detergents are preferred to soaps in washing machines.

OR

What is the repeating unit in the condensation polymer obtained by combining $HO_2CCH_2CH_2CO_2H$ (succinic acid) and $H_2NCH_2CH_2NH_2$ (ethylenediamine).

19. Silver crystallises in face-centred cubic unit cells. Each side of the unit cell has a length of 409 pm. What is the radius of silver atom? (Assume that each face atom is touching the four corner atoms in the unit cell.) **3**

20. Calculate the equilibrium constant for the reaction equilibrium

$$Fe(s) + Cd^{2+}(aq) \rightleftharpoons Fe^{2+}(aq) + Cd(s)$$

Given: $E^o_{Cd^{2+}/Cd} = -0.40V; E^o_{Fe^{2+}/Fe} = -0.44V$ **3**

21. Calculate the freezing point depression for 0.0711 m aqueous solution of sodium sulphate, if it is completely ionised in solution. If this solution actually freezes at – 0.320 °C, what is the value of Van't Hoff factor for it at the freezing point? (K_f for water is 1.86°C mol^{-1}) **3**

22. Describe what is observed when **3**

(*i*) an electric current is passed through a colloidal solution.

(*ii*) a beam of light is passed through a colloidal solution.

(*iii*) an electrolyte such as NaCl, is added to hydrated ferric oxide sol.

23. Explain the following observations: **3**

(*i*) With the same d-orbital configuration (d^4) Cr^{2+} ion is a reducing agent while Mn^{3+} ion is an oxidising agent.

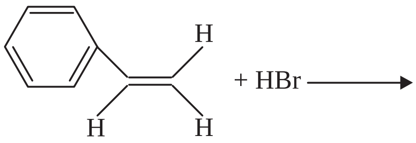
(*ii*) Cu^+ ion is not stable in aqueous solutions.

(*iii*) Among the 3*d* series of transition elements, the largest number of oxidation states are exhibited by manganese.

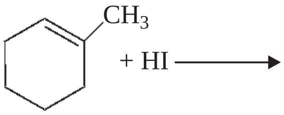
24. Three geometrical isomers are possible for $[Co(en)(H_2O)_2(NH_3)_2]^{3+}$. Draw molecular structure of these three isomers and indicate which one of them is chiral. **3**

25. Complete the equations for the following reactions: **3**

(*i*)



(*ii*)



(*iii*)

26. How are the following conversions carried out: **3**

(*i*) Aniline to nitrobenzene

(*ii*) Ethanamine to N-ethylethanamide

(*iii*) Chloroethane to propan-1-amine

OR

Give one chemical test each to distinguish between the compounds in the following pairs:

(*i*) Methylamine and dimethylamine

(*ii*) Aniline and benzylamine

(*iii*) Ethylamine and aniline

27. Differentiate between the modes of formation of an addition polymer and a condensation polymer. Give one example of each of these formations. **3**

28. (*a*) How are the following obtained:

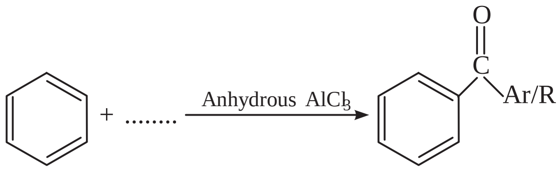
(*i*) Benzoic acid from ethylbenzene

(*ii*) Benzaldehyde from toluene

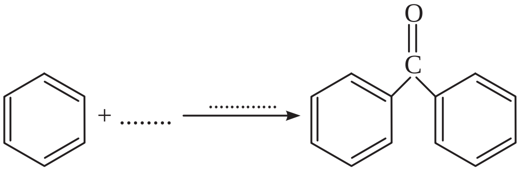
(*b*) Complete each of the following reactions by giving the missing reactant, reagent or product:

(*i*) $C_6H_5COCl \xrightarrow[Pd-BaSO_4]{H_2}$ ....

(*ii*)



(*iii*)



5

OR

(*a*) How will you bring about the following conversions:

(*i*) Ethanol to 3-hydroxybutanal

(*ii*) Benzaldehyde to benzophenone

(*b*) An organic compound A contains 69.77% carbon, 11.63% hydrogen and the rest oxygen. The molecular mass of the compound is 86. It does not react with Tollen's reagent but forms an addition compound with sodium hydrogen sulphite and gives a positive iodoform test. On vigorous oxidation it gives a mixture of ethanoic and propanoic acids. Derive the structure of compound A.

29. (*a*) Complete the following reaction equations:

(*i*) $XeF_2 + PF_5 \longrightarrow$

(*ii*) $Cl_2(g) + NaOH(aq)$
$\longrightarrow$ (hot and conc.)

(*b*) Explain the following observations:

(*i*) +3 oxidation state becomes more and more stable from As to Bi in the group.

(*ii*) Sulphur in vapour state exhibits paramagnetism.

(*iii*) Fluorine does not exhibit any positive oxidation state. **5**

OR

(*a*) Complete the following reaction equations:

(*i*) $PCl_5 + H_2O$ (excess)

$\longrightarrow$ (*ii*) $F_2 + H_2O \longrightarrow$

(*b*) Explain the following observations:

(*i*) No distinct chemical compound of helium is known.

(*ii*) Phosphorus has a greater tendency for catenation than nitrogen.

(*iii*) In solutions of H_2SO_4 in water, the second dissociation constant K_{a_2}, is less than the first dissociation constant K_{a_1}.

30. (*a*) A reaction is of second order with respect to a reactant. How is the rate of reaction affected if the concentration of this reactant is

(*i*) doubled, (*ii*) reduced to half?

(*b*) A first order reaction has a rate constant of 0.0051 min^{-1}. If we begin with 0.10 M concentration of the reactant, what will be the concentration of the reactant left after 3 hours? **5**

OR

(*a*) Define the following:

(*i*) Rate of reaction. (*ii*) Elementary step in a reaction

(*b*) For a decomposition reaction, the values of rate constant k at two different temperature are given below:

$k_1 = 2.15 \times 10^{-8}\ \text{L mol}^{-1}\ \text{s}^{-1}$ at 650 K

$k_2 = 2.39 \times 10^{-7}\ \text{L mol}^{-1}\ \text{s}^{-1}$ at 700 K

Calculate the value of activation energy (E_a) for this reaction. ($R = 8.314\ \text{J K}^{-1}\ \text{mol}^{-1}$)

CBSE (Foreign) SET–II

[Questions different from Set–I]

2. What is 'reverse osmosis'? **1**

6. Why is it that sulphide ores are concentrated by the 'froth floatation process'? **1**

8. What is meant by the 'broad spectrum antibiotics'? **1**

13. Complete the following chemical equations: **2**

(*i*) $C_2O_7^{2-}(aq) + C_2O_4^{2-}(aq) + H^+(aq) \longrightarrow$

(*ii*) $MnO_4^-(aq) + Fe^{2+}(aq) + H^+(aq) \longrightarrow$

17. Describe the following types of substances giving one example of each: **2**

(*i*) Cationic detergents

(*ii*) Food preservatives

19. Iron has a body-centred cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.87 g cm^{-3}. Use this information to calculate Avogadro's number. (At. mass of Fe = 56 g mol^{-1}) **3**

22. Write three special features of chemisorption which are not found in physisorption. **3**

24. Compare the following complexes with respect to their molecular shape and magnetic behaviour: **3**

(*i*) $[Cr(NH_3)_6]^{3+}$ (*ii*) $[Fe(CN)_6]^{4-}$ (*iii*) $[NiCl_4]^{2-}$

(At. No. Cr = 24, Fe = 26, Ni = 28)

30. Decomposition of phosphine (PH_3) at 120°C proceeds according to the equation:

$$4PH_3(g) \longrightarrow P_4(g) + 6H_2(g)$$

It is found that this reaction follows the following rate equation:

Rate = $k[PH_3]$

The half-life of PH_3 is 37.9 *s* at 120°C.

(*i*) How much time will be required for 3/4 of PH_3 to decompose?

(*ii*) What fraction of the original amount of PH_3 will remain undecomposed after 1 minute? **5**

OR

Hydrogen peroxide, H_2O_2 (*aq*) decomposes to $H_2O(l)$ and $O_2(g)$ in a reaction that is of first order in H_2O_2 and has a rate constant, $k = 1.06 \times 10^{-3}\ \text{min}^{-1}$.

(*i*) How long will it take 15% of a sample of H_2O_2 to decompose?

(*ii*) How long will it take 85% of a sample of H_2O_2 to decompose?

CBSE (Foreign) SET–III

[Questions different from Set–I and Set–II]

1. Which point defect in its crystal unit cells decreases the density of a solid? **1**

2. Write the structure of pent-2-enal. **1**

9. State the principles on which the following operations are based:

(*i*) Zone refining (*ii*) Vapour phase refining. **2**

12. Draw the structures of the following molecules:

(*i*) XeF_4 (*ii*) $H_2S_2O_7$ **2**

16. Name two fat soluble vitamins. State their sources and the diseases caused due to their deficiency in diet. **2**

18. State what the following are and how they differ from each other:

(*i*) a nucleotide, and (*ii*) a nucleoside. **2**

24. Explain the following giving an example in each case:

(*i*) Linkage isomerism (*ii*) An outer orbital complex

(*iii*) A bidentate ligand **3**

27. Draw the structures of the monomers of the following materials: **3**

(*i*) PVC (*ii*) Teflon (*iii*) Neoprene

30. (*a*) Complete the following reaction equations:

(*i*) $SO_2 + MnO_4^- + H_2O \longrightarrow$

(*ii*) $HgCl_2 + PH_3 \longrightarrow$

(*b*) Explain the following observations:

(*i*) Sulphur has a greater tendency for catenation than oxygen.

(*ii*) Fluorine is a stronger oxidising agent than chlorine.

(*iii*) The +5 oxidation state becomes less stable down the group in group 15 of the periodic table. **5**

OR

(*a*) Complete the following reaction equations:

(*i*) $P_4 + NaOH + H_2O$
$\longrightarrow$ (*ii*) $Cu + HNO_3$ (dilute)
$\longrightarrow$

(*b*) Explain why

(*i*) H_2O is a liquid while, inspite of a higher molecular mass, H_2S is a gas.
(*ii*) iron dissolves in HCl to form $FeCl_2$ and not $FeCl_3$.
(*iii*) helium is used in diving equipment

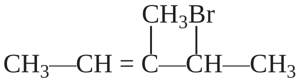
SOLUTIONS

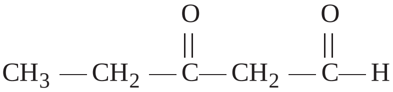
CBSE (Foreign) SET–I

1. 8 (Corner atoms) × $\frac{1}{8}$ + 1 (body centre atom) × 1 = 1 + 1 = 2

2. Emulsion is a colloidal solution in which both the dispersed phase and dispersion medium are liquids *e.g.* milk, cod liver oil, etc.

3. Sulphur.

4. 
$CH_3-CH=\overset{CH_3}{\overset{|}{C}}-\overset{Br}{\overset{|}{CH}}-CH_3$: 4–Bromo–3–methylpent–2–ene.

5. 3–oxopentanal: 
$CH_3-CH_2-\overset{O}{\overset{||}{C}}-CH_2-\overset{O}{\overset{||}{C}}-H$

6. Aluminium occurs as $Al_2O_3.2H_2O$

Iron occurs as Fe_2O_3

7. $NH_3 < R\text{–}NH_2 < R_3N < R_2NH$

8. Ranitidine (zantac).

9. Molality is the number of moles of solute per thousand grams of solvent whereas molarity is the number of moles of solute dissolved in one litre of solution.

Molality is independent of temperature whereas molarity changes with change in temperature as volume changes with temperature.

10. (*i*) Dilute NaCN forms a soluble complex with Ag or Ag_2S while the impurities remain unaffected which are filtered off.

$$4Ag + 8NaCN + O_2 + 2H_2O \longrightarrow 4Na[Ag(CN_2)] + 4NaOH$$

Or

$$Ag_2S + 4NaCN \longrightarrow \underset{\substack{\text{Sodium dicyanoargentate(I)}\\\text{(Soluble complex)}}}{2Na[Ag(CN)_2]} + Na_2S$$

(*ii*) Carbon monoxide forms a volatile complex, nickel tetracarbonyl with nickel which on decomposition gives pure nickel.

$$\underset{\text{Impure}}{Ni} + 4CO \xrightarrow{330-350K} \underset{\text{Nickel tetracarbonyl}}{Ni(CO)_4}$$

$$Ni(CO)_4 \xrightarrow{450-470K} \underset{\text{Pure}}{Ni} + 4CO$$

11. **At anode :** Oxidation of Fe atoms takes place

$$Fe \longrightarrow Fe^{2+} + 2e^- \qquad E^\circ_{Fe^{2+}/Fe} = -0.44V$$

At cathode : Reduction of oxygen in the presence of H^+ ions. The H^+ ions are produced by either H_2O or H_2CO_3 (formed by dissolution of CO_2 in moisture)

$$2H^+(aq) + 2e^- \longrightarrow 2H$$

$$2H + \frac{1}{2}O_2(g) \longrightarrow H_2O$$

Net reaction at cathodic area

$$2H^+(aq) + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O \qquad E^\circ_{H^+/O_2/H_2O} = 1.23V$$

The overall reaction

$$Fe(s) + 2H^+(aq) + \frac{1}{2}O_2(g) \longrightarrow Fe^{2+}(aq) + H_2O(l) \qquad E^\circ_{cell} = 1.67V$$

The ferrous ions are further oxidised by atmospheric oxygen to ferric ions which come out as rust in the form of hydrated ferric oxide ($Fe_2O_3 . xH_2O$).

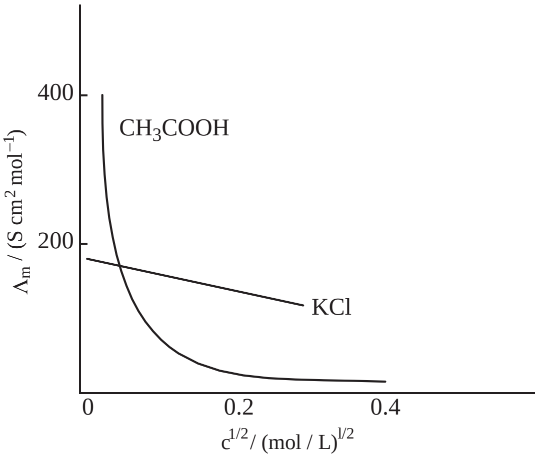
OR

Molar Conductivity (Λ_m): It may be defined as the conductance of a solution containing 1 mole of electrolyte such that the entire solution is placed is between two electrodes one centimeter apart.

$$\Lambda_m = \kappa \times v$$

or

$$\Lambda_m = \frac{\kappa \times 1000}{M}$$

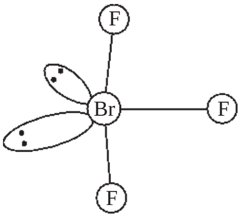


Molar conductivity increases with decrease in concentration or increase in dilution as number of ions as well as mobility of ions increased with dilution.

For strong electrolytes the number of ions do not increase appreciably on dilution and only mobility or ions increases due to decrease in inter-ionic attractions. Therefore Λ_m increases a little as shown in graph by a straight line.

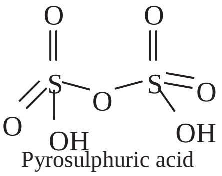
For weak electrolyte the number of ions as well as mobility of ions increases on dilution as shown by curve in the figure.

12. (*i*) No. of electron pairs around central atom (Br) = 5 — *b.p.* = 3, *l.p.* = 2



The shape would be slightly bent T.

(*ii*)

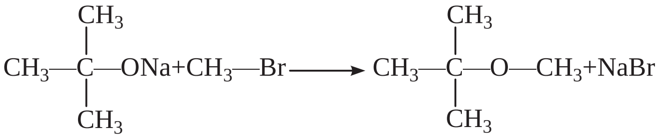


Pyrosulphuric acid
($H_2S_2O_7$)

13. (*i*) This is because, transition elements have strong metallic bonds due to presence of large number of unpaired electrons.

(*ii*) This is because in transition elements incoming electron goes into d-orbitals of inner shell whereas in main group elements, the incoming electron goes to outermost shell.

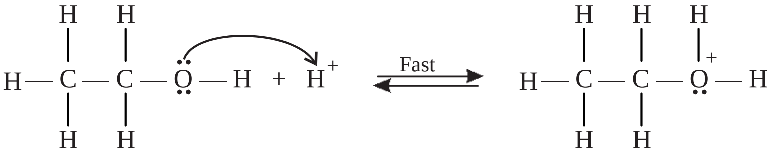
14. **(*i*) Williamson's Synthesis:**



$$CH_3-\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-ONa+CH_3-Br \longrightarrow CH_3-\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-O-CH_3+NaBr$$

Sodium tert-butoxide

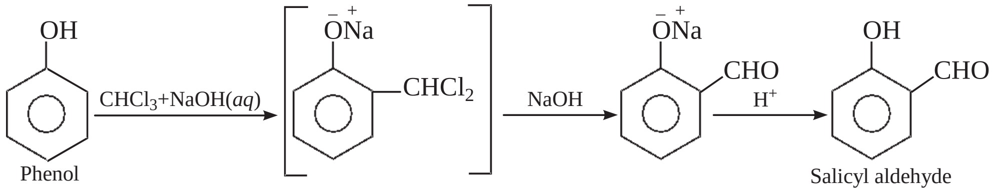
Methyl tert-butyl (ether)



Ethyl alcohol

Ethyl oxonium ion

(*ii*) Reimer-Tiemann reaction:



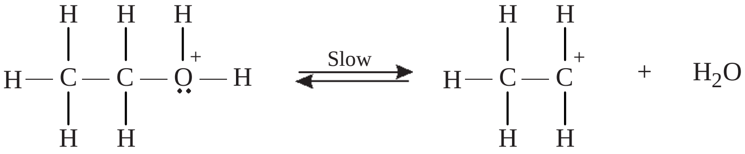
Phenol

Salicyl aldehyde

15. (*i*) $CH_3-CH_2-OH \xrightarrow[\Delta]{H^+} CH_2=CH_2+H_2O$

Mechanism

Step I: Formation of carbocation: It is the slowest step and hence, the rate determining step.

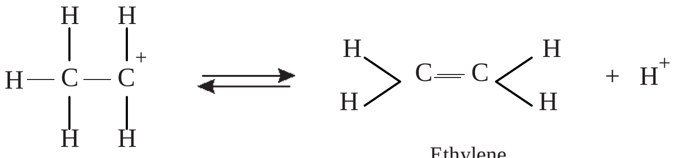


Ethyl oxonium ion

Ethyl carbocation

Step II: Formation of protonated alcohols

Step III: Formation of ethylene by elimination of a proton

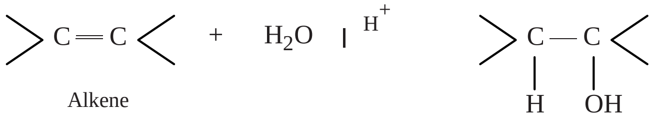


Ethyl carbocation

Ethylene

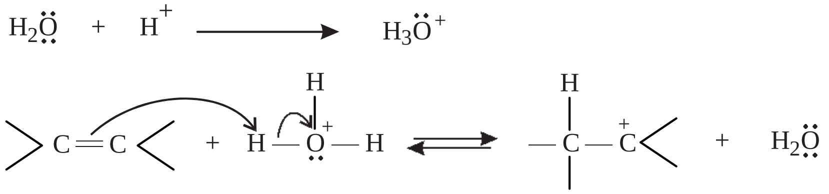
To drive the equilibrium to the right, ethylene is removed as it is formed.

(*ii*)

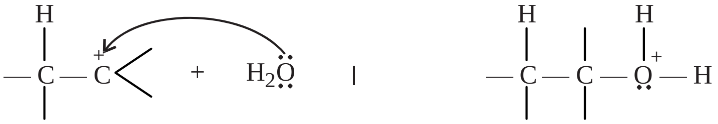


Mechanism

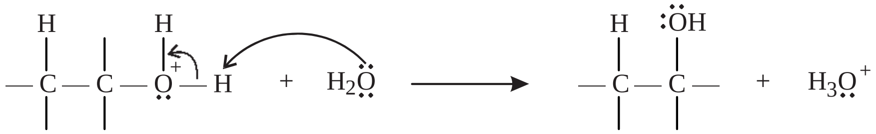
Step I: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.



Step II: Nucleophilic attack of water on carbocation.



Step III: Deprotonation to form an alchohol



16. B group vitamin and vitamin C are soluble in water.

	Name of Vitamins	**Sources**	**Deficiency diseases**
(*i*)	Vitamin B_{12}	Meat, fish, egg and curd	Pernicious anaemia
(*ii*)	Vitamin C	Citrus fruits and amla	Scurvy

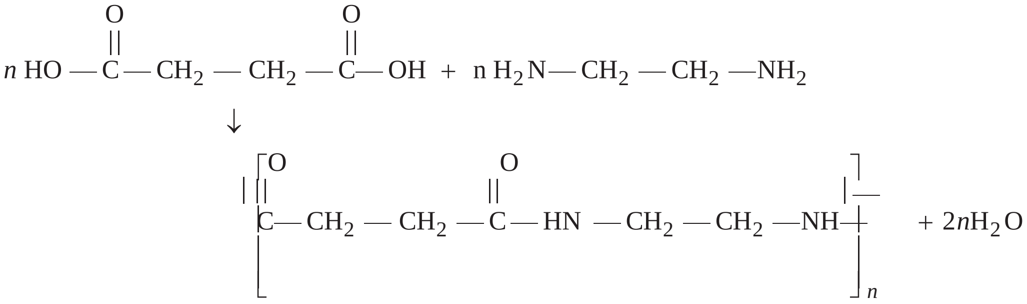
17. **(*i*) Invert Sugar:** Sucrose is dextrorotatory, on hydrolysis in the presence of HCl or enzyme invertase, it produces a mixture of D–C(+)–glucose and D–(–)–fructose which is laevorotatory called invert sugar.

(*ii*) Polypeptide: If more than ten α-amino acids are joined together by peptide bond (–CONH–) the polyamide thus formed is called polypeptide.

18. (*i*) This is because the Ca^{2+} and Mg^{2+} ions present in hard water get precipitated as calcium and magnesium soap which being insoluble stick to the clothes as gummy mass.

(*ii*) This is because detergents can be used in hard water as well as in acidic solutions, as sulphuric acid and their calcium and magnesium salts are soluble in water but the fatty acids and their calcium and magnesium salts are insoluble.

OR



$$n\,HO-\overset{\overset{\Large O}{||}}{C}-CH_2-CH_2-\overset{\overset{\Large O}{||}}{C}-OH + n\,H_2N-CH_2-CH_2-NH_2$$
$$\downarrow$$
$$\left[\overset{\overset{\Large O}{||}}{C}-CH_2-CH_2-\overset{\overset{\Large O}{||}}{C}-HN-CH_2-CH_2-NH\right]_n + 2nH_2O$$

19. For *fcc* unit cell

$$r = \frac{a}{2\sqrt{2}}$$

Given a = 409 pm

$$\therefore \quad r = \frac{409}{2\sqrt{2}} = \frac{409\sqrt{2}}{4}$$

$$r = 144.58 \text{ pm}$$

20. $Fe(s) + Cd^{2+}(aq) \rightleftharpoons Fe^{2+}(aq) + Cd(s)$

$$\log k_c = n\frac{E^\circ_{cell}}{0.059}$$

Here, $n = 2$

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$
$$= E^\circ_{Cd^{2+}/Cd} - E^\circ_{Fe^{2+}/Fe} = -0.40 - (-0.44)$$
$$E^\circ_{cell} = 0.04V$$
$$\log k_c = \frac{2 \times 0.04}{0.059} = \frac{0.08}{0.059}$$
$$\log k_c = 1.3536$$
$$k_c = \text{Antilog } 1.3536$$
$$k_c = 22.57$$

21. $\Delta T_f = [273.15 - (-0.320 + 273.15)]K = 0.320 \text{ K}$

$$\Delta T_f = K_f \,.m$$
$$= 1.86 \text{ K kg mol}^{-1} \times 0.0711 \text{ mol kg}^{-1}$$
$$= 0.132 \text{ K}$$
$$i = \frac{\text{Observed value of } \Delta T_f}{\text{Calculated value of } \Delta T_f} = \frac{0.320K}{0.132K}$$
$$i = 2.42$$

22. (*i*) Electrophoresis takes place in which colloidal particles move towards the oppositely charged electrode where they lose their charge and get coagulated.

(*ii*) The path of light becomes visible due to scattering of light by colloidal particles (Tyndall effect).

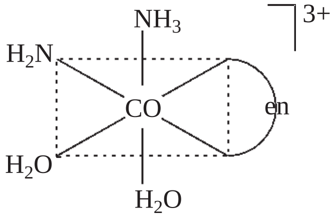
(*iii*) The positively charged colloidal particles of $Fe(OH)_3$ get coagulated by the negatively charged ions provided by electrolyte.

23. (*i*) Cr^{2+} is reducing as its configuration changes from d^4 to d^3, the latter having a half filled t_{2g} configuration. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled d^5 configuration which has extra stability therefore Mn^{3+} is oxidising.

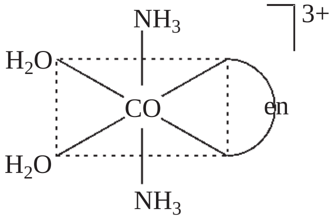
(*ii*) Because the high hydration enthalpy of Cu^{2+} easily compensates the second ionization enthalpy of Cu.

(*iii*) This is because manganese has electronic configuration $[Ar]3d^5 4s^2$, with five unpaired electrons in 3*d* orbitals.

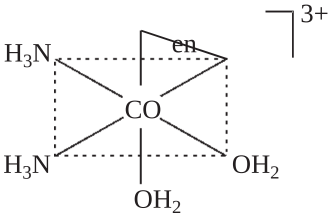
24.



Chiral
(*i*)

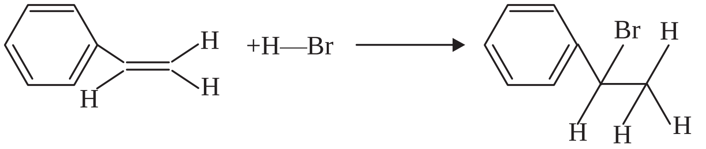


Chiral
(*ii*)



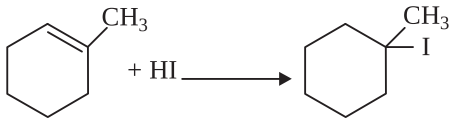
Chiral
(*iii*)

25. (*i*)



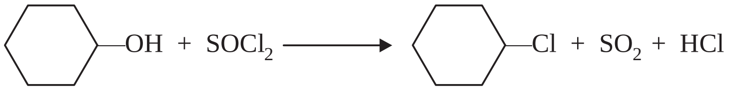
1–Bromo–1–phenyl–ethane

(*ii*)



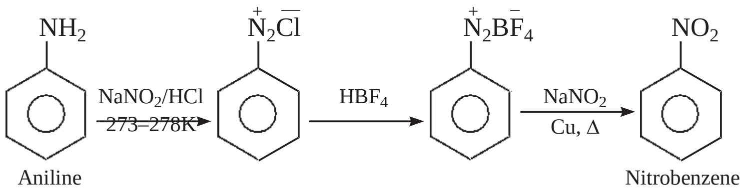
1–Iodo–1–methyl cyclohexane

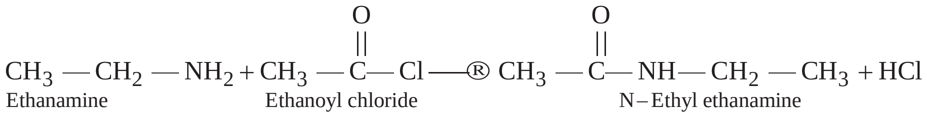
(*iii*)



Chlorocylohexane

26. (*i*)



(*ii*)


$$\underset{\text{Ethanamine}}{CH_3-CH_2-NH_2}+\underset{\text{Ethanoyl chloride}}{CH_3-\overset{\overset{\displaystyle O}{||}}{C}-Cl}\longrightarrow \underset{\text{N-Ethyl ethanamine}}{CH_3-\overset{\overset{\displaystyle O}{||}}{C}-NH-CH_2-CH_3}+HCl$$

(*iii*) $$\underset{\text{Chloroethane}}{CH_3-CH_2-Cl}\xrightarrow{\text{alc.KCN}} CH_3-CH_2-CN\xrightarrow[\text{or}\ Na/C_2H_5-OH]{LiAlH_4}\underset{\text{Propan-1-amine}}{CH_3-CH_2-CH_2-NH_2}$$

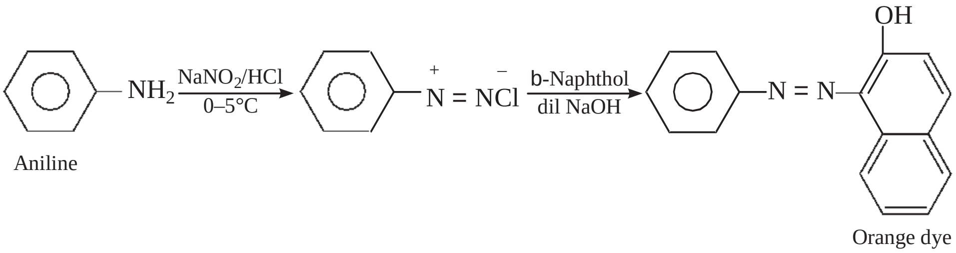
OR

(*i*) Methylamine on treatment with alcoholic KOH and $CHCl_3$ gives offensive smell of methyl isocyanide but dimethyl amine does not.

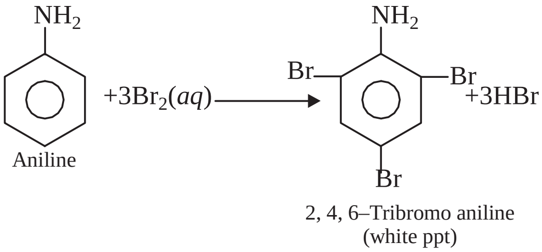
$$\underset{\substack{\text{Methyl amine}\\ \text{(1°amine)}}}{CH_3-NH_2}+CHCl_3+\underset{\text{(alc)}}{3KOH}\longrightarrow \underset{\substack{\text{Ethyl isocyanide}\\ \text{(Offensive smell)}}}{CH_3-CH_2-NC}+3KCl+3H_2O$$

$$\underset{\substack{\text{Dimethyl amine}\\ \text{(2°amine)}}}{(CH_3)_2NH}\xrightarrow[\Delta]{CHCl_3/KOH}\text{No reaction.}$$

(*ii*) Aniline on treatment with $NaNO_2/HCl$ (HNO_2) at 0–5°C followed by treatment with an alkaline solution of β–naphthol gives an orange coloured azodye while benzylamine does not give this test.



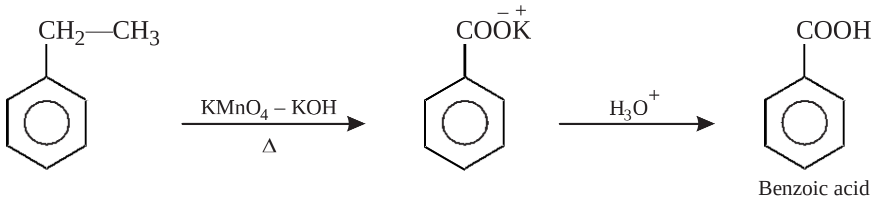
(*iii*) Add $Br_2(aq)$, aniline forms white ppt while ethyl amine does not form such ppt.



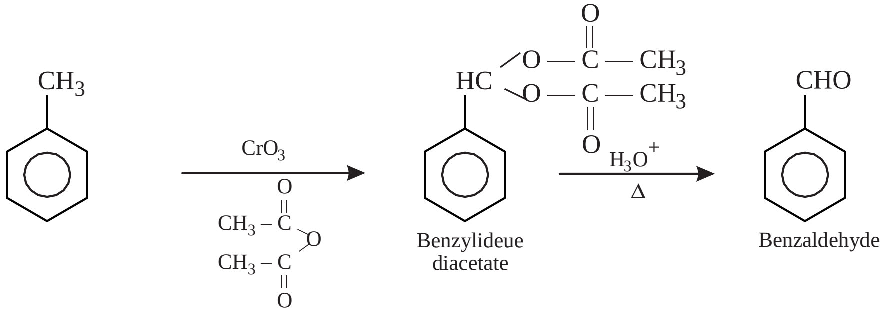
27.

Addition Polymerisation		Condensation Polymerisation	
(*i*)	Monomers are unsaturated molecules	(*i*)	Monomers have di or polyfunctional groups.
(*ii*)	Involves chain reaction	(*ii*)	Does not involve chain reaction.
(*iii*)	Formed by adding monomers to a growing chain without loss of any molecules. Examples: Polyethene, Polystyrene, Teflon etc.	(*iii*)	Monomers combine together with the loss of molecules like H_2O, NH_3, etc. Examples: Terylene, Bakelite, Nylon-66, etc.

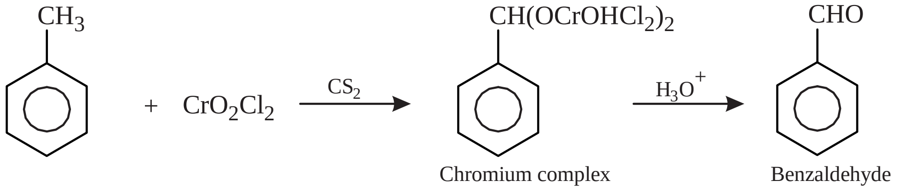
28. (*a*) (*i*)



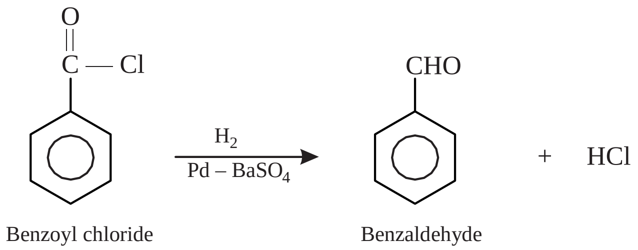
(*ii*)



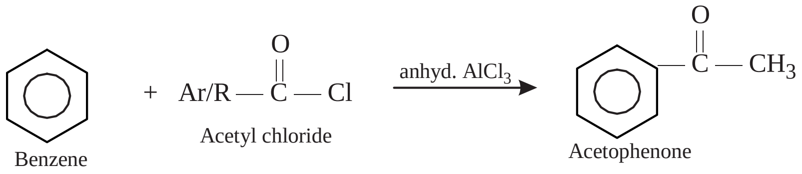
OR



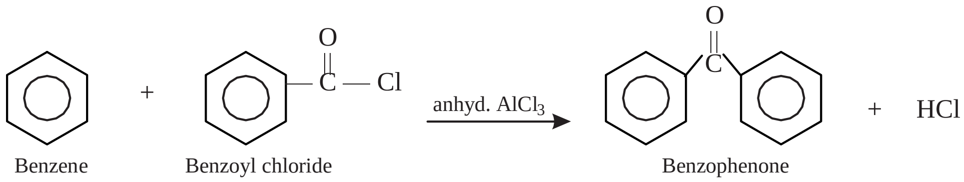
(*b*) (*i*)



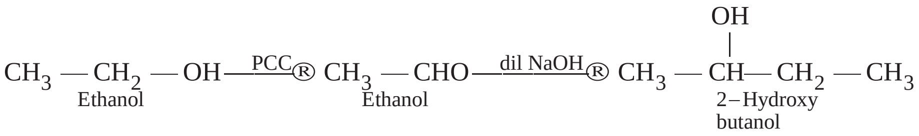
(*ii*)



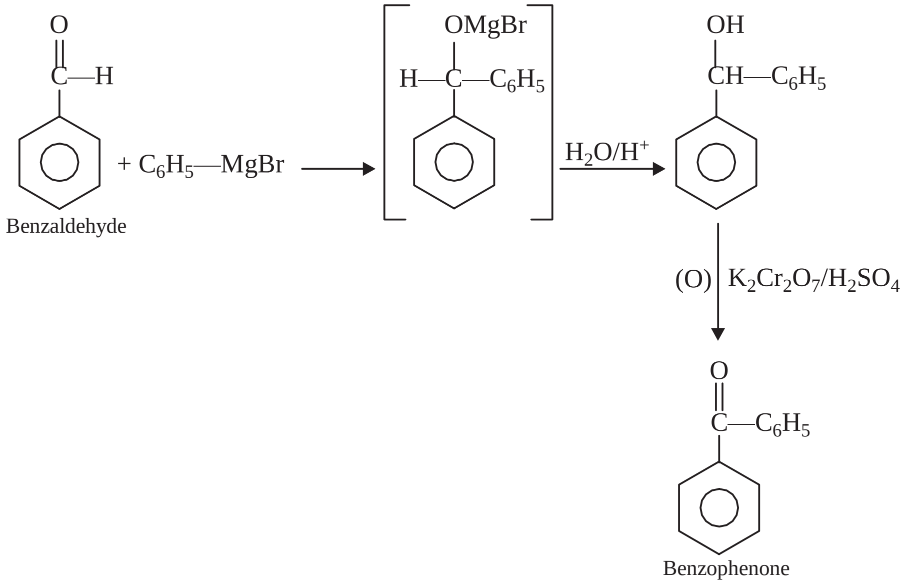
(*iii*)



OR

(*a*) (*i*) 

$$CH_3-CH_2-OH\xrightarrow{PCC}CH_3-CHO\xrightarrow{\text{dil NaOH}}CH_3-\overset{\overset{OH}{|}}{CH}-CH_2-CH_3$$

(*ii*) 

(*b*)

Element	Percentage	Atomic mass	No. of moles	Simplest molar ratio
C	69.77	12	$\frac{69\text{x}77}{12}=5\text{x}81$	$\frac{5\text{x}81}{1\text{x}16}=5$
H	11.63	1	$\frac{11\text{x}63}{1}=11\text{x}63$	$\frac{11\text{x}63}{1\text{x}16}=10$
O	(100 – 81.4) = 18.60	16	$\frac{18\text{x}60}{16}=1\text{x}16$	$\frac{1\text{x}16}{1\text{x}16}=1$

Empirical formula of the compound $A = C_5H_{10}O$

Molecular formula of the compound $A = n$ (Empirical formula)

$$n=\frac{\text{Molecular mass of compound } A}{\text{Empirical formula mass of compound } A}$$

Molecular mass of compound $A = 86$

Empirical formula mass of compound $A = 5\times12+1\times10+1\times16$

$$= 60 + 10 + 16$$

$$= 86$$

$$n = \frac{86}{86} = 1$$

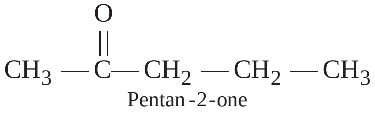
Molecular formula of the compound $A = 1(C_5H_{10}O)$

$$= C_5H_{10}O$$

As the compound *A* forms addition compound with $NaHSO_3$ therefore it must be either an aldehyde or ketone.

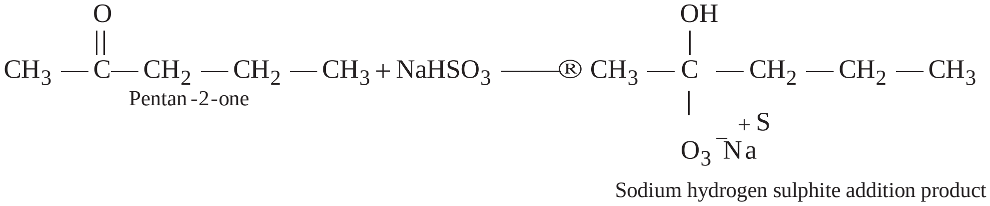
As it does not reduce Tollens reagent and give positive iodoform test therefore it must be a methyl ketone.

As on oxidation the compound A gives a mixture of ethanoic acid and propanoic acid, therefore compound *A* is

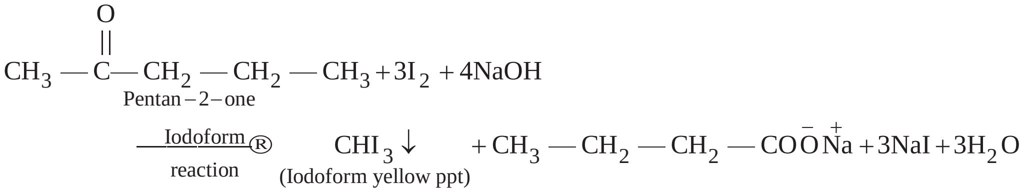


$$CH_3-\underset{\text{Pentan-2-one}}{\overset{O}{\overset{||}{C}}-CH_2}-CH_2-CH_3$$

The chemical reactions are:

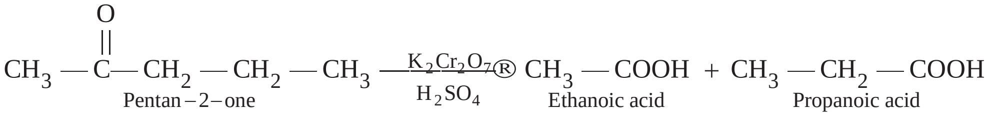


$$\underset{\text{Pentan-2-one}}{CH_3-\overset{O}{\overset{||}{C}}-CH_2-CH_2-CH_3} + NaHSO_3 \longrightarrow \underset{\text{Sodium hydrogen sulphite addition product}}{CH_3-\overset{OH}{\underset{SO_3^-\overset{+}{Na}}{\overset{|}{\underset{|}{C}}}}-CH_2-CH_2-CH_3}$$



$$\underset{\text{Pentan}-2-\text{one}}{CH_3-\overset{O}{\overset{||}{C}}-CH_2-CH_2-CH_3} + 3I_2 + 4NaOH$$

$$\xrightarrow[\text{reaction}]{\text{Iodoform}} \underset{\text{(Iodoform yellow ppt)}}{CHI_3\downarrow} + CH_3-CH_2-CH_2-CO\overset{-}{O}\overset{+}{Na} + 3NaI + 3H_2O$$



$$\underset{\text{Pentan}-2-\text{one}}{CH_3-\overset{O}{\overset{||}{C}}-CH_2-CH_2-CH_3} \xrightarrow[H_2SO_4]{K_2Cr_2O_7} \underset{\text{Ethanoic acid}}{CH_3-COOH} + \underset{\text{Propanoic acid}}{CH_3-CH_2-COOH}$$

29. (*a*) (*i*) $XeF_2 + PF_5 \longrightarrow [XeF]^+[PF_6]^-$

(*ii*) $3\,Cl_2(g) + \underset{\text{(Hot and conc.)}}{6NaOH(aq)} \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(*b*) (*i*) This is due to inert pair effect.

(*ii*) In vapour state sulphur partly exists as S_2 molecule having two unpaired electrons in the anti bonding π^* orbitals like O_2 and, hence exhibits paramagnetism.

(*iii*) This is because fluorine is the most electronegative element and does not have *d* orbitals in its valence shell.

OR

(*a*) (*i*) $PCl_5 + 4H_2O \text{ (excess)} \longrightarrow H_3PO_4 + 5HCl$

(*ii*) $2F_2(g) + 2H_2O(l) \longrightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$

(*b*) (*i*) This is due to small size, high ionisation enthalpy and stable electronic configuration of helium.

(*ii*) This is because P–P single bond is stronger than N–N single bond.

(*iii*) $Ka_2 << Ka_1$, because HSO_4^- ion has much less tendency to donate a proton to H_2O as compared to H_2SO_4.

30. (*a*) Let the rate law be, $r_1 = k\,[A]^2$

(*i*) If $[A]$ is doubled than rate $r_2 = k(2A)^2 = 4k\,[A]^2 = 4r_1$, *i.e.*, rate becomes 4 times.

(*ii*) If $[A]$ is reduced to half then rate, $r_3 = k\left[\frac{A}{2}\right]^2 = \frac{1}{4}k[A]^2 = \frac{1}{4}r_1$, i.e., rate becomes $\frac{1}{4}$ times

(*b*) For a first order reaction

$$t = \frac{2.303}{k}\log\frac{[R]_o}{[R]}$$

Here, t = 3 h = 3 × 60 min = 180 min

$k = 0.0051 \text{min}^{-1}$, $[R]_o = 0.10$ M, $[R] = ?$

$$180 \text{ min} = \frac{2.303}{0.0051\,\text{min}^{-1}}\log\frac{0.10}{[R]}$$

$$\text{Log}\frac{0.1}{[R]} = \frac{180\,\text{min} \times 0.0051\,\text{min}^{-1}}{2.303} = \frac{918}{2303}$$

$$\log\frac{0.1}{[R]} = 0.3986$$

$$\frac{0.1}{[R]} = \text{Anti log }(0.3986) = 2.503$$

$$[R] = \frac{0.1}{2.503} = 0.03995 \text{ M}$$

$$[R] = 0.04\text{M}$$

OR

(*a*) **(*i*) Elementary step:** Each step of a complex reaction is called an elementary step.

(*ii*) Rate of reaction: It is the change in the concentration of any of the reactants or products per unit time.

(*b*) $$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$E_a = \frac{2.303 \times R \times T_1 \times T_2}{T_2 - T_1} \log \frac{k_2}{k_1}$$

$$E_a = \frac{2.303 \times 8.314\,\text{J mol}^{-1}\text{K}^{-1} \times 650\,\text{K} \times 700\,\text{K}}{700\,\text{K} - 650\,\text{K}} \log \frac{2.39 \times 10^{-7}}{2.15 \times 10^{-8}}$$

$$E_a = \frac{19.147 \times 650 \times 700}{50} \log\ (23.9 - \log 2.15)\text{J mol}^{-1}$$

$$E_a = 174237.7(1.3783 - 0.3324)\text{J mol}^{-1}$$

$$E_a = 174237.7 \times 1.0459\ \text{J mol}^{-1} = 182235.2\ \text{J mol}^{-1}$$

$$E_a = 182.24\ \text{kJ mol}^{-1}.$$

CBSE (Foreign) SET–II

2. **Reverse osmosis:** If the pressure applied on the solution is greater than the osmotic pressure then the solvent molecules start to move from solution into solvent through semipermeable membrane. This process is called reverse osmosis.

6. As only sulphide ore particles are wet by oil while gangue particles are wet by water.

8. **Broad spectrum antibiotic:** Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria are known as broad spectrum antibiotics, *e.g.*, chloramphenicol, ofloxacin, vancomycin, etc.

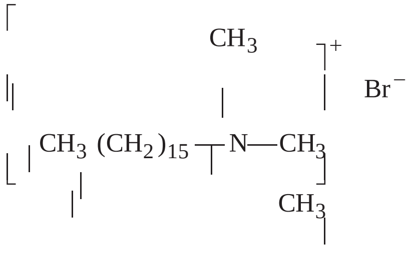
13. (*i*)

$$\begin{aligned}
&Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \longrightarrow 2Cr^{3+}(aq) + 7H_2O\\
&C_2O_4^{2-}(aq) \longrightarrow 2CO_2 + 2e^-\,] \times 3\\
\hline
&Cr_2O_7^{2-}(aq) + 3(C_2O_4^{2-}(aq) + 14H^+(aq) \longrightarrow 2Cr^{3+}(aq) + 6CO_2 + 7H_2O
\end{aligned}$$

(*ii*)

$$\begin{aligned}
&MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O\\
&Fe^{2+}(aq) \longrightarrow Fe^{3+}(aq) + e^-\,] \times 5\\
\hline
&MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \longrightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O
\end{aligned}$$

17. **(*i*) Cationic Detergents:** Cationic detergents are quaternary ammonium salts of amines with acetates, chlorides or bromides as anions. Cationic part possess a long hydrocarbon chain and a positive charge on nitrogen atom. Hence, these are called cationic detergents. Cetyltrimethylammonium bromide is a popular cationic detergent and is used in hair conditioners.



$$\left[CH_3(CH_2)_{15}-\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{N}}}}-CH_3\right]^+ Br^-$$

Cetyltrimethyl ammonium bromide

Cationic detergents have germicidal properties and are expensive, therefore, these are of limited use.

(*ii*) **Food Preservatives:** These are the chemical substances which are added to the food materials to prevent their spoilage due to microbial growth and to retain their nutritive value for long periods.

Preservatives prevent the rancidity of food and inhibit growth or kill the microorganisms.

The most-common preservations used are, sugar table salt, sodium benzoate, Sodium metabisulphite sorbic acid and propanoic acid.

19. $d = 7.87 \text{ g cm}^{-3}$, For bcc, $Z = 2$, $M = 56 \text{ g mol}^{-1}$

$a = 286.65\text{pm} = 286.65 \times 10^{-10}\text{cm}$, $N_A = ?$

$$d = \frac{Z \times M}{a^3 \times N_A}$$

$$7.87\text{g cm}^{-3} = \frac{2 \times 56 \text{ g mol}^{-1}}{(286.65 \times 10^{-3} \text{ cm})^3 \times N_A}$$

$$N_A = \frac{2 \times 56 \text{ g mol}^{-1}}{(2.8665 \times 10^{-8} \text{ cm})^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= \frac{2 \times 56 \text{ g mol}^{-1}}{23.553 \times 10^{-24} \text{ cm}^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= \frac{112 \text{ mol}^{-1}}{185.366 \times 10^{-24}} = 0.604 \times 10^{24} \text{ mol}^{-1}$$

$$= 6.024 \times 10^{23} \text{ mol}^{-1}.$$

22. (*i*) Chemisorption is caused by chemical bond formation where as physisorption arises due to Van der Waals' forces.

(*ii*) Chemisorption is highly specific in nature whereas physisorption is not specific.

(*iii*) Chemisorption results into unimolecular layer whereas physisorption results into multimolecular layers.

(*iv*) Chemisorption is irreversible in nature whereas physisorption is reversible in nature.

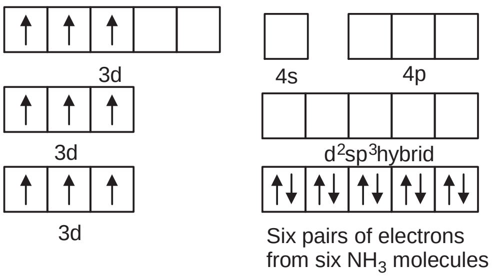
(*v*) Chemisorption first increases with increase in temperature, then decreases while physisorption decreases with increase in temperature.

24.

(*i*) Orbitals of Cr^{3+} ion

d^2sp^3 hybridised orbitals of Cr^{3+}

$[Co(NH_3)_6]^{3+}$

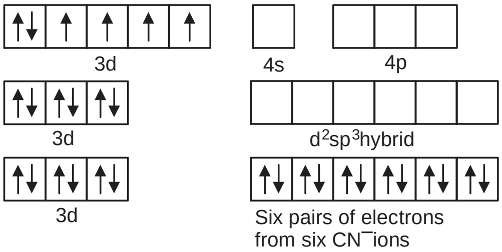


Shape: Octahedral
Magnetic behaviour: Paramagnetic.

(*ii*) Orbitals of Fe^{2+} ion

d^2sp^3 hybridised orbitals of Fe^{2+}

$[Fe(CN)_6]^{4-}$



Shape: Octahedral
Magnetic behaviour: Diamagnetic

(*iii*) Orbitals of Ni^{2+} ions

[redacted] [redacted] [redacted]

3d 4s 4p

sp^3 hybridised orbitals of Ni^{2+}

[redacted] [redacted]

3d sp^3hybrid

$[Ni(Cl)_4]^{2-}$

[redacted] [redacted]

3d

Four pairs of electrons from four Cl^-ions

Shape: Tetrahedral
Magnetic behaviour: Paramagnetic

30. (*i*) Given $t_{1/2} = 37.95$

$$t^{1/2} = \frac{0.693}{k}, \quad k = \frac{0.693}{t^{1/2}} = 1.83 \times 10^{-2}\ s^{-1}$$

$$k = \frac{0.693}{37.9}\ s^{-1}, \quad t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$

$$t_{3/4} = \frac{2.303}{1.83 \times 10^{-2}\ s^{-1}} \log \frac{[A]_0}{\frac{[A]_0}{4}} = \frac{2.303}{1.83} \times 100 \log 2^2\ s$$

$$t_{3/4} = \frac{2.303 \times 100 \times 2 \times 0.30105}{1.83} = \frac{138.64}{1.83}\ s$$

$$t_{3/4} = 75.76 s$$

(*ii*) $k = \dfrac{0.693}{t_{1/2}} = \dfrac{0.693}{37.9}\ s^{-1} = 1.83 \times 10^{-2}\ s^{-1}$

t = 1 minute = 60 s

$$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$

$$60\ \text{s} = \frac{2.303}{1.83 \times 10^{-2}\ s^{-1}} \log \frac{[A]_0}{[A]}$$

$$\log \frac{[A]_0}{[A]} = \frac{60 \times 1.83 \times 10^{-2}}{2.303} = 0.4768$$

$$\log\frac{[A]}{[A]_0} = -0.4768 = \bar{1}.5232$$

$$\frac{[A]}{[A]_0} = \text{Anti log } \bar{1}.5232 = 0.3336$$

$$\frac{[A]}{[A]_0} = 0.334$$

OR

(*i*) $t = \dfrac{2.303}{k}\log\dfrac{[A]_0}{[A]}$

Given: $k = 1.06\times10^{-3}\ \text{min}^{-1}, \dfrac{[A]_0}{[A]} = \dfrac{100}{85}$

$$t = \frac{2.303}{1.06\times10^{-3}\ \text{min}^{-1}}\log\frac{100}{85} = \frac{2303}{1.06}[2\log10 - \log 85]\ \text{min}$$

$$t = \frac{2303}{1.06}[2\times1 - 1.9294] = \frac{2303\times 0.0706}{1.06} = 153.39\ \text{min}$$

$t = 153.4$ min.

(*ii*) Given: $k = 1.06 \times 10^{-3}\ \text{mm}^{-1}, \dfrac{[A]_0}{[A]} = \dfrac{100}{15}$

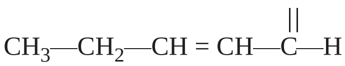
$$t = \frac{2.303}{1.06\times10^{-3}\ \text{min}^{-1}}, \log\frac{100}{15} = \frac{2303}{1.06}[2\log10 - \log15]\ \text{min}$$

$$= \frac{2303}{1.06}[2\times1 - 1.1761] = \frac{2303\times 0.8239}{1.06}\ \text{min}$$

$t = 1790$ min.

CBSE (Foreign) SET–III

1. Schottky defect.

2. Pent–2–enol: 

$CH_3—CH_2—CH = CH—\overset{\overset{\displaystyle O}{||}}{C}—H$

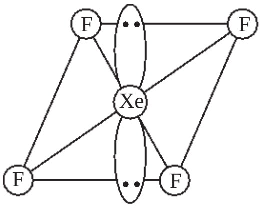
9. (*i*) Zone refining based on the principle that impurities are more soluble in the melt than in the solid state of the metal.

(*ii*) **Vapour phase refining of metals:** In this method, crude metal is freed from impurities by first converting it into volatile compound and collected elsewhere. It is then decomposed to give pure metal. For example refining of nickel by Mond process.

$$\underset{\text{impure}}{Ni} + 4CO \xrightarrow{330-350K} \underset{\text{Tetracarbonyl nickel (volatile)}}{Ni(CO)_4}$$

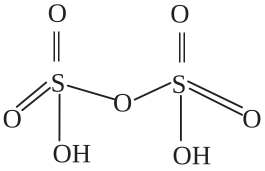
$$Ni(CO)_4 \xrightarrow{450-470K} \underset{\text{Pure}}{Ni} + 4CO$$

12. (*i*) No. of electron pairs around central atom (Xe) = $6 \begin{cases} b.p. = 4 \\ l.p. = 2 \end{cases}$



The shape would be square planar.

(*ii*)



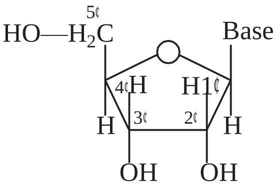
$H_2S_2O_7$ (Pyrosulphuric acid)

16.

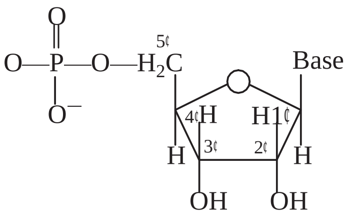
Fat soluble vitamins	Sources	Deficiency diseases
Vitamin A	Fish liver oil, carrots, milk	Xerophthalmia, Night blindness.
Vitamin D	Exposure to sunlight, fish and egg.	Rickets and osteomalacia.
Vitamin E	Vegetable oils like wheat germ oil, sunflower oil, etc.	Sterility and muscular atrophy
Vitamin K	Green leafy vegetables	Haemorrhages and increased blood clotting time.

18. **(*i*) Nucleotides:** The monomeric unit of nucleic acid is called nucleotide. When a nucleoside is linked to phosphoric acid at 5' position of sugar moiety, we get nucleotide.

(*ii*) Nucleoside: A nucleoside is the condensation product of purine or pyrimidine base with pentose sugar.



Nucleoside



Nucleotide

24. **(*i*) Linkage isomerism:** The isomers which have same molecular formula but differ in the linkage of ligand atom to the central metal atom are called linkage isomers, *e.g.*,

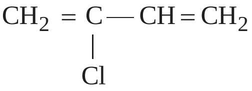
$[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$

Pentaamminenitrito–N–Cobalt (III) chloride pentaamminenitrito–O–Cobalt (III) chloride

(*ii*) Outer orbital complex: When ns, np and nd orbitals are involved in hybridisation, outer orbital complex is formed, *e.g.*, $[CoF_6]^{2-}$ in which cobalt is sp^3d^2 hybridised.

(*iii*) Bidentate ligand: When a ligand is bound to a metal ion through two donor atoms it is said to be bidentate ligand, *e.g.*, $H_2\ddot{N}-CH_2-CH_2-\ddot{N}H_2$ (ethane–1, 2–diamine, $C_2O_4^{2-}$ (oxalate), etc.

27.

Polymer	**Monomer**	**Structure**
PVC	Vinyl chloride	$CH_2 = CH–Cl$
Teflon	Tetrafluro ethene	$CF_2 = CF_2$
Neoprene	Chloroprene	 $CH_2=\underset{\substack{\vert\\ Cl}}{C}-CH=CH_2$

30. (*a*) (*i*)

$$\begin{array}{l} SO_2 + 2H_2O \longrightarrow SO_4^{2-} + 4H^+ + 2e^-]\times 5 \\ MnO_4^- + 8H^+ + 5\bar{e} \longrightarrow Mn^{2+} + 4H_2O]\times 2 \\ \hline 2MnO_4^- + 5SO_2 + 2H_2O \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 4H^+ \\ \hline \end{array}$$

(*ii*) $3HgCl_2 + 2PH_3 \longrightarrow Hg_3P_2 + 6HCl$

(*b*) (*i*) Sulphur has a greater tendency for catenation than oxygen because S-S bond is stronger than O – O bond due to less interelectronic repulsions.

(*ii*) It is due to

- low enthalpy of dissociation of F–F bond.
- high hydration enthalpy of F^-.

(*iii*) This is due to inert pair effect.

OR

(*a*) (*i*) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

(*ii*) $3Cu + 8HNO_3$ (dilute) $\longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(*b*) (*i*) Because of small size and high electro negativity of oxygen, molecules of water are highly associated through H-bonding resulting in its liquid state.

(*ii*) Its reaction with iron produces H_2

$Fe + 2HCl \longrightarrow FeCl_2 + H_2$

Liberation of hydrogen prevents the formation of ferric chloride.

(*iii*) Because of its very low solubility in blood it prevents 'bends'.

CBSE EXAMINATION PAPERS

DELHI–2010

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (Delhi) SET–I

1. Write a feature which will distinguish a metallic solid from an ionic solid.

2. Define 'order of a reaction'.

3. What is an emulsion?

4. Why does NO_2 dimerise?

5. Give an example of linkage isomerism.

6. A solution of KOH hydrolyses $CH_3CHClCH_2CH_3$ and $CH_3CH_2CH_2CH_2Cl$. Which one of these is more easily hydrolysed?

7. Draw the structural formula of 1-phenylpropan-1-one molecule.

8. Give the IUPAC name of $H_2N - CH_2 - CH_2 - CH = CH_2$.

9. Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.

10. A reaction is of first order in reactant A and of second order in reactant B. How is the rate of this reaction affected when (*i*) the concentration of B alone is increased to three times (*ii*) the concentrations of A as well as B are doubled?

11. The rate constant for a reaction of zero order in A is 0.0030 mol L^{-1} s^{-1}. How long will it take for the initial concentration of A to fall from 0.10 M to 0.075M?

12. Draw the structures of white phosphorus and red phosphorus. Which one of these two types of phosphorus is more reactive and why?

13. Explain the following observations:

(*i*) Generally there is an increase in density of elements from titanium (Z = 22) to copper (Z = 29) in the first series of transition elements.

(*ii*) Transition elements and their compounds are generally found to be good catalysts in chemical reactions.

14. Name the following coordination compounds according to IUPAC system of nomenclature:

(*i*) $[Co(NH_3)_4 (H_2O) Cl]Cl_2$

(*ii*) $[CrCl_2(en)_2]Cl$, (en = ethane –1, 2 – diamine)

15. Illustrate the following reactions giving a chemical equation for each:

(*i*) Kolbe's reaction, (*ii*) Williamson synthesis.

16. How are the following conversions carried out?

(*i*) Benzyl chloride to benzyl alcohol,

(*ii*) Methyl magnesium bromide to 2-methylpropan-2-ol.

17. Explain the following terms:

(*i*) Invert sugar (*ii*) Polypeptides

OR

Name the products of hydrolysis of sucrose. Why is sucrose not a reducing sugar?

18. What are essential and non-essential amino acids in human food? Give one example of each type.

19. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are 4 Ca^{2+} ions and 8 F^- ions and that Ca^{2+} ions are arranged in a fcc lattice. The F^- ions fill all the tetrahedral holes in the face centred cubic lattice of Ca^{2+} ions. The edge of the unit cell is 5.46×10^{-8} cm in length. The density of the solid is 3.18 g cm^{-3}. Use this information to calculate Avogadro's number (Molar mass of CaF_2 = 78.08 g mol^{-1})

20. A solution prepared by dissolving 1.25 g of oil of winter green (methyl salicylate) in 99.0 g of benzene has a boiling point of 80.31°C. Determine the molar mass of this compound. (B.P. of pure Benzene = 80.10°C and K_b for benzene = 2.53°C kg mol^{-1})

21. What is the difference between multimolecular and macromolecular colloids? Give one example of each type. How are associated colloids different from these two types of colloids?

22. Describe how the following changes are brought about:

(*i*) Pig iron into steel.

(*ii*) Zinc oxide into metallic zinc.

(*iii*) Impure titanium into pure titanium.

OR

Describe the role of

(*i*) NaCN in the extraction of gold from gold ore.

(*ii*) SiO_2 in the extraction of copper from copper matte

(*iii*) Iodine in the refining of Zirconium

Write chemical equations for the involved reactions.

23. How would you account for the following?

(*i*) The atomic radii of the metals of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second (4d) series.

(*ii*) The E° value for the Mn^{3+} / Mn^{2+} couple is much more positive than that for Cr^{3+} / Cr^{2+} couple or Fe^{3+} / Fe^{2+} couple.

(*iii*) The highest oxidation state of a metal is exhibited in its oxide or fluoride.

24. (*i*) State one use each of DDT and iodoform.

(*ii*) Which compound in the following couples will react faster in S_{N^2} displacement and why?

(*a*) 1-Bromopentane or 2-bromopentane

(*b*) 1-Bromo-2-methylbutane or 2-bromo-2-methylbutane.

25. In the following cases rearrange the compounds as directed:

(*i*) In an increasing order of basic strength:

$C_6H_5NH_2, C_6H_5N(CH_3)_2, (C_2H_5)_2NH$ and CH_3NH_2

(*ii*) In a decreasing order of basic strength:

Aniline, p-nitroaniline and p-toluidine

(*iii*) In an increasing order of pK_b values:

$C_2H_5NH_2, C_6H_5NHCH_3, (C_2H_5)_2NH$ and $C_6H_5NH_2$

26. Give **one** example each of

(*i*) addition polymers, (*ii*) condensation polymers,

(*iii*) copolymers.

27. What are analgesic medicines? How are they classified and when are they commonly recommended for use?

28. (*a*) State Kohlrausch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law.

(*b*) Calculate $\overset{\circ}{\Lambda}_m$ for acetic acid.

Given that $\overset{\circ}{\Lambda}_m$ (HC*l*) = 426 S cm^2 mol^{-1}

$\overset{\circ}{\Lambda}_m$ (NaCl) = 126 S cm^2 mol^{-1}

$\overset{\circ}{\Lambda}_m$ (CH_3COONa) = 91 S cm^2 mol^{-1}

OR

(*a*) Write the anode and cathode reactions and the overall reaction occurring in a lead storage battery.

(*b*) A copper-silver cell is set up. The copper ion concentration is 0.10 M. The concentration of silver ion is not known. The cell potential when measured was 0.422 V. Determine the concentration of silver ions in the cell. (Given $E^\circ_{Ag^+/Ag} = +0.80V, E^\circ_{Cu^{2+}/Cu} = 0.34$ V)

29. (*a*) Complete the following chemical equations:

(*i*) $NaOH_{(aq)} + Cl_{2(g)}$

$\longrightarrow$ (Hot and conc.)

(*ii*) $XeF_6(s) + H_2O(l) \longrightarrow$

(*b*) How would you account for the following?

- (*i*) The value of electron gain enthalpy with negative sign for sulphur is higher than that for oxygen.
- (*ii*) NF_3 is an exothermic compound but NCl_3 is endothermic compound.
- (*iii*) ClF_3 molecule has a T-shaped structure and not a trigonal planar one.

OR

(*a*) Complete the following chemical reaction equations::

- (*i*) $P_4 + SO_2Cl_2 \longrightarrow$
- (*ii*) $XeF_4 + H_2O \longrightarrow$

(*b*) Explain the following observations giving appropriate reasons:

- (*i*) The stability of +5 oxidation state decreases down the group in group 15 of the periodic table.
- (*ii*) Solid phosphorus pentachloride behaves as an ionic compound.
- (*iii*) Halogens are strong oxidizing agents.

30. (*a*) Explain the mechanism of a nucleophilic attack on the carbonyl group of an aldehyde or a ketone.

(*b*) An organic compound (A) (molecular formula $C_8H_{16}O_2$) was hydrolysed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid also produced (B). On dehydration (C) gives but-1-ene. Write the equations for the reactions involved.

OR

(*a*) Give chemical tests to distinguish between the following pairs of compounds:

- (*i*) Ethanal and propanal
- (*ii*) Phenol and Benzoic acid

(*b*) How will you bring about the following conversions?

- (*i*) Benzoic acid to benzaldehyde
- (*ii*) Ethanal to but-2-enal
- (*iii*) Propanone to propene

Give complete reaction in each case.

CBSE (Delhi) SET–II

Questions Uncommon to Set-I

1. Which point defect in crystals of a solid does not change the density of the solid?

4. What is the oxidation number of phosphorus in H_3PO_2 molecule?

5. Give an example of coordination isomerism.

12. Draw the structural formulae of molecules of following compounds:

(*i*) BrF_3 and (*ii*) XeF_4

14. Describe the shape and magnetic behaviour of following complexes:

(*i*) $[Co(NH_3)_6]^{3+}$

(*ii*) $[Ni(CN_4)]^{2-}$, (At. No. Co = 27, Ni = 28)

15. Explain the following reactions with an example for each:

(*i*) Reimer-Tiemann reaction

(*ii*) Friedel-Crafts reaction.

16. How are the following conversions carried out?

(*i*) Propene to propan-2-ol

(*ii*) Ethylmagnesium chloride to propan-1-ol.

22. A solution of glycerol ($C_3H_8O_3$; molar mass = 92 g mol^{-1}) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42°C. What mass of glycerol was dissolved to make this solution? K_b for water = 0.512 K kg mol^{-1}.

24. Complete the following chemical equations:

(*i*) $C_6H_5N_2Cl + C_6H_5NH_2 \xrightarrow{OH^-}$

(*ii*) $C_6H_5N_2Cl + CH_3CH_2OH \longrightarrow$

(*iii*) $RNH_2 + CHCl_3 + KOH \longrightarrow$

25. Write the name and structure of the monomer of each of the following polymers:

(*i*) Neoprene

(*ii*) Buna-S

(*iii*) Teflon

CBSE (Delhi) SET–III

Questions Uncommon to Set-I and Set–II.

1. Which point defect in crystals of a solid decreases the density of the solid?

2. Define ‘rate of a reaction’.

3. Give an example of ‘shape-selective catalyst’.

4. Draw the structure of O_3 molecule.

5. Give an example of ionization isomerism.

13. Explain the following observations:

(*i*) Transition elements generally form coloured compounds.

(*ii*) Zinc is not regarded as a transition element.

18. State clearly what are known as nucleosides and nucleotides.

19. The density of copper metal is 8.95 g cm^{-3}. If the radius of copper atom is 127.8 pm, is the copper unit cell a simple cubic, a body-centred cubic or a face-centred cubic structure? (Given: At. mass of

Cu=63.54 g mol^{-1} and $N_A = 6.022 \times 10^{23}$ mol^{-1})

20. How are the following colloids different from each other in respect of their dispersion medium and dispersed phase? Give one example of each.

(*i*) Aerosol (*ii*) Emulsion

(*iii*) Hydrosol

26. Differentiate between thermoplastic and thermosetting polymers. Give one example of each.

27. Explain the following terms with one suitable example in each case.

(*i*) Cationic detergents (*ii*) Enzymes

(*iii*) Antifertility drugs

Solutions

CBSE (Delhi) SET–I

1. Metals are malleable and ductile whereas ionic solids are hard and brittle.

2. The order of a reaction can be defined as the sum of the powers of the concentration terms as expressed in rate law.

3. An emulsion is a colloidal dispersion of one liquid in another liquid. For example, cod liver oil, milk etc.

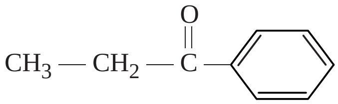
4. The dimerisation of NO_2 is because of unpaired electron on nitrogen atom to form N_2O_4 molecule with even number of electrons.

$$\underset{\text{Paramagnetic}}{2NO_2} \quad \overset{262\,K}{\blacksquare} \quad \underset{\text{Colourless and diamagnetic}}{N_2O_4}$$

5. The example of linkage isomerism: $[Co(NH_3)_5NO_2]^{2+}$ and $[Co(NH_3)_5ONO]^{2+}$.

6. $CH_3CH_2ClCHCH_3$

7.



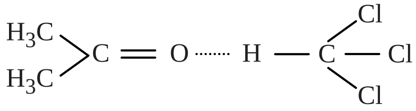
8. But-3-en-1-amine.

9. When the vapour pressure of a solution is either higher or lower than that predicted by Raoult's law then the solution exhibits deviation from Raoult's law.

These deviation are caused when solute-solvent molecular interactions $(A-B)$ are either weak or stronger than solvent-solvent $(A-A)$ or solute-solute $(B-B)$ molecular interactions.

Positive Deviation: When $(A-B)$ molecular interactions are weaker than $(A-A)$ and $(B-B)$ molecular interactions. For example a mixture of ethanol and acetone.

Negative deviation: When $(A-B)$ molecular interactions are stronger than $(A-A)$ and $(B-B)$ molecular interactions. For example a mixture of chloroform and acetone.



Hydrogen bond

10. According to the given reaction:

$$\text{Rate} = k[A][B]^2$$

(*i*) When the concentration of reactant '*B*' is increased three times the rate of reaction becomes 9 times.

i.e., $\text{Rate} = k[A][3B]^2 = 9k[A][B]^2$

(*ii*) When the concentration of reactants *A* and *B* are doubled, then rate becomes 8 times.

i.e., $\text{Rate} = k[2A]^1[2B]^2 = 8k[A][B]^2$

11. According to available data:

$k = 0.0030 \text{ mol L}^{-1}\text{s}^{-1}$, $[R]_0 = 0.10 \text{ M}$, $[R] = 0.075 \text{ M}$

We know that

$$[R] = -kt + [R]_0$$

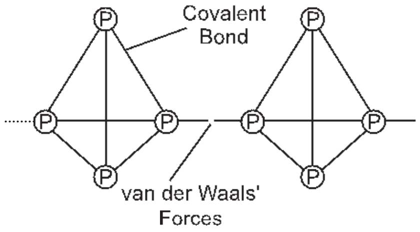
$$0.075 = -0.0030\,t + 0.10$$

$\Rightarrow 3t = 100 - 75 \quad \Rightarrow \quad t = 8.33$ second

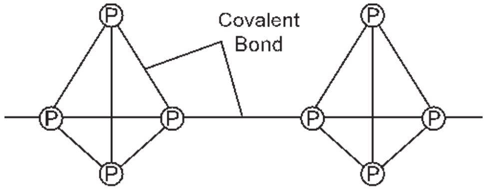
12. White phosphorus is more reactive due to its discrete tetrahedral structure and angular strain.

or

Red phosphorus is less reactive due to its polymeric structure.



(i) White phosphorus



(ii) Red phosphorus

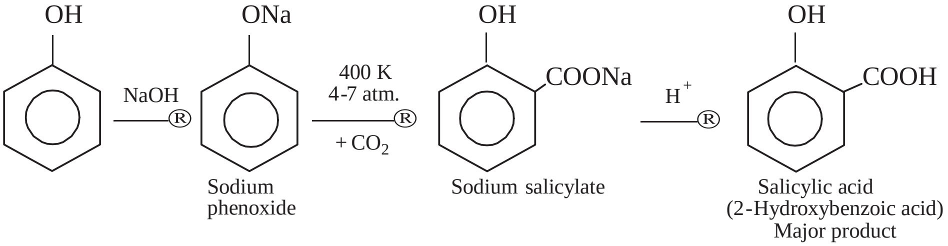
13. (*i*) The density of elements from titanium to copper increase in the first series of transition elements. This is due to decrease in metallic radius coupled with increase in atomic mass results in a general increase in the density.

(*ii*) Many transition metals and their components show catalytic properties. This property is due to their ability to exhibit variable oxidation states (incomplete d-orbitals) which enable them to form unstable intermediates.

14. (*i*) Tetraammineaquachloridocobalt (III) chloride

(*ii*) Dichlorido-bis (ethane-1, 2-diamine) chromium(III)chloride

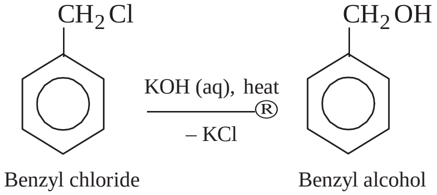
15. (*i*) Kolbe's reaction



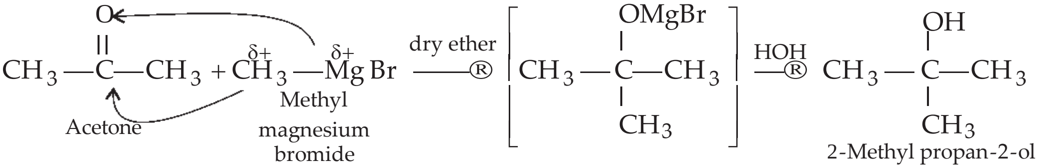
(*ii*) Williamson synthesis

$$\underset{\text{Sod. ethoxide}}{C_2H_5ONa} + \underset{\text{Methyl iodide}}{ICH_3} \longrightarrow \underset{\text{Methyl ethyl ether}}{C_2H_5OCH_3} + NaI$$

16. (*i*)



(*ii*)



17. (***i***) **Invert Sugar:** The dextrorotatory sucrose when hydrolysed by boiling with mineral acid produces an equal number of molecules of dextrorotatory fructose. The resulting mixture is laevorotatory and termed as invert sugar.

$$\underset{\substack{\text{Sucrose} \\ [\alpha]_D = 66.5°}}{C_{12}H_{22}OH} + H_2O \xrightarrow{H^+} \underbrace{\underset{\substack{\text{Glucose} \\ [\alpha]_D = 52.5°}}{C_6H_{12}O_6} + \underset{\substack{\text{Fructose} \\ [\alpha]_D = -93°}}{C_6H_{12}O_6}}_{\text{Invert sugar}}$$

(*ii*) **Polypeptides:** Polypeptides are polymers formed by condensation of more than ten amino acids. They have large number of peptides bonds in them. Polypeptides are amphoteric because of the presence of terminal-ammonium and carboxylate ions as well as the ionized side chains of amino acid residues

OR

Sucrose gives glucose and fructose on hydrolysis. It is a non-reducing sugar as it does not contain free ketone or aldehyde group in its ring form.

18. **Essential amino acids:** Amino acids which cannot be synthesized in the body but must be obtained through diet, are called essential amino acids. For example: valine, leucine.

Non-essential amino acids: The amino acids, which can be synthesized in the body are known as non-essential amino acids. For example: Glycine, Alanine.

19. Given: $d = 3.18 \text{ g cm}^{-3}$, $Z = 4$, $a = 5.46 \times 10^{-8}$ cm

$M = 78.08 \text{ g mol}^{-1}$ $N_A = ?$

$$d = \frac{Z \times M}{a^3 \times N_A}$$

$$\therefore \quad N_A = \frac{Z \times M}{a^3 \times P}$$

Substituting the given values, we get

$$N_A = \frac{4 \times 78.08}{(5.46 \times 10^{-8})^{-3} \times 3.18}$$

$$N_A = \frac{313\text{x}32 \times 10^{24}}{517\text{x}61}$$

$$N_A = 6.035 \times 10^{23} \text{ mol}^{-1}$$

20. Given $\Delta T_B = 80.31 - 80.10 = 0.21$ °C or 0.21 K

$W_B = 1.25\text{g}$, $K_b = 2.53°\text{C kg mol}^{-1}$

$M_B = ?$

$W_A = 99\text{g}$

$$M_B = \frac{K_b \times W_B}{\Delta T_b \times W_A} \times 1000$$

$$= \frac{2\text{x}53 \times 1\text{x}25 \times 1000}{0\text{x}21 \times 99} = \frac{3162.5}{20.79}$$

$\therefore \quad M_B = 152$ g/mol

21. **Multimolecular colloids:** In this type of colloids, colloidal particles are aggregates of atoms or molecules each having size less than 1nm, e.g., sulphur sol, gold sol.

Macromolecular colloids: In this type of colloids, colloidal particles are themselves large molecules of colloidal dimensions, e.g., starch, proteins, polyethene, etc.

Associated colloids: There are certain substances which at low concentrations behave as normal electrolyte, but at higher concentrations exhibit colloidal behaviour due to the formation of aggregates. Such colloids are known as associated colloids, e.g., soaps and detergents.

22. (*i*) **Pig iron into steel:** Pig iron is converted into steel by heating in a converter. A blast of oxygen diluted with carbon dioxide is blown through the converter. Oxygen reacts with impurities and raised the temperature to 2173K. Carbon gets oxidised to CO which burns off at the mouth of the converter. Oxides of silicon and Mg form slag. When the flame is stopped, slag is tapped off and other metals like Mn, Cr, Ni, W may be added in the end.

(*ii*) Metallic zinc can be obtained from zinc oxide. At first calcination of ZnO is done and converted into sinters of oxide.

$$\text{ZnO} + \text{C} \xrightarrow{\Delta} \text{Zn} + \text{CO}$$

The oxide is then made into brickettes with coke and clay and heated by producer gas in vertical retorts at 1673 K, zinc, boiling point is 1183 K, distills off and is collected by rapid chilling.

(*iii*) Impure Titanium into pure Titanium: Impure Titanium is heated with I_2 to form volatile complex (T_iI_4), which on heating at higher temperature decomposes to give pure titanium.

$$\text{Ti (impure)} + 2\,\text{I}_2 \longrightarrow \text{TiI}_4 \xrightarrow{\Delta} \text{T}_\text{i}\text{ (pure)} + \text{I}_2$$

OR

(*i*) Role of NaCN in the extraction of gold is to do the leaching of gold ore in the presence of air from which the gold is obtained later by replacement.

$$4\text{Au(s)} + 8\text{NaCN(aq)} + 2\text{H}_2\text{O} + \text{O}_2 \longrightarrow 4\text{Na[Au(CN)}_2\text{]} + 4\text{KOH}$$

(*ii*) SiO_2 is added to copper matte to convert the leftout FeS, FeO into slag.

$$\text{FeO} + \text{SiO}_2 \longrightarrow \text{FeSiO}_3\text{ (Slag)}$$

(*iii*) Iodine is heated with impure Zr to form volatile compound which on further heating decomposes to give pure zirconium.

$$\text{Zr (Impure)} + \text{I}_2 \xrightarrow{\Delta} \text{ZrI}_4 \xrightarrow{\Delta} \text{Zr (pure)} + 2\text{I}_2$$

23. (*i*) This is due to lanthanide contraction.

or

This is due to filling of 4*f* orbitals which have poor shielding effect.

(*ii*) The E° value for the Mn^{3+}/Mn^{2+} couple is much positive than Cr^{3+}/Cr^{2+} couple or Fe^{3+}/Fe^{2+} couple because Mn^{3+} ion receiving an electron gets d-subshell half-filled which is highly stable. While in case of Fe^{3+} d-sub shell is already half-filled, so it does not receive electron easily.

(*iii*) This is because fluorine and oxygen are highly electronegative elements and have small size.

24. (*i*) **DDT:** It is used as insecticide to control flies, mosquitoes, etc.
Iodoform: Iodoform is used as an antiseptic.

(*ii*) 1-Bromopentane, as it is a primary alkyl halide. and

(b) 1-Bromo-2-methyl butane, as it is a primary alkylhalide.

25. (*i*) Increasing order of basic strength is:

$$C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH$$

(*ii*) *p*-Toluidine > Aniline > tr-nitroaniline

(*iii*) $(C_2H_5)_2\ NH_2 < C_2H_5NH_2 < C_6H_5NHCH_3 < C_6H_5NH_2$

26. (*i*) Polythene, PVC.

(*ii*) Nylon 6, Nylon 6,6.

(*iii*) Buna-S, Buna-N.

27. **Analgesics:** They are the drugs used for relieving pain. Analgesics are classified into two categories:

(*a*) Narcotics (addictive) drugs (*b*) Non-narcotics (non-addictive) drugs

(*a*) Narcotics: Narcotic drugs are recommended for cardiac pain, post operative pains, terminal cancer and in child birth.

(*b*) Non-narcotics: Non-narcotic drugs are effective in relieving skeletal pain, reducing fever, preventing heart attack.

28. **(*a*) Kohlrausch Law:** "The molar conductance of an electrolyte at infinite dilution is equal to the sum of the molar conductances of the two ions, i.e., the cation and the anion."

Mathematically, $\Lambda^o_m = \Lambda^o_+ + \Lambda^o_-$

Expression for the molar conductivity of acetic acid:

$$\Lambda^o_m\ CH_3COOH = \Lambda^o_m CH_3COO^- + \Lambda^o_{H^+}$$

or $$\Lambda^o_m\ CH_3COOH = \Lambda^o_m(CH_3COO^-) + \Lambda^o_{H^+}$$

(*b*) Given $\Lambda^o_m\ (HCl) = 426\,S\ cm^2\ mol^{-1}$

$$\Lambda^o_m\ (NaCl) = 126\,S\ cm^2\ mol^{-1}$$

$$\Lambda^o_m\ (CH_3COONa) = 91\,S\ cm^2\ mol^{-1}$$

$$\Lambda^o_m\ (CH_3COOH) = \Lambda^o_m(CH_3COO^-) + \Lambda^o_m(H^+)$$

$$\Lambda^o_m\ (CH_3COONA) = \Lambda^o_m(CH_3COO^-) + \Lambda^o_m(Na^+) \quad ...(1)$$

$$\Lambda^o_m\ (NaCl) = \Lambda^o_m(Na^+) + \Lambda^o_m(Cl^+) \quad ...(2)$$

$$\Lambda^o_m\ (HCl) = \Lambda^o_m(H^+) + \Lambda^o_m(Cl^+) \quad ...(3)$$

Subtracting (2) from the sum of (1) and (3), we get:

$$\Lambda^o_m\ (CH_3COO^-) + \Lambda^o_m\ (Na^+) + \Lambda^o_m\ (H^+) + \Lambda^o_m\ (Cl^-) - \Lambda^o_m\ ((Na^+) + \Lambda^o_m Cl^-)$$
$$= \Lambda^o_m(CH_3COO^-) + \Lambda^o_m(H^+) = \Lambda^o_m(CH_3COOH)$$

$$\therefore\ \Lambda^o_m(CH_3COOH) = 91.0 + 426 - 126\ S\ cm^2\ mol^{-1}$$

$$= 391.0\ S\ cm^2\ mol^{-1}$$

OR

(*a*) When lead battery operates, the following cell reactions occur:

Anode half cell reaction:

$$Pb\ (s) + SO_4^{2-}(aq) \longrightarrow PbSO_4\ (s) + 2e^-$$

Cathode half cell reaction:

$$PbO_2\ (s) + 4\ H^+\ (aq) + SO_4^{2-} + 2e^- \longrightarrow PbSO_4\ (s) + 2H_2O\ (l)$$

Net reaction, $Pb(s) + PbO_2 + 2H_2SO_4\ (aq) \longrightarrow 2PbSO_4\ (s) + 2H_2O\ (l)$

(*b*) Given $E^o_{Ag+/Ag} = 0.80V$, $E^o_{Cu^{2+}/Cu} = +0.34V$

$[Cu^{2+}] = 0.10$ M $[Ag^+] = ?$

$E^o_{cell} = E^o_R - E^o_L = 0.80 - 0.34V = 0.46V$

From Nernst Equation:

$$E_{cell} = E^o_{cell} - \frac{0.0591}{2}\log\frac{[Cu^{2+}]}{[Ag^+]^2}$$

$$0.422 = 0.46 - \frac{0.591}{2}\log\frac{[0.10]}{[Ag^+]^2}$$

$$\log\frac{0.10}{[Ag^+]^2} = 1.2881$$

$$[Ag^+]^2 = 0.0051$$

$$\therefore \quad [Ag^+] = 7.1\times 10^{-2}\text{ M}$$

29. (*i*) $6\,NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(*ii*) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

or

$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$

(*i*) Due to smaller size of oxygen the electron cloud is distributed over a small region of space, making electron density high which repels the incoming electrons.

(*ii*) This is due to lower bond dissociation enthalpy of F_2 than Cl_2 and comparable size of fluorine and nitrogen.

(*iii*) ClF_3 molecule has a T-shaped structure. This is due to presence of two lone pairs in the outer shell of chlorine in ClF_3 molecule which repel the bond pairs.

OR

(*a*) Complete the following chemical reaction equations:

(*i*) $P_4 + 8SO_2Cl_2 \longrightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$

(*ii*) $6XeF_4 + 12H_2O \longrightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$

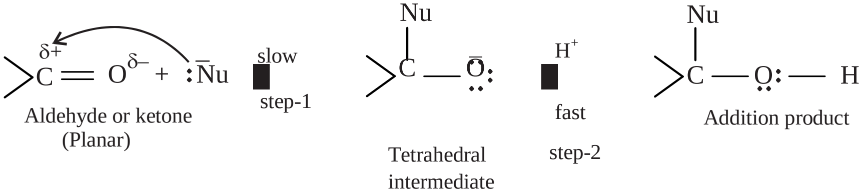
(*b*) (*i*) The stability of +5 oxidation state decreases down the group in group 15 of the periodic table. The + 3 oxidation state becomes more and more common on moving down the group from N to Bi. This is because of inert pair effect.

(*ii*) Solid PCl_5 behaves as an ionic compound because it is a salt containing the tetrahedral cation $[PCl_4]^+$ and octahedral anion $[PCl_6]^-$.

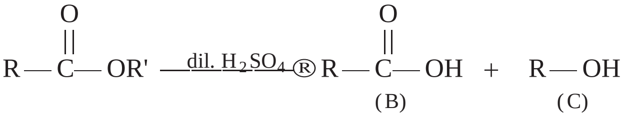
(*iii*) Halogens are strong oxidising agents because they have high electron affinities, so, they pick up electrons from other substances.

30. (*a*) Mechanism of nucleophilic addition reactions:

A nucleophile attacks the electrophilic carbon atom of the polar carbonyl group from a direction approximately perpendicular to the plane of sp^2 hybridized orbitals of carbonyl carbon. The hybridization of carbon changes from sp^2 to sp^3 in this process and a tetrahedral intermediate is produced. The intermediate captures a proton from the medium to give the neutral product.

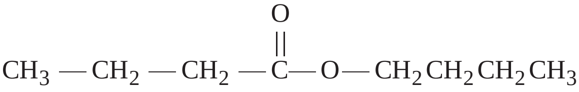


(*b*) The hydrolysis of the given compound with dil H_2SO_4 to give a carboxylic acid and an alcohol suggests that the compound is an ester.



$$R-\overset{\overset{O}{||}}{C}-OR' \xrightarrow{\text{dil. } H_2SO_4} \underset{(B)}{R-\overset{\overset{O}{||}}{C}-OH} + \underset{(C)}{R-OH}$$

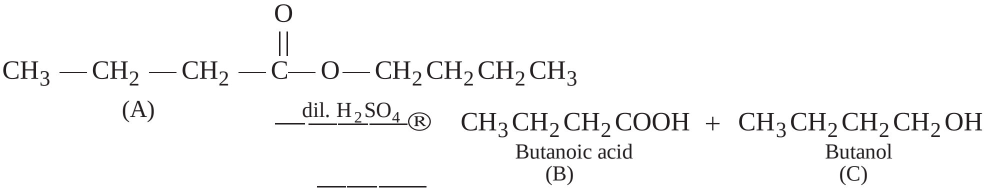
So, the possible structure of '*A*' is



$$CH_3-CH_2-CH_2-\overset{\overset{O}{||}}{C}-O-CH_2CH_2CH_2CH_3$$

Butyl butanoate

(*i*)



$$\underset{(A)}{CH_3-CH_2-CH_2-\overset{\overset{O}{||}}{C}-O-CH_2CH_2CH_2CH_3} \xrightarrow{\text{dil. } H_2SO_4} \underset{\substack{\text{Butanoic acid}\\(B)}}{CH_3CH_2CH_2COOH} + \underset{\substack{\text{Butanol}\\(C)}}{CH_3CH_2CH_2CH_2OH}$$

(*ii*) $\underset{\substack{\text{Butanol}\\(C)}}{CH_3CH_2CH_2CH_2OH} \xrightarrow[\text{acid oxidation}]{\text{chromic}} \underset{\substack{\text{Butanoic acid}\\(B)}}{CH_3CH_2CH_2COOH}$

(*iii*) $\underset{\text{Butanol}}{CH_3-CH_2CH_2CH_2OH} \xrightarrow{\text{dehydration}} \underset{\text{But-1-ene}}{CH_3-CH_2-CH=CH_2}$

OR

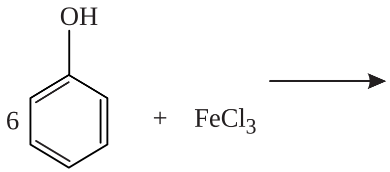
(*a*) Chemical tests to distinguish between ethanal and propanal

Iodoform Test: Ethanol gives iodoform test positive while propanal does not give this test.

$$CH_3CHO + 3I_2 + 4\,NaOH \rightarrow \underset{\text{(yellow)}}{CHI_3\downarrow} + HCOONa + 3NaI + 3H_2O$$

(*b*) Phenol and benzoic acid:

Phenol gives violet colour with neutral $FeCl_3$ solution. Benzoic acid does not give violet colour with $FeCl_3$.

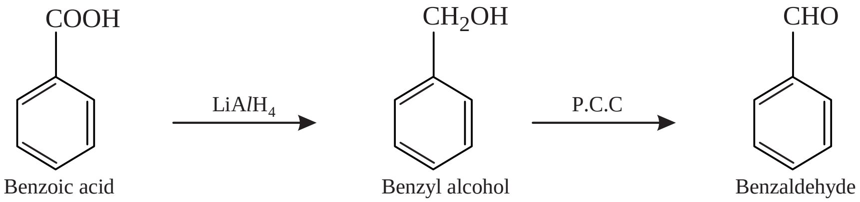


Phenol

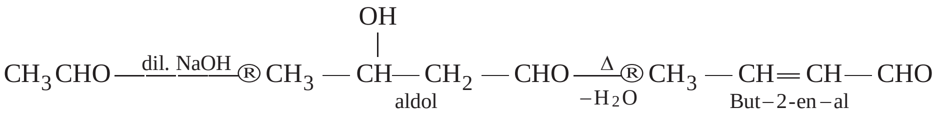
$[Fe(OC_6H_5)_6]^{3-}$ + $3H^+$ + HCl

Violet complex

(*i*)



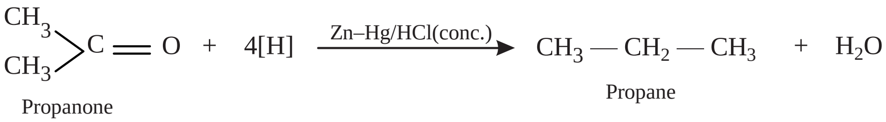
(*ii*) Ethanal to but-2-enal



$$CH_3CHO \xrightarrow{\text{dil. NaOH}} CH_3-\overset{\overset{\displaystyle OH}{|}}{C}H-CH_2-CHO \xrightarrow[-H_2O]{\Delta} CH_3-CH=CH-CHO$$

aldol But-2-en-al

(*iii*) Propanone to propane



$$\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!>\!C=O \;+\; 4[H] \xrightarrow{\text{Zn–Hg/HCl(conc.)}} CH_3-CH_2-CH_3 \;+\; H_2O$$

Propanone Propane

CBSE (Delhi) SET–II

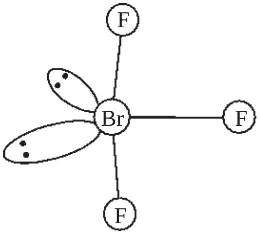
1. Frankel defects do not change the density of the solids.

4. Oxidation number of phosphorous in H_3PO_2 is +1.

5. Example of coordination isomerism.

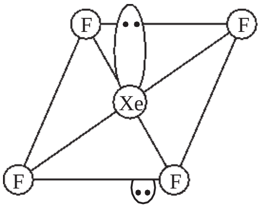
$[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$

12. (*i*) Structure of BrF_3



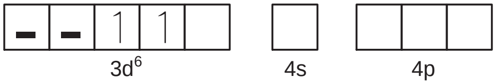
Bent T-shaped

(*ii*) Structure of XeF_4 molecule



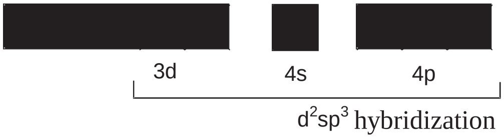
Square planar

14. (*i*) ∴ Co^{3+}



Pairing of electrons takes place against the Hund's role

∴ Co^{3+}

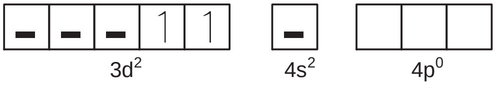


Thus, the complex will be octahedral and diamagnetic.

(*ii*) $[Ni(CN)_4]^{2-}$

The electronic configuration of the nickel atom and Ni^{2+} ion are depicted below:

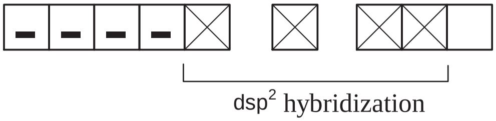
Ni (atom number 28)



Since coordination number in the complex is 4. It shows that complex is formed by sp^3 or dsp^2 hybridization.

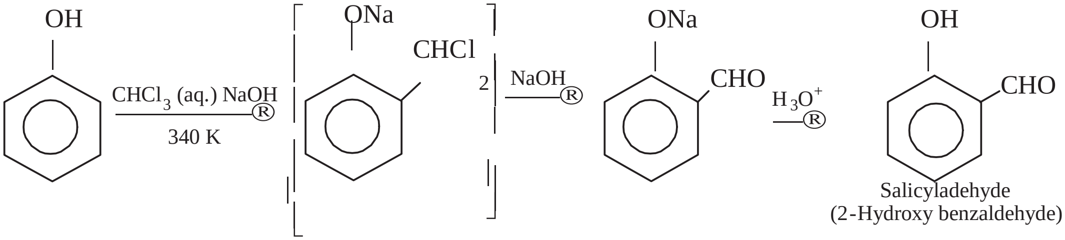
However, experiments show that the complex is diamagnetic.

∴ Ni^{2+} (after rearrangement)



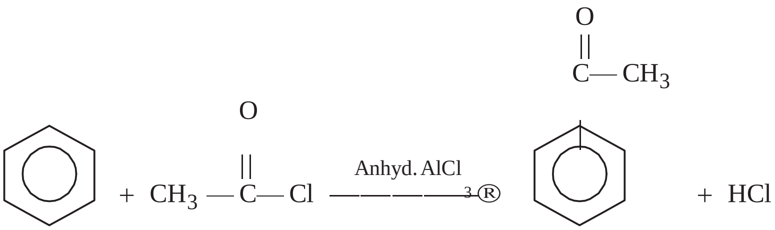
The resulting complex is square planar and diamagnetic as it has no unpaired electrons.

15. (*i*) Reimer Tiemann Reaction



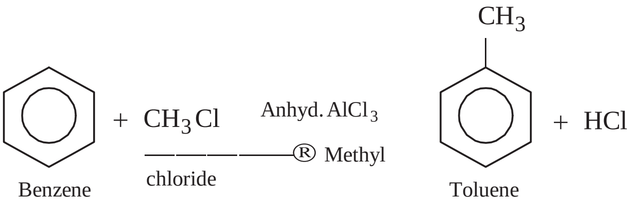
(*ii*) Friedel - Craft Reactions

Acylation:



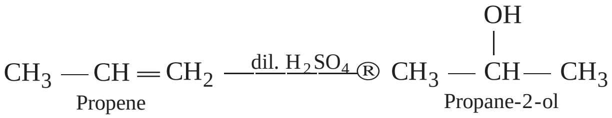
Benzene Acetophenone

Alkylation:



16.

(*i*)



$$CH_3-CH=CH_2 \xrightarrow{\text{dil. } H_2SO_4} CH_3-\overset{\overset{\large OH}{|}}{CH}-CH_3$$

(*ii*) $\underset{\text{Ethyl magnesium chloride}}{C_2H_5MgCl} \xrightarrow[\text{(ii) } H^+]{\text{(i) HCHO}} \underset{\text{Propan-1-ol}}{CH_3-CH_2-CH_2OH}$

22. Given $M_B = 92 \text{ g mol}^{-1}$

$W_A = 500 \text{ g}$

$\Delta T_b = 100.42 - 100 = 0.42°C$ or 0.42 K

$W_B = ?$

$\therefore$ $K_b = 0.512 \text{ kg mol}^{-1}$

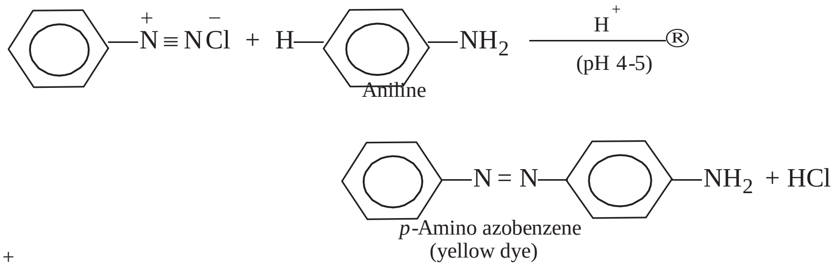
$$\Delta T_b = K_b \frac{W_B}{M_B} \times \frac{1000}{W_A}$$

or $$0.42 = \frac{0.512 \times W_B \times 1000}{92 \times 500}$$

$\therefore$ $$W_B = \frac{0.42 \times 92 \times 500}{0.512 \times 1000}$$

$$W_B = \frac{19320}{512} = 37.73 \text{ g}$$

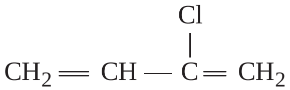
24. (*i*)



(*ii*) $Ar\overset{+}{N_2}Cl^- + CH_3-CH_2-OH \longrightarrow ArH + N_2 + CH_3-CHO + HCl$

(*iii*) $\underset{1° \text{ amine}}{R-NH_2} + CHCl_3 + 3KOH(\text{alc.}) \xrightarrow{\Delta} \underset{\text{Alkyl isocyanide}}{R-NC} + 3KCl + 3H_2O$

25. (*i*) The monomer of neoprone is chloroprene.



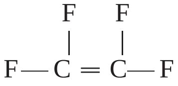
$$CH_2{=}CH{-}\overset{\overset{\displaystyle Cl}{|}}{C}{=}CH_2$$

chloroprene

(*ii*) The monomer of Buna-S is Buta-1,3-diene and styrene.

$\underset{\text{Buta–1,3–diene}}{CH_2 = CH - CH = CH_2}$ and $\underset{\text{Styrene}}{C_6H_5CH = CH_2}$

(*iii*) The monomer of teflon is Tetrafluoroethene.



$$F{-}\overset{\overset{\displaystyle F}{|}}{C}{=}\overset{\overset{\displaystyle F}{|}}{C}{-}F$$

Tetrafluoroethene

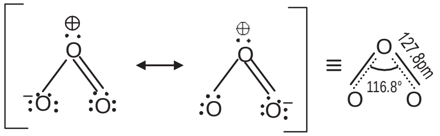
CBSE (Delhi) SET–III

1. Schottky defect.

2. Rate may be defined as the decrease in the concentration of reactant per unit time or increase in the concentration of product per unit time.

3. The example of shape selective catalyst is ZSM–5.

4.



5. Example of ionisation isomerism is –

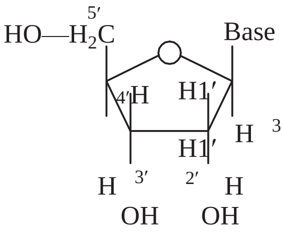
$[Pt(NH_3)_4Cl_2]Br_2$ and $[Pt(NH_3)_4Br_2]Cl_2$

13. (*i*) This is due to d-d transition. When visible (white) light falls on a compound, it absorbs certain radiations of white light and transmit the remaining ones. The transmitted light has the complementary colour to that of the absorbed light.

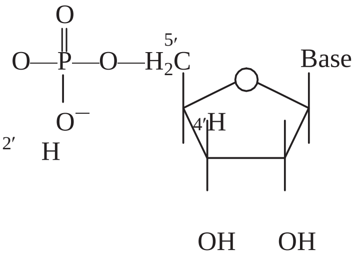
(*ii*) Because the atoms or simple ions of zinc never have partially filled d orbitals.

18. **(*i*) Nucleoside:** A nucleoside is the condensation product of purine or pyrimidine base with pentose sugar.

(*ii*) Nucleotides: The monomeric unit of nucleic acid is called nucleotide. When a nucleoside is linked to phosphoric acid at 5’ position of sugar moiety, we get nucleotide.



Nucleoside



Nucleotide

19. Given, Radius (r) = 127.8 pm

For fcc $a = 2\sqrt{2}\,r$

$\therefore \quad a^3 = (2\sqrt{2}r)^3 = 4.723 \times 10^{-23}\ \text{cm}^3$

Atomic mass of Cu = 63.54 g mol^{-1}

N_A = 6.022 × 1023 mol^{-1}

Density = 8.95 g cm^{-3}

$$d = \frac{Z \times M}{N_A \times a^3}$$

$$\Rightarrow \quad 8.95 = \frac{Z \times 63.54}{6.023 \times 10^{23} \times 4.723 \times 10^{-23}}$$

$$\therefore \quad Z = \frac{8.95 \times 6.022 \times 4.723}{63.54} \quad \Rightarrow \quad Z = 4.00$$

Thus copper has fcc structure.

20.

Aerosol	Emulsion	Hydrosol
1. Sols in which the dispersion medium is gas and dispersed phase is solid or liquid. For example: Smoke, dust	1. A colloidal system in which dispersion medium and dispersed phase both are liquids. For example: Milk, cod liver oil.	1. Sols in which the dispersed phase is solid and dispersion medium is water. For example: gum sol.

26. Differences between thermosetting and thermoplastic polymers.

Thermoplastics	Thermosetting plastics
(*i*) These polymer are linear or slightly branched chain molecules	(*i*) These polymers are cross linked or heavily branched molecules
(*ii*) Soften on heating and harden on cooling and can be remoulded.	(*ii*) On heating undergo extensive cross linking in moulds and become infusible.
(*iii*) Some common examples are polyethene, PVC, polystyrene, etc.	(*iii*) Some common examples are bakelite, urea-formaldehyde resins, terylene, etc.

27. **(*i*) Cationic detergents:** Cationic detergents are mostly acetate or chlorides of quaternary amines. For example: Cetyltrimethyl-ammonium chlorides.

(*ii*) Enzymes: Enzymes are the essential biological catalysts which catalyse specific biological reactions at a very high rate under mild conditions of temperature and pH. For example, invertase, zymase, pepsin, trypsin, etc.

(*iii*) Antifertility drugs: The drugs which are used to control the birth rate are known as antifertility drugs. For example, norethindrone, novestrol, etc.

CBSE EXAMINATION PAPERS

ALL INDIA–2010

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

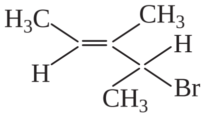
CBSE (All India) SET–I

1. What type of interactions hold the molecules together in a polar molecular solid?

2. What is meant by ‘limiting molar conductivity’?

3. Fluorine does not exhibit any positive oxidation state. Why?

4. Give the IUPAC name of the following compound:



5. Write the structure of the molecule of a compound whose IUPAC name is

1-phenylpropan-2-ol

6. What is Tollen’s reagent? Write one usefulness of this reagent.

7. What is meant by ‘reducing sugars’?

8. What does the designation ‘6, 6’ mean in the name nylon-6, 6?

9. Define the terms, ‘osmosis’ and ‘osmotic pressure’. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solutions.

10. Express the relation among the cell constant, the resistance of the solution in the cell and the conductivity of the solution. How is the conductivity of a solution related to its molar conductivity?

11. Given that the standard electrode potential (E°) of metals are:

$K^+/K = -2.93\ V, Ag^+/Ag = 0.80V, Cu^{2+}/Cu = 0.34\ V, Mg^{2+}/Mg = -2.37V, Cr^{3+}/Cr = -0.74V,$

$Fe^{2+}/Fe = -0.44V.$

Arrange these metals in an increasing order of their reducing power.

OR

Two half-reactions of an electrochemical cell are given below:

$$MnO^-_4(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l), \quad E° = + 1.51\ V$$

$$Sn^{2+}(aq) \longrightarrow Sn^{4+}(aq) + 2e^-, \quad E° = + 0.15V$$

Construct the redox reaction equation from the two half-reactions and calculate the cell potential from the standard potentials and predict if the reaction is reactant or product favoured.

12. Describe the following:

(*i*) Tyndal effect (*ii*) Shape-selective catalysis

13. What is meant by coagulation of a colloidal solution? Name any method by which coagulation of lyophobic sols can be carried out.

14. Complete the following chemical reaction equations:

(*i*) $I_2 + HNO_3 \longrightarrow$ (*ii*) $HgCl_2 + PH_3$
$\longrightarrow$ (conc.)

15. Draw the structural formulae of the following compounds:

(*i*) $H_4P_2O_5$ (*ii*) XeF_4

16. Give the chemical tests to distinguish between the following pairs of compounds:

(*i*) Ethylamine and Aniline

(*ii*) Aniline and Benzylamine

17. Identify A and B in each of the following processes:

(*i*) $CH_3CH_2Cl \xrightarrow{NaCN} A \xrightarrow[Ni/H_2]{Reduction} B$

(*ii*) $C_6H_5NH_2 \xrightarrow{NaNO_2/HCl} A \xrightarrow[OH^-]{C_6H_5NH_2} B$

18. Draw the molecular structures of the monomers of

(*i*) PVC (*ii*) Teflon

19. The density of copper metal is 8.95 g cm^{-3}. If the radius of copper atom be 127.8 pm, is the copper unit cell simple cubic, body-centred cubic or face-centred cubic?
(Given: atomic mass of Cu = 63.54 g mol^{-1} and $N_A = 6.02 \times 10^{23}\ mol^{-1}$)

20. What mass of NaCl (molar mass = 58.5 g mol^{-1}) must be dissolved in 65 g of water to lower the freezing point by 7.5°C? The freezing point depression constant, K_f, for water is 1.86 K kg mol^{-1}. Assume van't Hoff factor for NaCl is 1.87.

21. Describe the role of the following:

(*i*) NaCN in the extraction of silver from a silver ore

(*ii*) Iodine in the refining of titanium

(*ii*) Cryolite in the metallurgy of aluminium

OR

Describe the principle involved in each of the following processes of metallurgy:

(*i*) Froth floatation method

(*ii*) Electrolytic refining of metals

(*ii*) Zone refining of metals

22. Explain the following cases giving appropriate reasons:

(*i*) Nickel does not form low spin octahedral complexes.

(*ii*) The π-complexes are known for the transition metals only.

(*iii*) Co^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand.

23. How would you differentiate between S_N1 and S_N2 mechanisms of substitution reactions? Give one example of each.

24. How would you convert the following:

(*i*) Phenol to benzoquinone

(*ii*) Propanone to 2-methylpropan-2-ol

(*iii*) Propene to propan-2-ol

25. How would you account for the following:

(*i*) NCl_3 is an endothermic compound while NF_3 is an exothermic one.

(*ii*) XeF_2 is a linear molecule without a bend.

(*iii*) The electron gain enthalpy with negative sign for fluorine is less than that for chlorine, still fluorine is a stronger oxidising agent than chlorine.

26. Amino acids may be acidic, alkaline or neutral. How does this happen? What are essential and non-essential amino acids? Name one of each type.

27. Explain the following terms with one example in each case:

(*i*) Food preservatives

(*ii*) Enzymes

(*iii*) Detergents

28. (*a*) Explain the following terms:

(*i*) Rate of a reaction

(*ii*) Activation energy of a reaction

(*b*) The decomposition of phosphine, PH_3, proceeds according to the following equation:

$$4PH_3(g) \longrightarrow P_4(g) + 6H_2(g)$$

It is found that the reaction follows the following rate equation:

$$\text{Rate} = k[PH_3]$$

The half-life of PH_3 is 37.9 s at 120°C.

(*i*) How much time is required for $3/4^{th}$ of PH_3 to decompose?

(*ii*) What fraction of the original sample of PH_3 remains behind after 1 minute?

OR

(*a*) Explain the following terms:

(*i*) Order of a reaction

(*ii*) Molecularity of a reaction

(*b*) The rate of a reaction increases four times when the temperature changes from 300 K to 320 K. Calculate the energy of activation of reaction, assuming that it does not change with temperature. (R = 8.314 J K^{-1} mol^{-1})

29. (*a*) Complete the following chemical equations:

(*i*) $Cr_2O_7^{2-}(aq) + H_2S(g) + H^+(aq) \longrightarrow$

(*ii*) $Cu^{2+}(aq) + I^-(aq) \longrightarrow$

(*b*) How would you account for the following:

(*i*) The oxidising power of oxoanions are in the order $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.

(*ii*) The third ionization enthalpy of manganese (Z = 25) is exceptionally high.

(*iii*) Cr^{2+} is a stronger reducing agent than Fe^{2+}.

OR

(*a*) Complete the following chemical equations:

(*i*) $MnO_4^-(aq) + S_2O_3^{2-}(aq) + H_2O(l) \longrightarrow$

(*ii*) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \longrightarrow$

(*b*) Explain the following observations:

(*i*) La^{3+} (Z = 57) and Lu^{3+} (Z = 71) do not show any colour in solutions.

(*ii*) Among the divalent cations in the first series of transition elements, manganese exhibits the maximum paramagnetism.

(*iii*) Cu^+ ion is not known in aqueous solutions.

30. (*a*) Illustrate the following name reactions giving a chemical equation in each case:

(*i*) Clemmensen reaction

(*ii*) Cannizzaro's reaction

(*b*) Describe how the following conversions can be brought about:

(*i*) Cyclohexanol to cyclohexan-1-one

(*ii*) Ethylbenzene to benzoic acid

(*iii*) Bromobenzene to benzoic acid

OR

(*a*) Illustrate the following name reactions:

(*i*) Hell–Volhard–Zelinsky reaction

(*ii*) Wolff–Kishner reduction reaction

(*b*) How are the following conversions carried out:

(*i*) Ethylcyanide to ethanoic acid

(*ii*) Butan-1-ol to butanoic acid

(*iii*) Methylbenzene to benzoic acid

Write chemical equations for the involved reactions.

CBSE (All India) SET–II

Questions uncommon to Set–I

1. What type of semiconductor is obtained when silicon is doped with arsenic?

2. Nitrogen is relatively inert as compared to phosphorus. Why?

6. What are monosaccharides?

8. What is meant by ‘copolymerisation’?

13. Define the following:

(*i*) Peptization

(*ii*) Reversible sols

15. Complete the following chemical reaction equations:

(*i*) $NaOH + Cl_2 \longrightarrow$ (cold and dilute)

(*ii*) $XeF_6 + H_2O \longrightarrow$ (excess)

17. Give the chemical tests to distinguish between the following pairs of compounds:

(*i*) Methylamine and Dimethylamine

(*ii*) Aniline and N-methylaniline

18. Draw the structures of the monomers of the following polymers:

(*i*) Bakelite

(*ii*) Nylon-6

19. Silver crystalises in face-centred cubic unit cells. Each side of the unit cell has a length of 409 pm. What is the radius of silver atom?

20. What mass of ethylene glycol (molar mass = 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from 0°C to – 10.0°C? (K_f for water = 1.86 K kg mol^{-1})

27. What are analgesic drugs? How are they classified and when are they usually recommended for use?

CBSE (All India) SET–III

Questions uncommon to Set–I and Set–II

1. Write a distinguishing feature of metallic solids?

3. Differentiate between molarity and molality of a solution.

8. What are the products of hydrolysis of sucrose?

17. Silver crystallises in fcc lattice. If the edge length of the unit cell is 4.07×10^{-8} cm and the density of the crystal is 10.5 g cm^{-3}, calculate the atomic mass of silver. ($N_A = 6.02 \times 10^{23}$ atoms mol^{-1})

20. 15 g of an unknown molecular substance was dissolved in 450 g of water. The resulting solution freezes at – 0.34°C. What is the molar mass of the substance? (K_f for water = 1.86 K kg mol^{-1}).

22. How would you account for the following:

(*i*) The electron gain enthalpy with negative sign is less for oxygen than that for sulphur.

(*ii*) Phosphorus shows greater tendency for catenation than nitrogen.

(*iii*) Fluorine never acts as the central atom in polyatomic interhalogen compounds.

25. Write the name, the state of hybridization, the shape and the magnetic behaviour of the following complexes:

$[CoCl_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O)_2(C_2O_4)_2]^-$

(Atomic number: Co = 27, Ni = 28, Cr = 24)

26. Differentiate between fibrous proteins and globular proteins. What is meant by the denaturation of a protein?

27. Explain the following terms with an example for each:

(*i*) Antibiotics (*ii*) Antiseptics

(*iii*) Analgesics

Solutions

CBSE (All India) SET–I

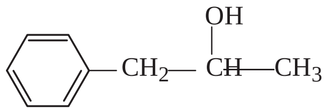
1. The interactions hold the molecules together in a polar molecular solid is dipole-dipole attractions.

2. When concentration of an electrolyte approaches zero, the molar conductivity is known as limiting molar conductivity (Λ_m^o).

3. Fluorine does not exhibit any positive oxidation state because it is the most electronegative element in the periodic table.

4. 4–Bromo–3–methyl–pent–2–ene

5.



6. Tollen's reagent – A solution of $AgNO_3$ dissolved in NH_4OH is known as Tollen's reagent. This is used to detect the presence of –CHO group in an organic compound. For example:

$$RCHO + 2Ag(NH_3)_2OH \longrightarrow RCOONH_4 + 2Ag\downarrow + H_2O + 3NH_3.$$

7. Reducing Sugars: The carbohydrates which reduces Fehling's Reagent and Tollen's Reagent are referred to as reducing sugar. For example, all monosaccharide are reducing sugars.

8. Each monomer of nylon 6, 6 consists of six carbon each.

9. **Osmosis:** The phenomenon in which solvent molecules flow through a semipermeable membrane from a solution of low concentration to a solution of higher concentration is termed as osmosis.

Osmotic Pressure: The hydrostatic pressure exerted by the column of the solution which is just sufficient to prevent the osmosis is called osmotic pressure.

Advantage of using osmotic pressure as compared to other collegative properties:

(*i*) The equilibrium is established very quickly. Hence, results are obtained in a very short time.

(*ii*) The concentration of the solution does not change during determination of osmotic pressure.

(*iii*) This is ideal method for proteins to find their molar mass since it happens at room temperature and no coagulation occurs.

10. $$\text{Conductivity } (K) = \frac{1}{\text{Resistance } (R)} \times \text{Cell constant}$$

$$\text{Molar Conductivity } (\Lambda_m) = \frac{\text{Conductivity } (\kappa) \times 1000}{\text{Molarity } (M)}$$

OR

$$\Lambda_m = \frac{K \times 1000}{M} = \frac{\Lambda_m \times M}{1000}$$

$$K = \frac{138.95\ \text{cm}^2\ \text{mol}^{-1} \times 1.5\ \text{mol L}^{-1}}{1000\ \text{cm}^3\ \text{L}^{-1}} = 0.208355\ \text{cm}^{-1}$$

11. Increasing order of reducing power:

Ag < Cu < Fe < Cr < Mg < K

OR

(*i*) $MnO_4^- + 8H^+ + S\bar{e} \longrightarrow Mn^{2+} + 4H_2O,\ \Delta E° = +1.51V$ (Reduction)

(*ii*) $Sn^{2+} \longrightarrow Sn^{4+} + 2\bar{e},\ E° = 0.15V$

Multiplying equation (*i*) by 2 and (*ii*) by 5 we get:

$$Sn^{2+} + 2MnO_4^- + 16H^+ \longrightarrow 5\ Sn^{4+} + 8H_2O + 2Mn^{2+}$$

$$E^\circ_{cell} = E^\circ_R - E^\circ_L$$

$$= 1.51 - 0.15 = 1.36\ V$$

Since E°_{cell} is positive, therefore it will favour product formation.

12. **(*i*) Tyndall effect:** Tyndall (1869) observed that when a beam of light is passed through a colloidal solution whose particle size is comparable to the wave length of light, the path of the **beam** is illuminated. This phenomenon is called Tyndall effect.

(*ii*) Shape Selective Catalyst: The catalysis reaction which depends upon the pore size of the catalyst and the size of the reactant and product molecules is called shape-selective catalysis. Zeolites are good shape-selective catalysts because of their honey comb-like structures. ZSM-5 used in petroleum industry to convert alcohols directly into gasoline by dehydrating them to give a mixture of hydrocarbons.

$$x\ CH_3 - OH \xrightarrow{\text{ZSM-5}} \underset{\text{Gasoline}}{(CH_2)_x} + xH_2O$$

13. The colloidal particles bear similar electric charge and that is why they stay away from each other due to repulsion. If the charge is removed, they come together and are precipitated.

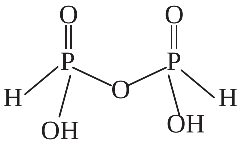
The precipitation and settling down of the discharged particles is called coagulation or flocculation.

The coagulation of a **lyophobic** sols can be done by mixing of two opposite charged sols or by addition of electrolyte.

14. (*i*) $I_2 + 10HNO_3 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$

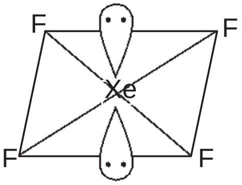
(*ii*) $3HgCl_2 + 2PH_3 \longrightarrow Hg_3P_2 + 6HCl$

15. (*i*)



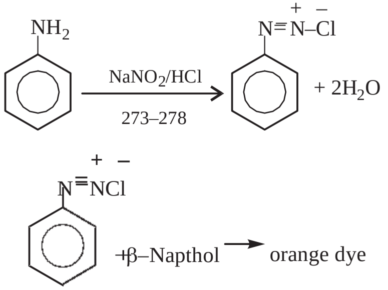
$H_4P_2O_5$

(*ii*)

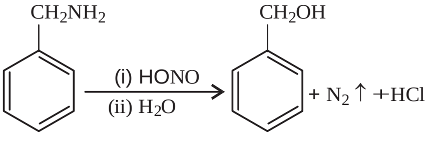


Xe F_4 (Square planar)

16. (*i*) To distinguish Ethylamine and aniline.

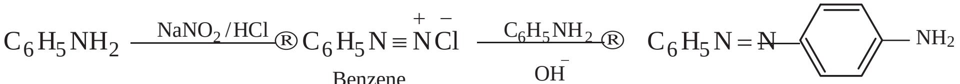
Chemical Test	$C_2H_5NH_2$	$C_6H_5NH_2$
Azo dye Test: Add $NaNO_2$ + dil. HCl at 273 - 278K followed by NaOH and β-naphthol	No reaction	Yellow orange dye is obtained. 

(*ii*) Aniline and Benzyl amine

Chemical Test	Aniline	Benzyl amine
Test: Add nitrous acid ($NaNO_2$/HCl) to both the samples.	No evolution of N_2 gas	N_2 gas is evolved 

17. (*i*) $CH_3CH_2Cl \xrightarrow{NaCN} \underset{\substack{\text{Ethyl cyanide} \\ (A)}}{CH_3CH_2CN} \xrightarrow[Ni/H_2]{\text{reduction}} \underset{\substack{\text{n-Propyl amine} \\ (B)}}{CH_3CH_2CH_2NH_2}$

(*ii*)

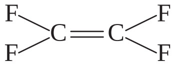


Benzene
diazonium chloride
(A)

p-Amino-azobenzene
(B)

18. (*i*) PVC — structure of monomer: $CH_2 = CH - Cl$ (vinylchloride)

(*ii*) Teflon — structure of monomer:



(Tetrafluoroethylene)

19. Given, Radius (r) = 127.8 pm

For fcc $a = 2\sqrt{2}\,r$

$\therefore \quad a^3 = (2\sqrt{2}r)^3 = 4.723 \times 10^{-23}\ \text{cm}^3$

Atomic mass of Cu = 63.54 g mol^{-1}

$N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$

Density = 8.95 g cm^{-3}

$$d = \frac{Z \times M}{N_A \times a^3}$$

$$\Rightarrow \quad 8.95 = \frac{Z \times 63.54}{6.023 \times 10^{23} \times 4.723 \times 10^{-23}}$$

$$\therefore \quad Z = \frac{8.95 \times 6.022 \times 4.723}{63.54} \quad \Rightarrow \quad Z = 4.00$$

Thus copper has fcc structure.

20. Given: $M_B = 58.5\ \text{g mol}^{-1}$

$W_A = 65\text{g}, \quad W_B = ?$

$\Delta T_f = 7.5°\text{C}$ or 7.5 K,

$K_f = 1.86\ \text{K kg mol}^{-1}$

$i = 1.87$

We know that,

$$\Delta T_f = i\,K_f \times \frac{W_B}{M_B} \times \frac{1000}{W_A}$$

$$7.5 = 1.87 \times 1.86 \times \frac{W_B}{58.5} \times \frac{1000}{65}$$

$$\therefore \quad W_B = \frac{7.5 \times 58.5 \times 65}{1.87 \times 1.86 \times 1000}$$

$$W_B = \frac{28518.75}{3478.2}$$

$$W_B = 8.199\ \text{g.}$$

21. **(*i*) NaCN is used in the leaching of argentite (Ag_2S).** Argentite is leached with dilute aqueous solution of NaCN in the presence of air

$$Ag_2S + 4NaCN \longrightarrow 2\,Na\,[Ag\,(CN)_2] + Na_2S.$$

(*ii*) Iodine in the refining of titanium.

The crude metal is heated with iodine in an evacuated vessel to form volatile compound.

$$Ti\,(\text{impure}) + 2I_2 \longrightarrow TiI_4$$

Metal iodide decomposes on heating at 1800°C on a **tungston** filament. The pure metal deposit on the filament.

$$TiI_4 \xrightarrow{1800°C} Ti(\text{pure}) + 2I_2$$

(*iii*) Cryolite in the metallurgy of aluminium: In the metallurgy of Al, purified Al_2O_3 is mixed with cryolite (Na_3AlF_6) which lowers the melting point of the mixture and increase the conductivity.

OR

(*i*) Froth floatation method: This method is used to remove gangue from sulphide ores. In this process a suspension of the powdered ore is made with water, some pine oil (collector) and stablisers are added. A rotating paddle agitates the mixture and draws air in it. The froth is light and it skimmed off.

(*ii*) Electro refining of metals: In this method, the impure metal is made to act as anode. A strip of the same metal in pure form is used a cathode. They are put in a suitable electrolyte containing soluble salt of the same metal.

Anode: $M \longrightarrow M^{n+} + ne^-$

Cathode: $M^{n+} + ne^- \longrightarrow M\ (\text{pure metal})$

Sb, Ag, Au, Pt, Cu, Zn may be refined by this process.

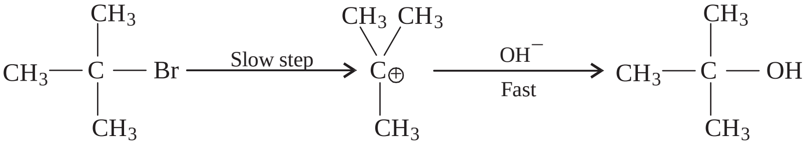
(*iii*) Zone refining: This method is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal. A circular mobile heater is fixed at one end of a rod of the impure metal. The molten zone moves along with the heater. The pure metal crystallises out of the melt and impurities pass on into the adjacent molten zone.

22. (*i*) Nickel does not form low spin octahedral complexes because 'Ni' has electronic configuration $3d^8\ 4s^2$, in which two inner *d*-orbitals are not available which are required to form d^2sp^3 hybridization.

(*ii*) The π-complexes are known for the transition metals only because they have 'sandwich' structure in which the metal ion lies between two planar C_5H_5 rings. The bonding involves overlap of π-electrons of the C_5H_5 rings with unfilled d-orbital of the metal. So that all M–C bonds are identical for their stability.

(*iii*) Co^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand because in presence of strong ligand, the 3d electrons pair up leaving two orbitals empty to be involved in d^2sp^3 hybridisation.

23. S_N1 Reactions: They are substitution nucleophilic unimolecular reactions in which the rate of the reaction depends on the concentration of only one reactant. Product formation takes place by the formation of carbo cation as reaction intermediate. For example:



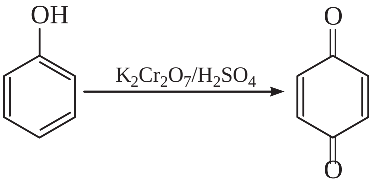
S_N2 reactions they are substitution nucleophilic bimolecular reactions in which rate of the reaction depends on the concentration of two reactants. For example:

$R - Cl \xrightarrow{OH^-} R -$

$OH + Cl^- Rate \propto [R - Cl][OH^-]$

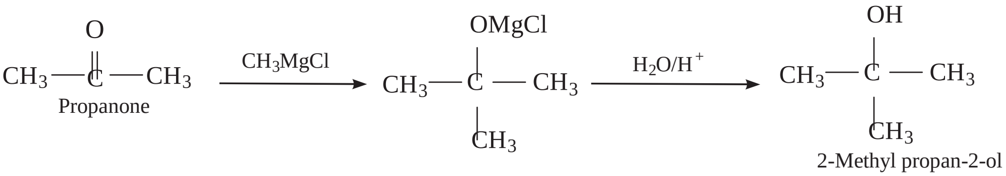
The product formation takes place by formation of transition state.

24. (*i*)



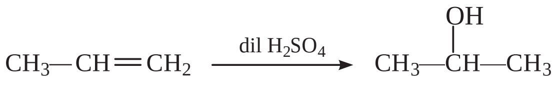
Phenol p-Benzoquinone

(*ii*)



Propanone 2-Methyl propan-2-ol

(*iii*)



$$CH_3-CH{=}CH_2 \xrightarrow{\text{dil } H_2SO_4} CH_3-\overset{OH}{\overset{|}{C}H}-CH_3$$

Propene Propan-2-ol

25. (*i*) This is because of (*a*) bond dissociation enthalpy of F_2 is lower than Cl_2 and (*b*) fluorine forms stronger bond with nitrogen due to comparable size.

(*ii*) As xenon is sp^3 hybridised with three lone pair of electrons.

(*iii*) This is due to (*a*) low bond dissociation enthalpy of F_2 and (*b*) high hydration enthalpy of F^-.

26. This is due to presence of carboxylic acid as well as amino groups.

- Amino acids which contain two $-\overset{O}{\overset{\|}{C}}-O-H$ group and one $-NH_2$ group are called acidic amino acid, *e.g.*, aspartic acid.

- Amino acids which contain two $—NH_2$ group and one $—\overset{\overset{\displaystyle O}{\|}}{C}—O—H$ group are called basic amino acids, *e.g.*, lysine.
- Amino acids which contain one $—\overset{\overset{\displaystyle O}{\|}}{C}—O—H$ and one $—NH_2$ group are called neutral amino acids, *e.g.*, glycine.
- Amino acids that cannot be synthesized by the body and must be supplied in the diet are called essential amino acids, *e.g.*, lysine, valine, leucine, etc.
- The amino acids which are synthesized by our body are called non-essential amino acids, *e.g.*, alanine, glycine, etc.

27. (*i*) **Food preservatives:** Chemical substance which are used to prevent food spoilage due to microbial growth are called preservative. For example, sodium benzoate, potassium sorbate, etc.

(*ii*) **Enzymes:** Enzymes are the essential biological catalysts which catalyse specific biological reactions at a very high rate under mild conditions of temperature and pH. For example, invertase, zymase etc.

(*iii*) **Detergents:** They are very similar to the salts of fatty acids found in soap but they are manufactured from materials other than animal fats. For example: Sodium alkylbenzene sulphonates are common ingredients of synthetic detergents.

28. (*a*) (*i*) **Rate of Reaction:** It is defined as the decrease in the concentration of reactants per unit time or increase in the concentration of products per unit time.

For a hypothetical reaction R ® P

$$\text{Rate} = \frac{-\Delta[\text{R}]}{\Delta t} \quad \text{Rate} = \frac{+\Delta[\text{P}]}{\Delta t}$$

(*ii*) **Activation energy:** The amount of energy which the reactants must absorb to pass over the energy barrier between reactants and products is known as the activation energy.

(*b*) (*i*) We know that $k = \frac{2.303}{t} \log \frac{[A]_0}{[A]t}$

$$t_{1/2} = \frac{0.693}{k}$$

$$\therefore \quad k = \frac{0.693}{t_{1/2}}$$

$$\therefore \quad k = \frac{0.693}{37.9}$$

$$\therefore \quad k = 0.0183 \text{ s}^{-1}$$

$$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

$$\therefore \quad t = \frac{2.303}{0.0183} \log \frac{1}{1/4}$$

$$= \frac{2.303}{0.0183} \log 2^2 = \frac{2 \times 2.303}{0.0183} \log 2$$

$$t = \frac{2 \times 2.303}{0.0183} \times 0.3010$$

$$t = 75.8 \text{ s.}$$

(*ii*) 1 minute = 60 second

$$t = \frac{2.303}{k} \log \frac{[A]_o}{[A]}$$

$$60 = \frac{2.303}{0.0183} \times \log \frac{[A]_o}{[A]}$$

$$\frac{60 \times 0.0183}{2.303} = \log \frac{[A]_o}{[A]}$$

Taking antilog,

$$0.4767 = \log \frac{[A]_o}{[A]}$$

$$\text{Antilog } (0.4767) = \frac{[A]_o}{[A]}$$

$$2.997 = \frac{[A]_o}{[A]}$$

$$\frac{[A]}{[A]_o} = \frac{1}{2.997} = 0.333 = 0.333\%$$

Hence, amount left out = 33.3%

OR

(*a*) (*i*) The order of a reaction can be defined as the sum of the powers of the concentration terms as expressed in rate law.

(*ii*) **Molecularity:** It may be defined as the number of reacting species (molecules, atoms or ions) taking part in an elementary reaction, which must collide simultaneously in order to bring about a chemical reaction.

(*b*) (*i*) Given $T_1 = 300 \text{ K}$

$T_2 = 320 \text{ K}$

$R = 8.134 \text{ JK}^{-1} \text{ mol}^{-1}$

$E_a = ?$

We know that, $$E_a = 2.303 \text{ R} \left[\frac{T_1 T_2}{T_2 - T_1}\right] \log \frac{k_2}{k_1}$$

$$E_a = 2.303 \times 8.314 \left[\frac{300 \times 320}{20}\right] \log 4$$

$$E_a = 19.15 \,[4800] \times 0.602$$

$$= 55.32 \text{ kJ mol}^{-1}.$$

29. (*a*) (*i*) $Cr_2O_7^{2-} + 3H_2S + 8H^+ \longrightarrow 2Cr^{3+} + 3S + 7H_2O$

(*ii*) $2Cu^{2+} + 4I^- \longrightarrow Cu_2I_2 + I_2$

(*b*) (*i*) The oxidising power of oxonions are in the order $VO_2^{+} < Cr_2O_7^{2-} < MnO_4^{-}$, this is due to increase in the oxidation state of the metal ion.

(*ii*) The third ionisation enthalpy of manganese (Z = 25) is exceptionally high because Mn^{2+} ion has $3d^5$ configuration which is highly stable since it is half-filled.

(*iii*) Cr^{2+} stronger reducing agent than Fe^{2+} as its configuration changes from d^4 to d^3, a more stable half filled t_{2g} configuration.

OR

(*a*) (*i*) $8MnO_4(aq)^{2} + 3S_2O_3^{-}(aq) + H_2O \longrightarrow 8MnO_2^{3}$

$+ 6SO_4^{-} + 2OH^{-}$(*ii*) .

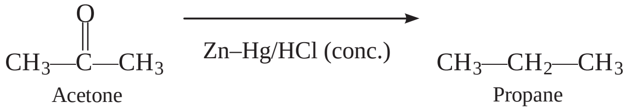
$$Cr_2O_7(aq) + 6Fe^{2+}(aq) + 14H^{+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

(*b*) (*i*) La^{3+} and Lu^{3+} ions do not show any colour in solution because they do not contain any unpaired electrons.

(*ii*) Among the divalent cations in the first series of transition elements, manganese exhibits the maximum paramagnetism because manganese (Mn^{2+}) ion has maximum number of 5 unpaired electrons.

(*iii*) Cu^{+} ion is not known in aqueous solutions because Cu^{2+} ions are more stable due to more negative ΔH_{hyd} of Cu^{2+} than Cu^{+}, which compensates for the second ionisation enthalpy of Cu.

30. (***a***) (***i***) **Clemmensen reaction**

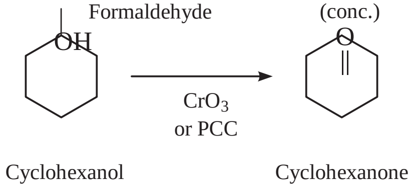


$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow[\text{}]{\text{Zn–Hg/HCl (conc.)}} CH_3-CH_2-CH_3$$

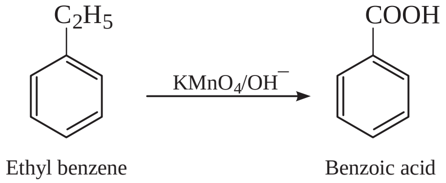
(***ii***) **Cannizzaro's reaction:**

$$\underset{\text{Formaldehyde}}{2HCHO} + \underset{\text{(conc.)}}{NaOH} \longrightarrow \underset{\text{Sodium formate}}{HCOONa} + \underset{\text{Methanol}}{CH_3OH}$$

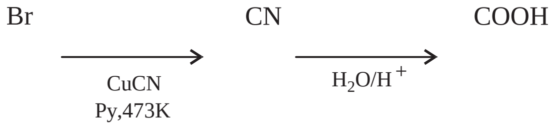
(***b***) (***i***)

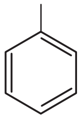


(***ii***)

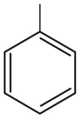


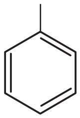
(***iii***)





Bromobenzene

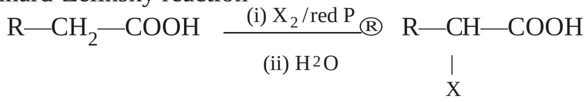




Benzoic acid

OR

(*a*) (*i*) Hell-Volhard-Zelinsky reaction



$$\underset{\text{Carboxylic acid}}{R\text{—}CH_2\text{—}COOH} \xrightarrow[\text{(ii) } H_2O]{\text{(i) } X_2/\text{red P}} \underset{\alpha\text{–Halocarboxylic acid}}{R\text{—}\underset{|\atop X}{CH}\text{—}COOH} \qquad (X = Cl, Br)$$

(*ii*) Wolf-Kishner reduction

$$\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow[\text{(ii) KOH, Ethylene glycol, }\Delta]{\text{(i) } NH_2-NH_2} \underset{\text{Propane}}{CH_3CH_2CH_3}$$

(*b*) (*i*)

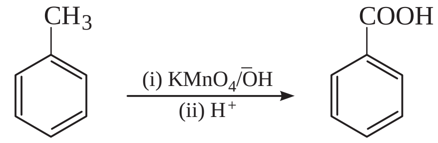
$$\underset{\text{Ethyl cyanide}}{C_2H_5CN} \xrightarrow{H^+} C_2H_5COOH \xrightarrow[\Delta]{NaOH/CaO} C_2H_6 \xrightarrow{Cl_2/hv} C_2H_5Cl$$

$$\underset{\text{Ethanoic acid}}{CH_3COOH} \xleftarrow{H_2O/H^+} CH_3CN \xleftarrow{\text{alc. KCN}}$$

(*ii*)

$$\underset{\text{Butan-l-ol}}{CH_3\text{—}CH_2\text{—}CH_2\text{—}CH_2\text{—}OH} \xrightarrow[{[O]}]{KMnO_4} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$$

(*iii*)



Methyl benzene Benzoic acid

CBSE (All India) SET–II

1. *n*-type semiconductor.

2. Due to presence of triple bond whose dissociation energy is very high.

6. They are the simplest carbohydrates which do not undergo further hydrolysis, for example: glucose.

13. **(*i*) Peptization:** The process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of a suitable electrolyte.

(*ii*) Reversible sols: These are the sols in which dispersion medium can be separated from dispersed phase and reconstituted easily.

15. (*i*) $2NaOH + Cl_2 \longrightarrow NaCl + NaOCl + H_2O$

(*ii*) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

17. (*i*) To distinguish CH_3NH_2 and $CH_3–NH–CH_3$

Reaction with HONO

CH_3NH_2 gives methyl alcohol and N_2 gas.

$$CH_3NH_2 + HONO \xrightarrow{4°C} CH_3OH + N_2 + H_2O$$

Dimethyl amine forms nitroso amine which is water insoluble yellow oil.

$$(CH_3)_2\,NH + HONO \;\text{——®}\; (CH_3)_2\,N-N=O + H_2O$$

N-Nitroso
dimethyl amine
(yellow oil)

(*iii*) Aniline and N-methyl aniline

Test: Carbyl amine test:

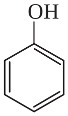
Aniline on warming with chloroform and **KOH** gives offensive smell of **carbylamine** while N-methyl aniline does not.

$$\underset{\text{Aniline}}{C_6H_5NH_2} + CHCl_3 + 3KOH \;\text{——®}\; \underset{\text{Phenyl carbylamine}}{C_6H_5NC} + 3KCl + 3H_2O$$

18. **(*i*)** **Bakelite**

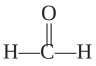
Monomers: Phenol and formaldehyde

Structure:



Phenol

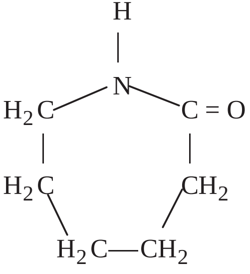
and



Formaldehyde

(*ii*) Nylon–6

Monomers: Caprolactum



Caprolactum

19. Atomic mass (M) = 108 g mol^{-1}, a = 409 pm

We know that for fcc lattice:

$$r = \frac{a}{2\sqrt{2}}$$

$$\therefore \qquad r = \frac{409}{2 \times 1.414} = \frac{409}{2.828}$$

$$r = 144.62 \text{ pm}$$

20. M_B = 62.0 g mol^{-1} , W_A = 5.50 kg or 5500 g

K_f = 1.86 K kg mol^{-1}, ΔT_f = 10 K

We know that,

$$\Delta T_f = K_f \times \frac{W_B}{M_B} \times \frac{1000}{W_A}$$

$$10 = 1.86 \times \frac{W_B}{62} \times \frac{1000}{5500}$$

$$W_B = \frac{62 \times 5500 \times 10}{1000 \times 1.86}$$

$$\therefore \qquad W_B = \frac{3410000}{1860} = 1833.3 \text{ g}$$

27. **Analgesics:** They are the drugs used for relieving pain. Analgesics are classified into two categories:

(*a*) Narcotics (addictive) drugs (*b*) Non-narcotics (non-addictive) drugs

(***a***) **Narcotics:** Narcotic drugs are recommended for cardiac pain, post operative pains, terminal cancer and in child birth.

(***b***) **Non-narcotics:** Non-narcotic drugs are effective in relieving skeletal pain, reducing fever, preventing heart attack.

CBSE (All India) SET–III

1. Metallic solids have high melting and boiling points.

3. Molality of a solution does not change on changing the temperature of the solution while molarity does change.

8. $$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + \underset{\text{(Fructose)}}{C_6H_{12}O_6}$$

19. For *fcc*, Z = 4

$a = 4.07 \times 10^{-8}$ cm, d = 10.5 g cm^{-3}, M = atomic mass = ?, $N_A = 6.02 \times 10^{23}$

We know that,

$$d = \frac{Z \times M}{N_A \times a^3} \qquad \Rightarrow \qquad M = \frac{d \times N_A \times a^3}{Z}$$

$$\therefore \qquad M = \frac{10.5 \times 6.022 \times 10^{23} \times (4.07 \times 10^{-8})^3}{4}$$

$$M = 106.5 \text{ g mol}^{-1}$$

20. Given: $W_B = 15$ g, $W_A = 450$ g

$\Delta T_f = [273 - (273 - 0.34)]\text{K} = 0.34$ K

$M_B = ?$, $K_f = 1.86$ K kg mol^{-1}

$$\Rightarrow \qquad M_B = K_f \times \frac{W_B \times 1000}{\Delta T_f \times W_A}$$

$$= 1.86 \text{ K kg mol}^{-1} \times \frac{15 \text{ g} \times 1000}{0.34 \text{ K} \times 450 \text{ kg}} = 182.3 \text{ g mol}^{-1}$$

22. (*i*) This is due to smaller size of oxygen the electron cloud is distributed over a small region of space, making electron density high which repels the incoming electrons.

(*ii*) Because P—P bond is stronger than N—N bond.

(*iii*) Fluorine never acts as the central atom in polyatomic inter-halogen compounds since it is the most electronegative element of the group.

25. (*i*) Tetrachloridocobaltate (II) ion
sp^3 hybridisation
Tetrahedral
Paramagnetic

(*ii*) Tetracyanonickelate (II) ion
dsp^2 hybridisation
Square plannar
Diamagnetic.

(*iii*) Diaquadioxalatochromate (III) ion
d^2sp^3 hybridisation
Octahedral
Paramagnetic.

26.

Fibrous Proteins	**Globular Proteins**
1. Consist of linear thread-like molecules which tend to lie side by side to form fibre like structure.	1. Polypeptide chain is folded, around itself forming almost spheroidal shape.
2. Insoluble in water.	2. Soluble in water.
3. Keratin in hair, fibroin in silk, etc.	3. Albumin in eggs, insulin, etc.

Denaturation of Proteins

When a protein in its native form, is subjected to a change in temperature or change in pH, the hydrogen bond are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation 2° and 3° structures are destroyed but 1° structures remain intact, *e.g.*, coagulation of egg white on boiling, curdling of milk, etc.

27. **(*i*) Antibiotics**

The chemical substances produced from some micro-organism and are used to inhibit the growth of other microorganism or even kill them are called antibiotics. For example, penicillin, chloramphenicol.

(*ii*) Antiseptics

Antiseptics are the chemicals which prevent or destroy the growth of the harmful microorganism. For example: Savlon, dettol.

(*iii*) Analgesics

These are the substances which are used to get relief from pain. For example: Aspirin.

CBSE EXAMINATION PAPERS

FOREIGN–2010

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (Foreign) SET–I

1. What is the number of atoms in a unit cell of a simple cubic crystal?

2. Identify the order of reaction from the following unit for its rate constant:

$L\ mol^{-1}s^{-1}$

3. Give an example of shape-selective catalyst.

4. Which is a stronger acid in aqueous solution—HCl or HI, and why?

5. What is an ambidentate ligand? Give an example.

6. Draw the structure of the following compound:

4-Bromo-3-methylpent-2-ene

7. Give IUPAC name of the following compound:

$(CH_3)_2C{=}CHCOCH_3$

8. What happens when glucose is treated with bromine water?

9. Write the anode and cathode reactions occurring in a commonly used mercury cell. How is the overall reaction represented?

10. Define:

(*i*) Elementary reaction in a process

(*ii*) Rate of a reaction.

11. The rate constant for a zero order reaction is 0.0030 mol L^{-1} s^{-1}. How long will it take for the initial concentration of the reactant to fall from 0.10 M to 0.075 M?

12. Draw the structures of the following molecules:

(*i*) BrF_3 (*ii*) $XeOF_4$

13. Describe the preparation of

(*i*) Potassium dichromate from sodium chromate, and

(*ii*) $KMnO_4$ from K_2MnO_4

14. Describe the state of hybridization, the shape and the magnetic behaviour of the following complexes:

(*i*) $[Cr(H_2O)_2(C_2O_4)_2]^-$

(*ii*) $[Co(NH_3)_2(en)_2]^{3+}$, (en = ethane-1,2-diamine)

(At. Nos : Cr = 24, Co = 27)

OR

Explain the following terms:

(*i*) Crystal field splitting in an octahedral field

(*ii*) Spectrochemical series.

15. Write the mechanisms of the following reactions:

(*i*) Hydration of ethene to ethanol

(*ii*) Dehydration of ethanol, giving ethene.

16. Illustrate the following name reactions giving chemical equations:

(*i*) Reimer-Tiemann reaction

(*ii*) Williamson synthesis.

17. Explain the following giving a reason in each case:

(*i*) Why is an alkylamine more basic than ammonia?

(*ii*) Why do primary amines have higher boiling points than the tertiary amines?

18. Complete the following reaction equations:

(*i*) $C_6H_5NH_2 + CHCl_3 + KOH\ (alc)$ ——®

(*ii*) $C_6H_5N_2\,Cl + H_3PO_2 + H_2O$ ——®

19. Iron has a body-centred cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Avogadro's number. (At. mass of iron = 56 g mol^{-1})

20. One half-cell in a voltaic cell is constructed from a silver wire dipped in silver nitrate solution of unknown concentration. The other half-cell consists of a zinc electrode in a 0.10 M solution of Zn $(NO_3)_2$. A voltage of 1.48 V is measured for this cell. Use this information to calculate the concentration of silver nitrate solution.

(Given $E^{\circ}_{Zn^{2+}/Zn} = -0.763$ V, $E^{\circ}_{Ag^{2+}/Ag} = +0.80$ V)

21. What is the difference between multimolecular and macromolecular colloids? Give one example of each type. How are associated colloids different from the above two types of colloids?

22. Explain the following observations:

(*i*) The enthalpies of atomisation of transition metals are quite high.

(*ii*) There is a close similarity in physical and chemical properties of the 4 d and 5 d series of the transition elements, much more than expected on the basis of usual family relationship.

(*iii*) The members in the actinoid series exhibit larger number of oxidation states than the corresponding members in the lanthanoid series.

23. Answer the following:

(*i*) Identify chiral in $CH_3CHOHCH_2CH_3$ and $CH_3CHOHCH_3$.

(*ii*) Among the following compounds, which one is more easily hydrolysed and why?

$CH_3CHClCH_2CH_3$ or $CH_3CH_2CH_2CH_2Cl$

(*iii*) Which of these will react faster in S_N^2 displacement and why?

1-bromopentane or 2-bromopentane

24. Describe how the following changes are brought about:

(*i*) Pig iron into steel (*ii*) Bauxite into pure alumina

(*iii*) Impure copper into pure copper.

25. Explain the meanings of the following terms:

(*i*) Invert sugar (*ii*) Peptide linkage

(*iii*) Denaturation of proteins.

OR

Mention three such facts/reactions about glucose which cannot be explained by its open end structure. What is meant by pyranose structure of glucose?

26. Identify the four groups into which the polymers are classified on the basis of the magnitude of intermolecular forces present in them. To which group or groups do polythene and bakelite belong?

27. How do antiseptics differ from disinfectants? Name a substance that can be used as an antiseptic as well as a disinfectant.

28. (*a*) Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and how are they caused?

(*b*) What mass of NaCl (molar mass = 58.5 g mol^{-1}) must be dissolved in 65g of water to lower the freezing point by 7.50°C? The freezing point depression constant, K_f for water is 1.86 K kg mol^{-1}. Assume van't Hoff factor for NaCl is 1.87.

OR

(*a*) Define the terms osmosis and osmotic pressure. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solution?

(*b*) A solution prepared from 1.25 g of oil of wintergreen (methyl salicylate) in 99.0 g of benzene has a boiling point of 80.31°C. Determine the molar mass of this compound. (Boiling point of pure benzene = 80.10°C and K_b for benzene = 2.53°C kg mol^{-1}).

29. (*a*) Complete the following chemical reaction equations:

(*i*) $HgCl_2(aq) + PH_3(g) \longrightarrow$

(*ii*) $SiO_2(s) + HF(g) \longrightarrow$

(*b*) Explain the following observations:

(*i*) Sulphur in vapour state exhibits paramagnetic behaviour.

(*ii*) The stability of +3 state increases down the group in group 15 of the periodic table.

(*iii*) XeF_2 has a linear shape and not a bent structure.

OR

(*a*) Complete the following chemical reaction equations:

(*i*) AgCl(*s*) + NH_3(*aq*) ——®

(*ii*) P_4(*s*) + NaOH(*aq*) + H_2O(*l*)

——® (*b*) Explain the following observations:

(*i*) H_2S is less acidic than H_2Te

(*ii*) Fluorine is a stronger oxidising agent than chlorine

(*iii*) Noble gases are the least reactive elements.

30. (*a*) How will you prepare the following compounds starting with benzene?

(*i*) Benzaldehyde

(*ii*) Acetophenone.

(*b*) Give chemical tests to distinguish between the following pairs of compounds:

(*i*) Ethanal and Propanal

(*ii*) Benzaldehyde and Acetophenone

(*iii*) Phenol and Benzoic acid.

OR

(*a*) Explain the mechanism of nucleophilic attack on a carbonyl group of an aldehyde or a ketone.

(*b*) How would you bring about the following conversions?

(*i*) Propanone to Propene

(*ii*) Ethanol to 3-hydroxybutanal

(*iii*) Benzaldehyde to Benzophenone.

CBSE (Foreign) SET–II

Questions uncommon to Set I

1. State a feature to distinguish a metallic solid from an ionic solid.

2. Which one of these compounds is more easily hydrolysed by KOH solution and why?

CH_3 $CHCICH_2CH_3$ Or $CH_3CH_2CH_2CH_2Cl$

9. Draw the structures of O_3 and S_8 molecules.

14. How are the following conversions carried out?

(*i*) Propene to Propan-2-ol

(*ii*) Ethyl magnesium chloride to Propan-1-ol

19. Silver crystallises in a fcc lattice. If the edge length of the unit cell is 4.07×10^{-8} cm and density of silver is 10.5g cm^{-3}, calculate the atomic mass of silver. (NA = 6.02×10^{23} atoms mol^{-1})

20. A copper-silver cell is set up. The copper ion concentration is 0.10 M. The concentration of silver ions is not known. The cell potential was found to be 0.422 V. Determine the concentration of silver ions in the cell.

(Given $E^\circ_{Ag^+/Ag} = +0.80\,V, \quad E^\circ_{Cu^{2+}/Cu} = +0.34\,V$)

21. State what is observed when

(*i*) an electrolyte NaCl, is added to hydrated ferric oxide sol.

(*ii*) an electric current is passed through a colloidal solution.

(*iii*) a beam of light is passed through a colloidal solution.

26. What are biodegradable and non-biodegradable detergents? Give one example of each. Is there any structural difference between the two?

27. Write the structure of the monomer of each of the following polymers:

(*i*) Polyvinyl chloride

(*ii*) Teflon

(*iii*) Bakelite.

CBSE (Foreign) SET–III

Questions uncommon to Set I and Set II

2. Identify the order of reaction for which the rate constant is expressed in units of L^{-1} mol s^{-1}.

3. What is meant by 'reversible sols'?

4. Give an example of coordination isomerism.

8. What happens when glucose reacts with nitric acid?

12. Draw the structure of the following molecules:

(*i*) XeF_2

(*ii*) $HClO_4$

16. Illustrate the following name reactions giving a chemical reaction equation for each:

(*i*) Kolbe's reaction of phenol

(*ii*) Friedel-Crafts' acetylation of anisole.

19. The well-known mineral fluorite is calcium fluoride. It is known that in the unit cell of this mineral there are 4 Ca^{2+} ions and $8F^{-}$ ions and the Ca^{2+} ions are arranged in a face-centred cubic lattice. The F^{-} ions fill all the tetrahedral holes in the fcc lattice of Ca^{2+} ions. The edge of the unit cell is 5.46×10^{-8} cm in length. The density of the mineral is 3.18g cm^{-3}. Use this information to calculate Avogadro's number. (Molar mass of CaF_2 = 78.08 g mol^{-1})

20. A voltaic cell is set up at 25°C with the following half-cells, Al^{3+} (0.0010 M) and Ni^{2+} (0.50 M). Write an equation for the reaction that occurs in the cell when the cell generates an electric current and determine the cell potential.

(Given $E^{\circ}_{Ni^{2+}/Ni} = -0.25V$, $E^{\circ}_{Al^{3+}/Al} = -1.66V$)

21. Write three features of chemisorption which are not found in physisorptions. Illustrate your answer with suitable examples.

22. Explain the following:

(*i*) The transition elements have great tendency for complex formation.

(*ii*) There is a gradual decrease in the atomic sizes of transition elements in a series with increasing atomic numbers.

(*iii*) Lanthanum and Lutetium do not show colouration in solutions. (At. No.: La = 57, Lu = 71)

Solutions

CBSE (Foreign) SET–I

1. One atom.

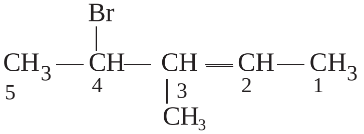
2. Second order

3. ZSM–5

4. HI is stronger acid then HCl because dissociation energy of H–I bond is less than that of H–Cl.

5. An ambidentate ligand is one which can link through either of the two donor atoms to the central metal ion. For example: NO_2^- and $\overline{O}NO$, $C\overline{N}$ and $N\overline{C}$.

6.



$$\underset{5}{CH_3}-\underset{4}{\overset{\overset{Br}{|}}{CH}}-\underset{\underset{CH_3}{|\,3}}{CH}=\underset{2}{CH}-\underset{1}{CH_3}$$

7. 4-Methyl-pent-3-en-2-one

8. When glucose is treated with bromine water it forms gluconic acid.

$$HOCH_2-(CHOH)_4-CHO \xrightarrow{Br_2/H_2O} \underset{\text{Gluconic acid}}{HOCH_2-(CHOH)_4-COOH}$$

9. Chemical reactions of mercury cell

Anode: $Zn(s)+2OH^- \longrightarrow ZnO(s) + H_2O+2e^-$

Cathode: $HgO+H_2O+2e^- \longrightarrow Hg(l)+2OH^-$

The overall reaction is represented by

$$Zn(s)+HgO(s) \longrightarrow ZnO(s) + Hg(l)$$

10. (*i*) Some reactions occur by a series of elementary steps and such simple steps are known as elementary reactions in a process.

(*ii*) **Rate of a reaction:** The change in the concentration of reactants products of or per unit time is called rate of the reaction.

$$\text{Rate} = \frac{-\Delta[R]}{\Delta t} \text{ or } + \frac{\Delta[P]}{\Delta t}$$

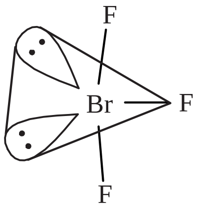
11. **Given:** $[R_o] = 0.10$ M $\qquad [R] = 0.075$ M

$k = 0.0030$ mol L^{-1} s^{-1}, $t = ?$

We know that $\quad k = \dfrac{[R_o]-[R]}{t}$

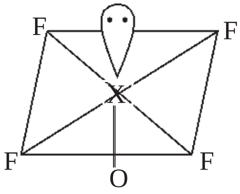
or $\quad t = \dfrac{[R_o]-[R]}{k} = \dfrac{0.10-0.075}{0.0030} = 8.33$ s.

12. (*i*) Structure of BrF_3 molecule



Bent T–shaped

(*ii*) Structure of $XeOF_4$ molecule.



Square pyramidal

13. (*i*) Preparation of potassium dichromate from sodium chromate

(*a*) $2Na_2CrO_4 + H_2SO_4 \longrightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$

(*b*) $Na_2CrO_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$

(*ii*) Preparation of $KMnO_4$ from K_2MnO_4

$2K_2MnO_4 + Cl_2 \longrightarrow 2KMnO_4 + 2KCl$

OR

$2K_2MnO_4 + H_2O + O_3 \longrightarrow 2KMnO_4 + 2KOH + O_2$

14. (*i*) $[Cr\,(H_2O)_2\,(C_2O_4)_2]^-$

(*a*) Hybridization — d^2sp^3

(*b*) Shape — octahedral

(*c*) Magnetic behaviour — Paramagnetic

(*ii*) $[Co\,(NH_3)_2\,(en)_2]^{3+}$

(*a*) Hybridisation — d^2sp^3

(*b*) Shape — Octahedral

(*c*) Magnetic behaviour — diamagnetic

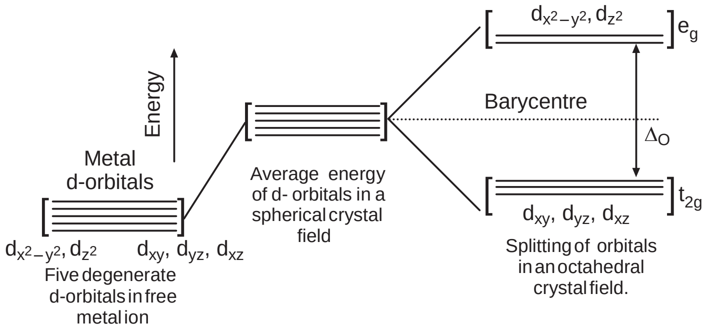
OR

(*i*) **Crystal field splitting in an octahedral field.**

According to C.F.T at first there is an increase in the energy of d-orbitals relative to that of the free ion just as would be the case in spherical field. The two orbitals lying along the axis get repelled more strongly than other three (d_{xy}, d_{yz}, d_{xz}). The degenerate set of d-orbitals get split into two sets: the lower energy t_{2g} set and e_g set. The energy separation is denoted by Δ_o. The actual configuration adopted is decided by the relative values of Δ_o and P. P-represents the energy required for electron pairing in a single orbital.

(*a*) If $\Delta_o < P$ then fourth electron goes to e_g

(*b*) When $\Delta_o > P$, then fourth electron pairs the t_{2g} orbital.



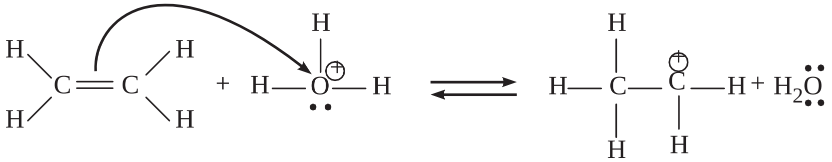
(*ii*) **Spectrochemical Series:** It is a series in which ligands can be arranged in the order of increasing field strength or in order of increasing magnitude of splitting they produce.

The order is

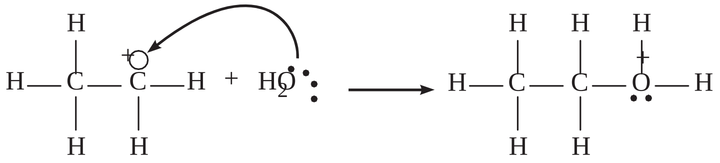
$$I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < NCS < edta^{4-} < NH_3 < en < CN^- < CO$$

15. (*i*) Mechanism of hydration of ethene to ethanol

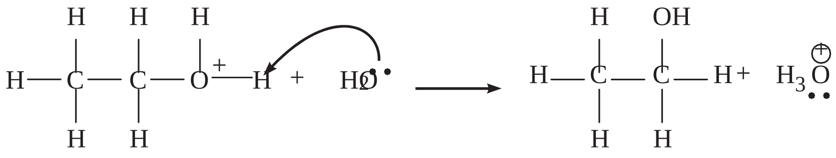
Step-I: Protonation of alkene



Step-II: Nucleophilic attack of water as carbocation

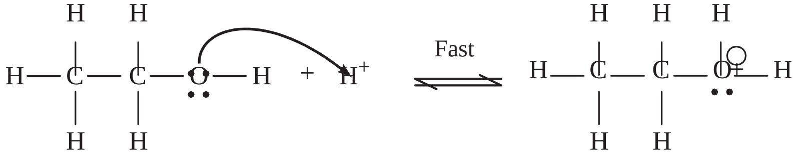


Step-III: Deprotonation of alcohol



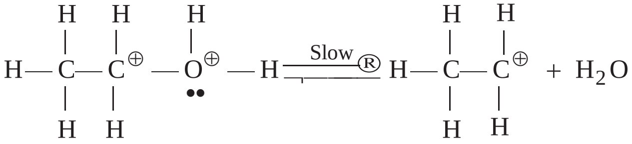
(*ii*) Mechanism of dehydration of ethanol to ethene.

Step-I: Formation of protonated alcohol

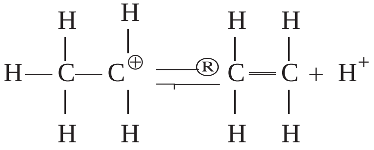


Ethyloxonium ion

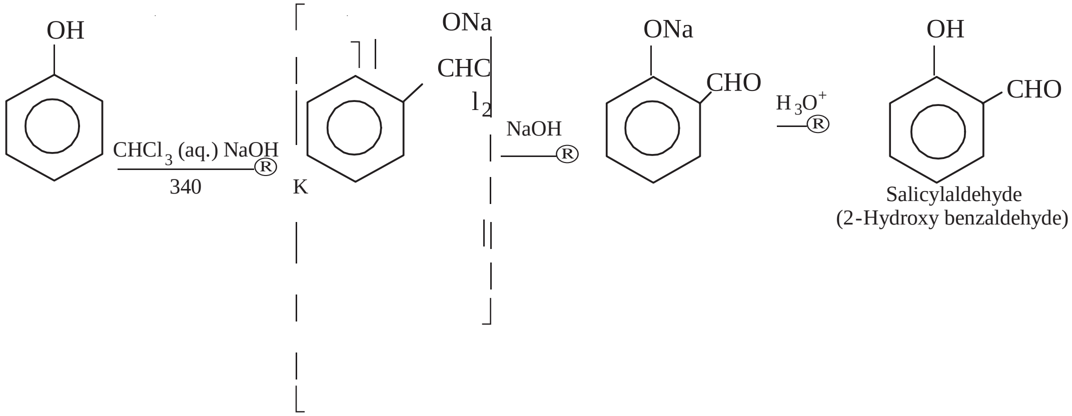
Step–II: Formation of carbocation



Setp-III. Formation of ethene


ethene

16. (*i*) **Reimer-Tiemann reaction**

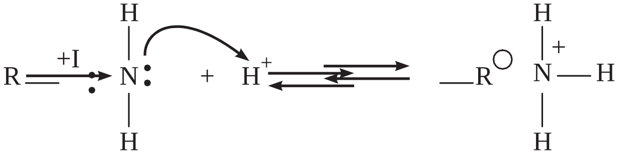


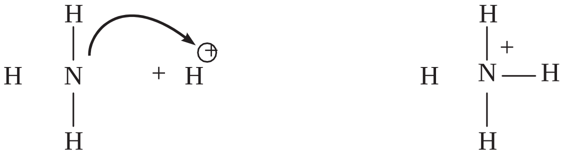
Salicylaldehyde
(2-Hydroxy benzaldehyde)

(*ii*) **Williamson synthesis**

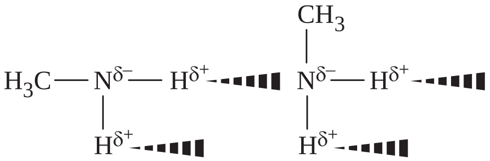
$$\underset{\text{Sodium ethoxide}}{C_2H_5ONa} + ICH_3 \longrightarrow \underset{\text{Methyl-ethyl ether}}{C_2H_5OCH_3} + NaI$$

17. (*i*) Alkylamine is more basic than ammonia because in aliphatic amines, the electron releasing alkyl group stabilize their ammonium cations by dispersing the positive charge and in parent amine make the nitrogen unshared electrons more available for sharing with a proton.





(*ii*) The boiling points of primary amine are higher than the tertiary amines because strong intermolecular hydrogen bonding takes place between the molecules of primary amine.



18. (*i*) $$\underset{\text{Aniline}}{C_6H_5NH_2} + CHCl_3 + 3KOH(alco) \longrightarrow \underset{\text{Phenyl isocyanide}}{C_6H_5NC} + 3KCl + 3H_2O$$

(*ii*) $$\underset{\substack{\text{Benzene diazonium}\\ \text{chloride}}}{C_6H_5N_2Cl} + H_3PO_2 + H_2O \longrightarrow \underset{\text{Benzene}}{C_6H_6} + N_2 + HCl + H_3PO_3$$

19. **Given:** Z = 2

$a = 286.65$ pm $\qquad d = 7.874$ g cm^{-3}

$M = 56$ g mol^{-1} $\qquad N_A = ?$

$$d = \frac{ZM}{(a^3)\times N_A}$$

$$7.874 = \frac{2\times 56}{(286.65)^3 \times 10^{-30} \times N_A}$$

$$\therefore \quad N_A = \frac{2\times 56}{7.874\times(286.65)^3\times 10^{-30}} = \frac{112}{18.5\times 10^{-23}} = \frac{112\times 10^{23}}{18.5}$$

$$N_A = 6.054 \times 10^{23}$$

20. **Electrochemical cell**

Zn(*s*)| Zn^{2+} (.10 M) | | Ag$^+$ (conc.) | Ag (*s*)

$$E^o_{cell} = E^o_R - E^o_L$$

$$= 0.80\ (-\ 0.763)V = 1.563\ V$$

We know that

$$E^o_{cell} = (E^o_R - E^o_L) - \frac{0.0591}{n}\log\frac{[Zn^{2+}]}{[Ag^+]^2}$$

$$1.48 = 1.563 - \frac{0.0591}{2}\log\frac{[0.10]}{[Ag^+]^2}$$

$$\log\frac{0.10}{[Ag^+]^2} = \frac{0.083}{0.02955} = 2.8087$$

Or $$\frac{0.10}{[Ag^+]^2} = \text{antilog of } 2.8087 = 643.7$$

$$[Ag^+]^2 = \frac{0.10}{643.7} = 1.553\times 10^{-4}$$

$$\therefore \quad [Ag^+] = 1.247 \times 10^{-2}\ M$$

21. (*i*) **Macro molecular colloids:** Macromolecules in suitable solvents form solution. Where in size of the macromolecules may fall within the colloidal range. The system showing such characteristics are called macromolecular colloids. The colloids are quite stable and in many respect they resemble true solutions. Examples of naturally occurring macro molecules are starch, cellulose, proteins and those of manmade macromolecules are nylon, polythene, polystyrene, synthetic rubber etc.

(*ii*) **Multimolecular colloids:** A large number of atoms or smaller molecules (diameter < 1 nm) of a substance on dissolution aggregate together to form species having size in the colloidal range. Such species are called *multimolecular colloids.* Example: A sulphur sol contains thousands of S_8 sulphur molecules, a platinum or gold sol may have particles of various sizes having many atoms.

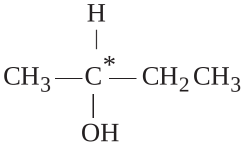
(*iii*) **Associated colloides (Micelles):** There are certain substances which at low concentrations behave like normal strong electrolytes but at higher concentration behave as colloidal solutions due to the formation of aggregated particles. Such colloids are *associated colloids* and aggregated particles as *micelles.* Examples: soaps and detergents.

22. (*i*) This is because transition metals have strong metallic bonds as they have large number of unpaired electrons.

(*ii*) There is a close similarity in physical and chemical properties of the 4*d* and 5*d* series of the transition elements much more than expected on the basis of usual family relationship. This is because 5*d* and 4*d* series elements have virtually the same atomic and ionic radii due to lanthanide contraction. Due to equality in size of Zr and Hf, Nb and Ta, Mo and W, etc., the two elements of pair have the same properties.

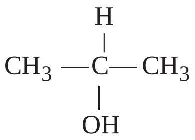
(*iii*) The members in the actinoid series exhibit larger number of oxidation states than the corresponding members in the lanthanide series due to the fact that the 5*f*, 6*d* and 7*s* levels are of comparable energies.

23. (*i*)



$CH_3—\overset{\overset{H}{|}}{\underset{\underset{OH}{|}}{C^*}}—CH_2CH_3$

(Chiral)



$CH_3—\overset{\overset{H}{|}}{\underset{\underset{OH}{|}}{C}}—CH_3$

(Non-chiral)

(*ii*) $CH_3CHClCH_2CH_3$, in more easily hydrolysed as it forms secondary carbocation which is more stable than primary carbocation.

(*iii*) 1–bromopentane will react faster in S_N^2 displacement reaction as it is a 1° alkyl halide.

24. (*i*) **Pig iron into steel:** Pig iron is converted into steel by heating in a converter. A blast of oxygen diluted with carbon dioxide is blown through the converter. Oxygen reacts with impurities and raised the temperature to 2173K carbon gets oxidised to CO which burns off at the mouth of the converter. Oxides of silicon and Mg form slag. When the flame is stopped, slag is tapped off and other metals like Mn, Cr, Ni, W may be added in the end.

(*ii*) Bauxite into pure alumina.

(*a*) $Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \longrightarrow 2Na[Al(OH)_4](aq)$

(*b*) $2Na[Al(OH)_4](aq) + CO_2(g) \longrightarrow Al_2O_3.xH_2O(s) + 2NaHCO_3(aq)$

(*c*) $Al_2O_3.xH_2O \xrightarrow{1470\ K} Al_2O_3(s) + xH_2O(g)$

(*iii*) Impure copper into pure copper

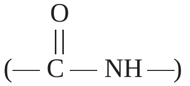
Pure copper is obtained by electro-refining process. In this method, the impure metal is made to act as anode. A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolyte bath containing soluble salt of the same metal.

Anode: $Cu \longrightarrow Cu^{2+} + 2\bar{e}$

Cathode: $Cu^{2+} + 2\bar{e} \longrightarrow Cu$ (Pure copper)

25. (*i*) **Invert Sugar:** The dextrorotatory sucrose when hydrolysed by boiling with mineral acid produces an equal number of molecules of dextrorotatory fructose. The resulting mixture is laevorotatory and termed as invert sugar.

$$\underset{\substack{\text{Sucrose}\\ [\alpha]_D = 66.5°}}{C_{12}H_{22}OH} + H_2O \xrightarrow{H^+} \underbrace{\underset{\substack{\text{Glucose}\\ [\alpha]_D = 52.5°}}{C_6H_{12}O_6} + \underset{\substack{\text{Fructose}\\ [\alpha]_D = -93°}}{C_6H_{12}O_6}}_{\text{Invert sugar}}$$

(*ii*) **Peptide linkage:** The amide linkage  $(-\overset{\overset{\displaystyle O}{||}}{C}-NH-)$ formed between two α–amino acid molecules with the loss of a water molecule in a polypeptide is called a peptide linkage.

(*iii*) **Denaturation of Proteins:** When a protein in its native form, it is subjected to a change, change in temperature or change in pH, the hydrogen bond are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation 2° and 3° structures are destroyed but 1° structures remain intact, *e.g.*, coagulation of egg white on boiling, curdling of milk, etc.

OR

The following reactions cannot be explained by the open chain structure of glucose.

(*i*) Despite having the aldehyde group, glucose does not give 2, 4– DNP test, Schiffs test and it does not form the hydrogensulphite addition product with $NaHSO_3$.

(*ii*) The penta acetate of glucose does not react with hydroxyl amine indicating the absence of free —CHO group.

(*iii*) D–Glucose on treatment of methyl alcohol in the presence of dry HCl gas gives two isomeric nonomethyl derivatives known as α-D-glucoside and methyl β– D–glucoside. These glucosides do not reduce fehling solution and also do not react with hydrogen cyanide indicating the absence of free —CHO group.

A ring structure called pyranose structure (α- or β-) is proposed for the glucose molecule.

26. Polymers are classified into four groups based on the magnitude of intermolecular forces. They are—

(*i*) Elastomers
(*ii*) Fibers
(*iii*) Thermoplastic polymers
(*iv*) Thermosetting polymers

Polythene—Polythene is a thermoplastic polymer.

Bakelite— It is a thermosetting polymer.

27. **Antiseptics:** Antiseptics are the chemicals which prevent the growth of the harmful microorganism. They do not harm the living tissues. For example dettol.

Disinfectants: These are the chemicals which completely destroy the microorganism: They are toxic to living tissues. 1% solution of phenol is a disinfectant whereas 0.2% solution of phenol is antiseptic.

28. (*a*) **Positive deviation from Raoult's law:** When the partial vapour pressure of each component (A and B) consequently the total vapour pressure is greater than the pressure expected on the basis of Raoult's law then the deviation is termed as positive deviation.

Cause of positive deviation: This type of deviation is observed by solution in which the forces of attraction between A–A molecules and between B–B molecules is greater then the forces of attraction between A–B molecules.

$$\gamma_{A-B} < \gamma_{A-A} \quad \text{or} \quad \gamma_{B-B}$$

Negative deviation from Raoult's law: When the partial vapour pressure of each component of solution is less than the vapour pressure expected on the basis of Raoult's law then the deviation is called as negative deviation.

Causes of negative deviation: This type of deviation is shown by solutions in which the forces of attraction between A–A and B–B molecules is less than the forces of attraction between A and B molecules.

$$\gamma_{A-B} > \gamma_{A-A} \quad \text{or} \quad \gamma_{B-B}$$

(***b***) Given: $M_B = 58.5 \text{ g mol}^{-1}$

$W_A = 65\text{g}, \quad W_B = ?$

$\Delta T_f = 7.5°\text{C}$ or 7.5 K,

$K_f = 1.86 \text{ K kg mol}^{-1}$

$i = 1.87$

We know that,

$$\Delta T_f = iK_f \times \frac{W_B}{M_B} \times \frac{1000}{W_A}$$

$$7.5 = 1.87 \times 1.86 \times \frac{W_B}{58.5} \times \frac{1000}{65}$$

$$\therefore \quad W_B = \frac{7.5 \times 58.5 \times 65}{1.87 \times 1.86 \times 1000}$$

$$W_B = \frac{28518.75}{3478.2}$$

$$W_B = 8.199 \text{ g.}$$

OR

(*a*) **Osmosis:** The phenomenon in which solvent molecules flow through a semipermeable membrane from a solution of low concentration to a solution of higher concentration is termed as osmosis.

Osmotic Pressure: The hydrostatic pressure exerted by the column of the solution which is just sufficient to prevent the osmosis is called osmotic pressure.

Advantage of using osmotic pressure as compared to other collegative properties:

(*i*) The equilibrium is established very quickly. Hence, results are obtained in a very short time.

(*ii*) The concentration of the solution does not change during determination of osmotic pressure.

(*iii*) This is ideal method for proteins to find their molar mass since it happens at room temperature and no coagulation occurs.

(*b*) Given $\Delta T_B = 80.31 - 80.10 = 0.21\ ^\circ\text{C or } 0.21\ \text{K}$

$W_B = 1.25\text{g},\ K_b = 2.53^\circ\text{C kg mol}^{-1}$

$M_B = ?,\ \ W_A = 99\text{g}$

$$M_B = \frac{K_b \times W_B}{\Delta T_b \times W_A} \times 1000$$

$$= \frac{2.53 \times 1.25 \times 1000}{0.21 \times 99} = \frac{3162.5}{20.79}$$

$\therefore$ $M_B = 152$ g/mol

29. (*a*) (*i*) $3HgCl_2 + 2PH_3 \longrightarrow Hg_3P_2 + 6HCl$

(*ii*) $SiO_2 + 6HF \longrightarrow H_2SiF_6 + 2H_2O$

(*b*) (*i*) Sulphur in vapour state exhibits paramagnetic behaviour because it forms S_2 molecules like O_2 which contains two unpaired electrons.

(*ii*) The stability of +3 state increases down the group in group 15 due to inert pair effect.

(*iii*) This is due to presence of two bond pairs and three lone pairs of electrons in XeF_2.

OR

(*a*) (*i*) $AgCl + 2NH_3 \longrightarrow [Ag\ (NH_3)_2]^+\ Cl^-$

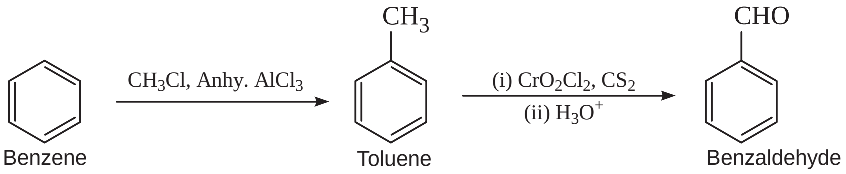
(*ii*) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

(*b*) (*i*) This is because bond dissociation enthalpy of H–Te bond is less than H–S as the size of Te is larger than S.

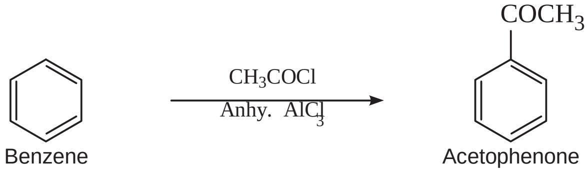
(*ii*) Fluorine is a stronger oxidising agent than chlorine due to low dissociation enthalpy of F–F bond and high hydration enthalpy of F^- ions.

(*iii*) Noble gases are the least reactive elements due to fully filled outermost shells and zero electron gain enthalpy.

30. (*a*) (*i*)



(*ii*)



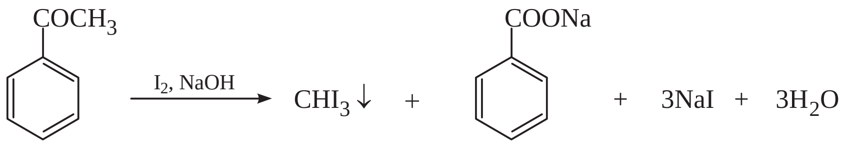
(*b*) (*i*) Ethanol and propanal

Iodoform test: Ethanol will give iodoform test positive while propanal will not.

$$CH_3\ CHO + 3I_2 + 4NaOH \longrightarrow \underset{\text{(Yellow ppt.)}}{CHI_3 \downarrow} + HCOONa + 3H_2O + 3NaI$$

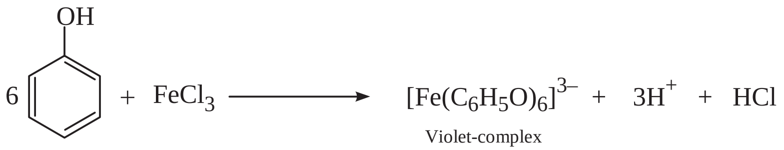
(*ii*) Benzaldehyde and Acetophenone

Iodoform test: Treat both the compounds with I_2 and NaOH. A yellow ppt. of iodoform will be obtained in acetophenone.



(*iii*) Phenol and Benzoic acid

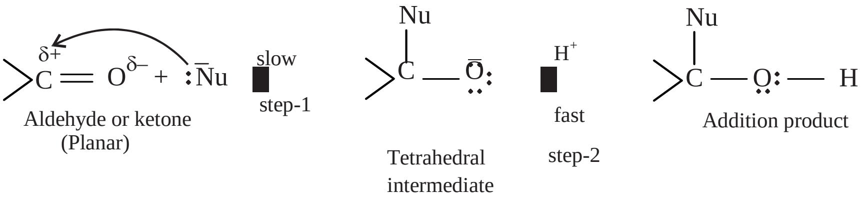
Neutral $FeCl_3$ test: Add few drops of $FeCl_3$ solution to both the samples of the compounds. A violet colouration will be obtained in case of phenol.



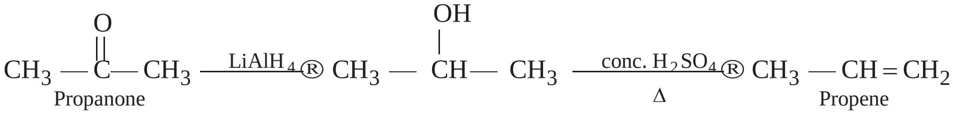
OR

(*a*) Mechanism of nucleophilic addition reactions:

A nucleophile attacks the electrophilic carbon atom of the polar carbonyl group from a direction approximately perpendicular to the plane of sp^2 hybridized orbitals of carbonyl carbon. The hybridization of carbon changes from sp^2 to sp^3 in this process and a tetrahedral intermediate is produced. The intermediate captures a proton from the medium to give the neutral product.

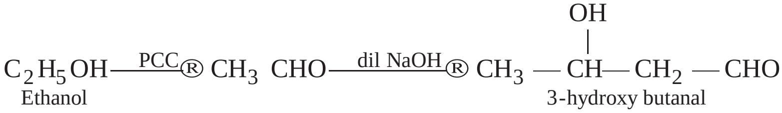


(*b*) (*i*)



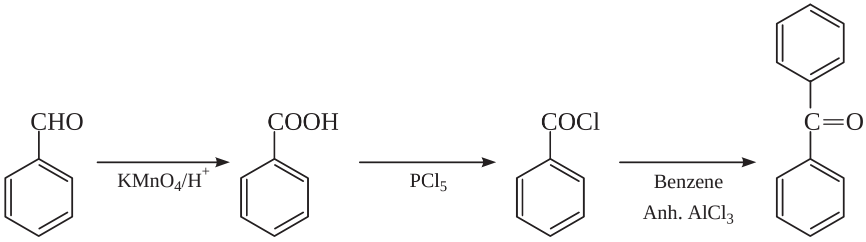
$$\underset{\text{Propanone}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3} \xrightarrow{LiAlH_4} CH_3-\overset{OH}{\overset{|}{C}H}-CH_3 \xrightarrow[\Delta]{\text{conc. } H_2SO_4} \underset{\text{Propene}}{CH_3-CH=CH_2}$$

(*ii*)



$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{PCC} CH_3\ CHO \xrightarrow{\text{dil NaOH}} \underset{\text{3-hydroxy butanal}}{CH_3-\overset{OH}{\overset{|}{C}H}-CH_2-CHO}$$

(*iii*)



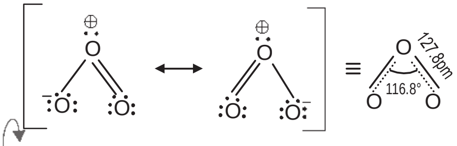
Benzaldehyde Toluene Benzophenone

CBSE (Foreign) SET–II

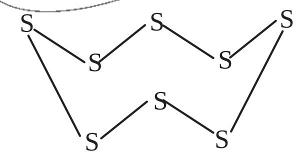
1. Metallic solids have high melting and boiling points.

2. $CH_3\ CHClCH_2CH_3$ because it forms secondary carbocation which is more stable.

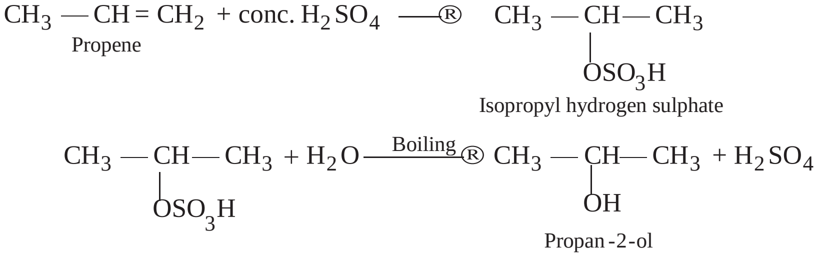
9. (*a*) (*i*) Ozone molecule:



(*ii*) Structure of S_8 molecule



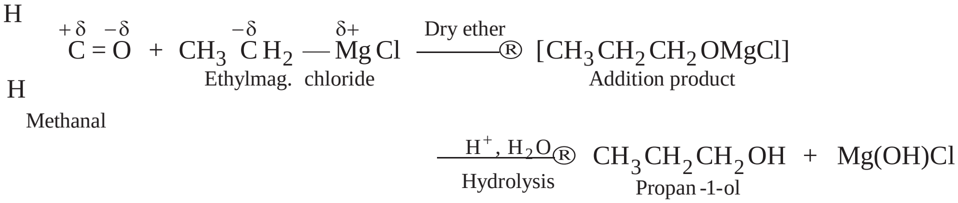
14. (*i*) Propan-2-ol can be prepared from propene by hydration as shown below:



$$\underset{\text{Propene}}{CH_3-CH=CH_2} + \text{conc. } H_2SO_4 \longrightarrow \underset{\text{Isopropyl hydrogen sulphate}}{CH_3-\underset{|}{\overset{}{CH}}(OSO_3H)-CH_3}$$

$$CH_3-CH(OSO_3H)-CH_3 + H_2O \xrightarrow{\text{Boiling}} \underset{\text{Propan-2-ol}}{CH_3-CH(OH)-CH_3} + H_2SO_4$$

(*ii*)



$$\underset{\text{Methanal}}{\overset{+\delta}{H_2C}=\overset{-\delta}{O}} + \underset{\text{Ethylmag. chloride}}{CH_3\overset{-\delta}{C}H_2-\overset{\delta+}{Mg}Cl} \xrightarrow{\text{Dry ether}} \underset{\text{Addition product}}{[CH_3CH_2CH_2OMgCl]}$$

$$\xrightarrow[\text{Hydrolysis}]{H^+,\ H_2O} \underset{\text{Propan-1-ol}}{CH_3CH_2CH_2OH} + Mg(OH)Cl$$

19.
$$M = \frac{d \times a^3 \times N_A}{Z} = \frac{10.5 \text{ g cm}^{-3} \times (4.077 \times 10^{-8} \text{ cm})^3 \times (6.02 \times 10^{23} \text{ mol}^{-1})}{4}$$

$$= \frac{10.5 \text{ g cm}^{-3} \times 67.767 \times 10^{-24} \text{ cm}^3 \times 6.02 \times 10^{23} \text{ mol}^{-1}}{4}$$

$$= \mathbf{107.09 \text{ g mol}^{-1}}$$

20. Given $E^o\ Ag^+/Ag = 0.80V$, $E^o_{Cu^{2+}/Cu} = +0.34V$

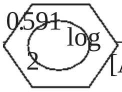
$[Cu^{2+}] = 0.10\ M$ $[Ag^+] = ?$

$E^o_{cell} = E^o_R - E^o_L = 0.80 - 0.34V = 0.46V$

From Nernst Equation:

$$E_{cell} = E^o_{cell} - \frac{0.0591}{2} \log \frac{[Cu^{2+}]}{[Ag^+]^2}$$

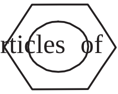
$$0.422 = 0.46 - \frac{0.591}{2} \log \frac{[0.10]}{[Ag^+]^2}$$



$$\log \frac{0.10}{[Ag^+]^2} = 1.2881$$

$$[Ag^+]^2 = 0.0051$$

$$\therefore \quad [Ag^+] = 7.1 \times 10^{-2} \text{ M}$$



21. (*i*) The positively charged colloidal particles of $Fe(OH)_3$ get coagulated by the oppositely charged Cl^- ions provided by NaCl.

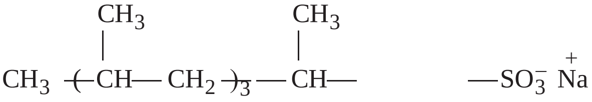
(*ii*) On passing direct current, colloidal particles move towards the oppositely charged electrode where they lose their charge and get coagulated.

(*iii*) Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

26. **Biodegradable detergents:** Detergents having straight hydrocarbon chains are easily degraded by micro-organism and hence called biodegradable detergents, *e.g.*, sodium–4–(1-dodecyl) benzene sulphonate.

$$CH_3 — (CH_2)_{11} — \qquad — SO_3^- \overset{+}{Na}$$

Non-biodegradable detergents: Detergents having branched hydrocarbon chains are not easily degraded by micro-organisms and hence are called non-biodegradable detergents, *e.g.*, sodium-4-(1, 3, 5, 7-**tetramethyl octyl**) benzenesulphonate.



$$CH_3 \left(\underset{}{\overset{CH_3}{\overset{|}{C}H}} — CH_2 \right)_3 — \overset{CH_3}{\overset{|}{C}H} — \qquad — SO_3^- \overset{+}{Na}$$

Non-biodegradable detergents accumulate in rivers and waterways thereby causing water pollution.

27. (*i*) $CH_2 = CHCl$ Vinyl chloride

(*ii*) $CF_2 = CF_2$ Tetrafluoroethene

(*iii*) Phenol and formaldehyde

CBSE (Foreign) SET–III

1. Second order.

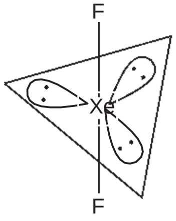
3. Those colloids which can be separated back into dispersed phase and dispersion medium.

4. $[Co(NH_2)_6]\,[Cr(CN)_6]$ and $[Cr(NH_2)_6]\,[Co(CN)_6]$

8. Glucose gets oxidised to succinic acid

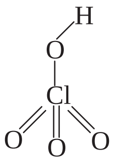
$$HOCH_2-(CHOH)_4-CHO \xrightarrow{HNO_3} ® \; \underset{\text{succinic acid}}{HOOC-(CHOH)_4-COOH}$$

12. (*i*)



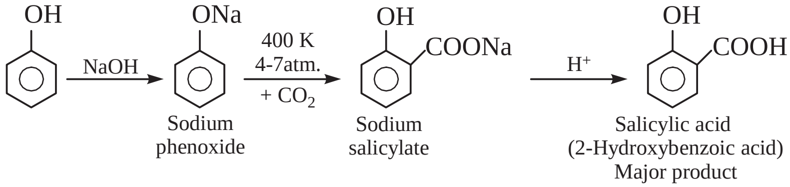
XeF_2 (Linear shape)

(*ii*)

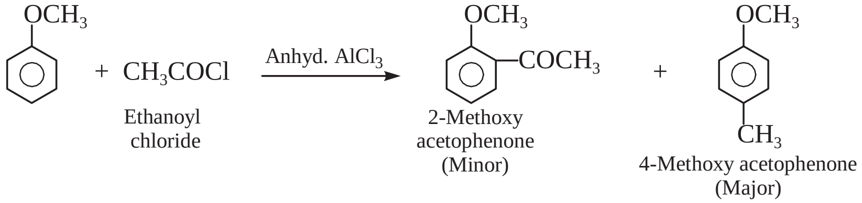


$HClO_4$ (Perchloric acid)

16. **(*i*) Kolbe's reaction**



(*ii*) Friedel-Crafts' acetylation of anisole



19. Given: $d = 3.18 \text{ g cm}^{-3}$, $Z = 4$, $a = 5.46 \times 10^{-8}$ cm

$M = 78.08 \text{ g mol}^{-1}$ $N_A = ?$

$$d = \frac{Z \times M}{a^3 \times N_A}$$

$$\therefore \quad N_A = \frac{Z \times M}{a^3 \times P}$$

Substituting the given values, we get

$$N_A = \frac{4 \times 78.08}{(5.46 \times 10^{-8})^{-3} \times 3.18}$$

$$N_A = \frac{313 \times 32 \times 10^{24}}{517 \times 61}$$

$$N_A = 6.035 \times 10^{23} \text{ mol}^{-1}$$

20. At anode: $\text{Al}(s) \longrightarrow \text{Al}^{3+}(aq) + 3\bar{e}] \times 2$

At cathode: $\text{Ni}^{2+}(aq) + 2\bar{e} \longrightarrow Ni(s)] \times 3$

$$2\text{Al}(s) + 3\text{Ni}^{2+}(aq) \longrightarrow 2\text{Al}^{3+}(aq) + \text{Ni}(s)$$

$$E_{\text{cell}} = E^{o}_{\text{cell}} - \frac{0.0591}{n} \log \frac{[\text{Al}^{3+}]^2}{[\text{Ni}^{2+}]^3}$$

Here, $n = 6$, $[Al^{3+}] = 0.001M = 1\times 10^{-3}M$, $[Ni^{2+}] = 0.5M$

$$E^{o}_{cell} = E^{o}_{Ni^{2+}/Ni} - E^{o}_{Al^{3+}/Al} = -0.25\,V - (-1.66\,V)$$

$$E^{o}_{cell} = 1.41V$$

$$E_{cell} = 1.41 - \frac{0.0591}{6}\log\frac{(10^{-3})^{2}}{(0.5)^{3}} = 1.41 - \frac{0.0591}{6}\log\frac{10^{-6}}{0.125}$$

$$= 1.41 - \frac{0.0591}{6}\log(10^{-6}\times 8) = 1.41 - \frac{0.0591}{6}(\log 10^{-6} + \log 2^{3})$$

$$= 1.41 - \frac{0.0591}{6}(-6\log 10 + 3\log 2) = 1.41 - \frac{0.0591}{6}(-6 + 3\times 0.3010)$$

$$= 1.41 - \frac{0.0591}{6}(-5.097) = 1.41 + \frac{0.3012}{6}$$

$$= 1.41 + 0.0502 = 1.4602V$$

$$E_{cell} = 1.46\ V$$

21. **Three features of chemisorption**

(*i*) It is caused by chemical bond formation and enthalpy of adsorption is high (80-240 kJ mol^{-1})

(*ii*) It forms unimolecular layer.

(*iii*) It is highly specific in nature.

22. (*i*) The transition elements have great tendency for complex formation due to presence of vacant d-orbitals of suitable energy, small size of cations and higher nuclear charge.

(*ii*) There is a gradual decrease in the atomic sizes of transition elements in a series with increasing atomic numbers due to poor shielding effect of d-electrons, the net electrostatic attraction between the nucleus and the outermost electrons increase.

(*iii*) Lanthanum and Lutetium do not show colouration in solutions because both the element exhibit +3 oxidation state in their compound thus their cations do not possess any unpaired electrons in them.

CBSE EXAMINATION PAPERS

DELHI–2011

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory*.

(*ii*) *Question numbers* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question numbers* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question numbers* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question numbers* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables, if necessary. Use of calculators is not allowed.*

CBSE (Delhi) SET–I

1. ‘Crystalline solids are anisotropic in nature.’ What does this statement mean?

2. Express the relation between conductivity and molar conductivity of a solution held in a cell?

3. Define ‘electrophoresis’.

4. Draw the structure of XeF_2 molecule.

5. Write the IUPAC name of the following compound:

$(CH_3)_3\ CCH_2Br$

6. Draw the structure of 3-methylbutanal.

7. Arrange the following compounds in an increasing order of their solubility in water:

$C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$

8. What are biodegradable polymers?

9. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.

10. Determine the values of equilibrium constant (K_C) and $\Delta G°$ for the following reaction:

$Ni(s) + 2Ag^{+}(aq) \longrightarrow Ni^{2+}(aq) + 2Ag(s),\ E° = 1.05\ V$

$(1\ F = 96500\ C\ mol^{-1})$

11. Distinguish between ‘rate expression’ and ‘rate constant’ of a reaction.

12. State reasons for each of the following:

(*i*) The N–O bond in NO_2^- is shorter than the N–O bond in NO_3^-.

(*ii*) SF_6 is kinetically an inert substance.

OR

State reasons for each of the following:

(*i*) All the P—Cl bonds in PCl_5 molecule are not equivalent.

(*ii*) Sulphur has greater tendency for catenation than oxygen.

13. Assign reasons for the following :

(*i*) Copper (I) ion is not known in aqueous solution.

(*ii*) Actinoids exhibit greater range of oxidation states than lanthanoids.

14. Explain the following giving one example for each:

(*i*) Reimer–Tiemann reaction.

(*ii*) Friedel–Crafts acetylation of anisole.

15. How would you obtain

(*i*) Picric acid (2, 4, 6-trinitrophenol) from phenol,

(*ii*) 2-Methylpropene from 2-methylpropanol?

16. What is essentially the difference between α-form of glucose and β-form of glucose? Explain.

17. Describe what you understand by primary structure and secondary structure of proteins.

18. Mention two important uses of each of the following:

(*i*) Bakelite

(*ii*) Nylon-6

19. Silver crystallizes in face-centered cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom. (Assume the atoms just touch each other on the diagonal across the face of the unit cell. That is, each face atom is touching the four corner atoms.)

20. Nitrogen pentoxide decomposes according to equation:

$$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g).$$

This first order reaction was allowed to proceed at 40°C and the data below were collected:

[N_2O_5] (M)	**Time (min)**
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

(*a*) Calculate the rate constant. Include units with your answer.

(*b*) What will be the concentration of N_2O_5 after 100 minutes?

(*c*) Calculate the initial rate of reaction.

21. Explain how the phenomenon of adsorption finds application in each of the following processes:

(*i*) Production of vacuum

(*ii*) Heterogeneous catalysis

(*iii*) Froth floatation process

OR

Define each of the following terms:

(*i*) Micelles

(*ii*) Peptization

(*iii*) Desorption

22. Describe the principle behind each of the following processes:

(*i*) Vapour phase refining of a metal.
(*ii*) Electrolytic refining of a metal.
(*iii*) Recovery of silver after silver ore was leached with NaCN.

23. Complete the following chemical equations:

(*i*) $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow$
(*ii*) $KMnO_4 \xrightarrow{\text{heated}}$
(*iii*) $Cr_2O_7^{2-} + H_2S + H^+ \longrightarrow$

24. Write the name, stereochemistry and magnetic behaviour of the following:
(At. nos. Mn = 25, Co = 27, Ni = 28)

(*i*) $K_4[Mn(CN)_6]$
(*ii*) $[Co(NH_3)_5Cl]Cl_2$
(*iii*) $K_2[Ni(CN)_4]$

25. Answer the following:

(*i*) Haloalkanes easily dissolve in organic solvents, why?
(*ii*) What is known as a racemic mixture? Give an example.
(*iii*) Of the two bromoderivatives, $C_6H_5CH(CH_3)Br$ and $C_6H_5CH(C_6H_5)Br$, which one is more reactive in S_N1 substitution reaction and why?

26. (*a*) Explain why an alkylamine is more basic than ammonia.
(*b*) How would you convert
  (*i*) Aniline to nitrobenzene
  (*ii*) Aniline to iodobenzene?

27. Describe the following giving one example for each:

(*i*) Detergents
(*ii*) Food preservatives
(*iii*) Antacids

28. (*a*) Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?

(*b*) Calculate the freezing point of an aqueous solution containing 10.50 g of $MgBr_2$ in 200 g of water. (Molar mass of $MgBr_2$= 184 g)
(K_f for water = 1.86 K kg mol^{-1})

OR

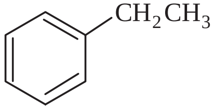
(*a*) Define the terms osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.

(*b*) Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.00 g of water. (K_b for water = 0.512 kg mol^{-1}),
(Molar mass of NaCl = 58.44 g)

29. (*a*) Give chemical tests to distinguish between
  (*i*) Propanal and propanone,
  (*ii*) Benzaldehyde and acetophenone.
(*b*) How would you obtain
  (*i*) But-2-enal from ethanal
  (*ii*) Butanoic acid from butanol,
  (*iii*) Benzoic acid from ethylbenzene?

OR

(*a*) Describe the following giving linked chemical equations:
  (*i*) Cannizzaro reaction
  (*ii*) Decarboxylation
(*b*) Complete the following chemical equations:

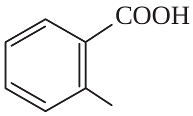
(*i*) 

$KMnO_4$

——

———® K

OH, heat

(*ii*) 

$SoCl_2$

———

—® h

eat

COOH

(*iii*) $C_6H_5CONH_2$ H_3O^+

———

—® he

at

30. (*a*) Explain the following:
  (*i*) NF_3 is an exothermic compound whereas NCl_3 is not.
  (*ii*) F_2 is most reactive of all the four common halogens.
(*b*) Complete the following chemical equations:
  (*i*) C + H_2SO_4(conc.) —®
  (*ii*) P_4 + NaOH + H_2O
  —®
  (*iii*) Cl_2 + F^2 —®
  (excess)

OR

(*a*) Account for the following:
  (*i*) The acidic strength decreases in the order HCl > H_2S > PH_3.

(*ii*) Tendency to form pentahalides decreases down the group in group 15 of the periodic table.

(*b*) Complete the following chemical equations:

(*i*) $P_4 + SO_2Cl_2 \longrightarrow$

(*ii*) $XeF_2 + H_2O \longrightarrow$

(*iii*) $I_2 + HNO_3$
$\longrightarrow$ (conc)

CBSE (Delhi) SET - II

Questions Uncommon to Set-I

1. Which stoichiometric defect in crystals increases the density of a solid?

3. What is meant by 'shape-selective catalysis' of reactions?

4. Draw the structure of XeF_4 molecule.

9. Explain what is meant by (*i*) a peptide linkage, (*ii*) a glycosidic linkage.

10. Name the bases present in RNA. Which one of these in not present in DNA?

22. Explain the role of each of the following in the extraction of metals from their ores:

(*i*) CO in the extraction of nickel.
(*ii*) Zinc in the extraction of silver.
(*iii*) Silica in the extraction of copper.

24. For the complex $[Fe(en)_2 Cl_2] Cl$, identify the following:

(*i*) Oxidation number of iron.
(*ii*) Hybrid orbitals and shape of the complex.
(*iii*) Magnetic behaviour of the complex.
(*iv*) Number of its geometrical isomers.
(*v*) Whether there may be optical isomer also.
(*vi*) Name of the complex.

27. Explain the following terms with one suitable example for each:

(*i*) A sweetening agent for diabetic patients.
(*ii*) Enzymes
(*iii*) Analgesics

28. (*a*) State the following:

(*i*) Henry's law about partial pressure of a gas in a mixture.
(*ii*) Raoult's law in its general form in reference to solutions.

(*b*) A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming the gene fragment is a non-electrolyte, determine its molar mass.

OR

(*a*) Differentiate between molarity and molality in a solution. What is the effect of temperature change on molarity and molality in a solution?

(*b*) What would be the molar mass of a compound if 6.21g of it dissolved in 24.0 g of chloroform form a solution that has a boiling point of 68.04°C. The boiling point of pure chloroform is 61.7°C and the boiling point elevation constant, K_b for chloroform is 3.63°C/m.

CBSE (Delhi) SET-III

Questions Uncommon to Set-I and II

2. Express the relation among the conductivity of solution in the cell, the cell constant and the resistance of solution in the cell.

4. Draw the structure of BrF_3 molecule.

8. In nylon-6, 6 what does the designation '6, 6' mean?

9. What type of a battery is lead storage battery? Write the anode and the cathode reactions and the overall reactions occurring in a lead storage battery.

10. Two half-reactions of an electrochemical cell are given below:

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O_{(l)}, \quad E^o = +1.51\ V$$

$$Sn^{2+}(aq) \longrightarrow Sn^{4+}(aq) + 2e^-, \quad E^o = +0.15\ V$$

Construct the redox equation from the standard potential of the cell and predict if the reaction is reactant favoured or product favoured.

13. Assign reasons for each of the following:

(*i*) Transition metals generally form coloured compounds.

(*ii*) Manganese exhibits the highest oxidation state of +7 among the 3*d* series of transition elements.

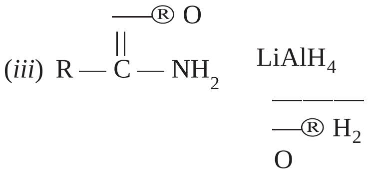
18. Name the sub-groups into which polymers are classified on the basis of magnitude of intermolecular forces.

19. The density of lead is 11.35 g cm^{-3} and the metal crystallizes with *fcc* unit cell. Estimate the radius of lead atom. (At. mass of lead = 207 g mol^{-1} and $N_A = 6.02 \times 10^{23}\ mol^{-1}$)

26. Complete the following chemical equations :

(*i*) $CH_3CH_2Cl \xrightarrow{NaCN} (A) \xrightarrow[Ni/H_2]{reduction} (B)$

(*ii*) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$



(*iii*) $R-\overset{\overset{O}{||}}{C}-NH_2 \xrightarrow[H_2O]{LiAlH_4}$

27. Answer the following questions :

(*i*) Why do soaps not work in hard water ?

(*ii*) What are the main constituents of dettol?

(*iii*) How do antiseptics differ from disinfectants?

Solutions

CBSE (Delhi) SET - I

1. Crystalline solids are anisotropic in nature means some of their physical properties like electrical conductivity, refractive index, etc., are different in different directions.

2. $\lambda_m = \dfrac{\kappa \times 1000}{C}$, where κ is the conductivity and C is the molar concentration.

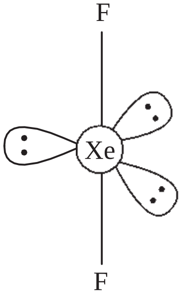
3. The movement of colloidal particles under an applied electric potential is called electrophoresis.

4. Total no. of electron pairs in the valence shell of central Xe atom $= \dfrac{8+2}{2} = 5$

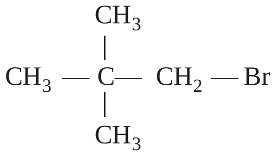
No. of bond pairs = 2

No. of lone pairs = 3

Therefore, the shape of molecule would be linear.



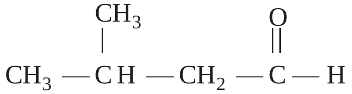
5.



$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-CH_2-Br$$

1-Bromo-2, 2-dimethyl propane

6.



$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{C}H-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-H$$

7. Increasing order of solubility of amines in water

$C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$

8. Polymers which get disintegrated by themselves in biological systems during a certain period of time by enzymatic hydrolysis or to some extent by oxidation are called biodegradable polymers. An example of biodegradable polymer is PHBV, *i.e.*, poly-β-hydroxy butyrate-co-β hydroxyvalerate.

9. According to electrochemical theory of rusting the impure iron surface behaves like small electrochemical cell in the presence of water containing dissolved oxygen or carbon dioxide. In this cell pure iron acts as anode and impure iron surface acts as cathode. Moisture having dissolved CO_2 or O_2 acts as an electrolyte. The reactions are given below.

At anode: $Fe \longrightarrow Fe^{2+} + 2e^- \;;\; E^o_{Fe^{2+}/Fe} = -0.44\text{ V}$

At cathode: $2H^+ + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O; \; E^\circ_{H^+/O_2/H_2O} = 1.23\text{V}$

Overall reaction: $Fe + 2H^+ + \frac{1}{2}O_2 \longrightarrow Fe^{2+} + H_2O; \; E^\circ_{cell} = 1.67\text{V}$

The Fe^{2+} ions are further oxidised by atmospheric oxygen to Fe^{3+} ions, which comes out in the form of hydrated ferric oxide (rust).

$2Fe^{2+} + \frac{1}{2}O_2 + 2H_2O \longrightarrow Fe_2O_3$

$+ 4H^+ Fe_2O_3 + xH_2O \longrightarrow Fe_2O_3\, xH_2O$

(Rust)

10. $Ni(s) + 2Ag^{+}(aq) \longrightarrow Ni^{2+}(aq) + 2Ag(s)$; $E° = 1.05$ V

Here, $n = 2$

$$\log K_c = \frac{n}{0.059} \; E^{o}_{cell}$$

$$\log K_c = \frac{2}{0.059} \times 1.05 = 39.5932$$

$$K_c = \text{antilog } 39.5932 = 3.919 \times 10^{39}$$

$$K_c = 3.92 \times 10^{39}$$

$$\Delta G^{o} = -nFE^{o}_{cell}$$

$$\Delta G^{o} = -2 \times 96500 \times 1.05 = -202650 \text{ J}$$

$$\Delta G^{o} = -202.65 \text{ kJ}$$

11. Rate expression is an experimentally determined expression which relates the rate of reaction with the concentration of the reactants whereas rate constant is the rate of reaction when concentration of each reactant in the reaction is unity.

Consider a general reaction

$$aA + bB \longrightarrow cC + dD$$

The rate expression for this reaction is

$$\text{Rate} = k\,[A]^{m}\,[B]^{n}$$

Where the proportionality constant k is called rate constant.

12. (*i*) This is because the N—O bond in NO_2^- is an average of a single bond and a double bond whereas the N—O bond in NO_3^- is an average of two single bonds and a double bond.

(*ii*) In SF_6, S atom is sterically protected by six F atoms and does not allow water molecules to attack the S atom. Further, F does not have *d*-orbitals to accept the electrons denoted by H_2O molecules. Due to these reasons, SF_6 is kinetically an inert substance.

OR

(*i*) In PCl_5 the two axial bonds are longer than the three equatorial bonds. This is due to the fact that the axial bond pairs suffer more repulsion as compared to equatorial bond pairs.

(*ii*) The property of catenation depends upon bond strength of the element. As S—S bond is much stronger (213 kJ mol^{-1}) than O—O bond (138 kJ mol^{-1}), sulphur has greater tendency for catenation than oxygen.

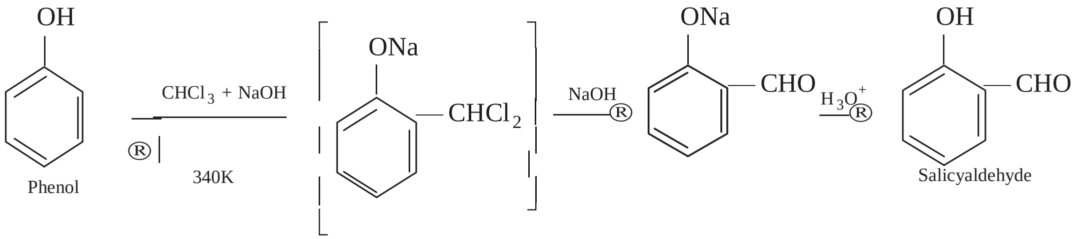
13. (*i*) In aqueous solution Cu^{+} undergoes disproportionation to form a more stable Cu^{2+} ion.

$$2\,Cu^{+}(aq) \longrightarrow 2\,Cu^{2+}(aq) + Cu(s)$$

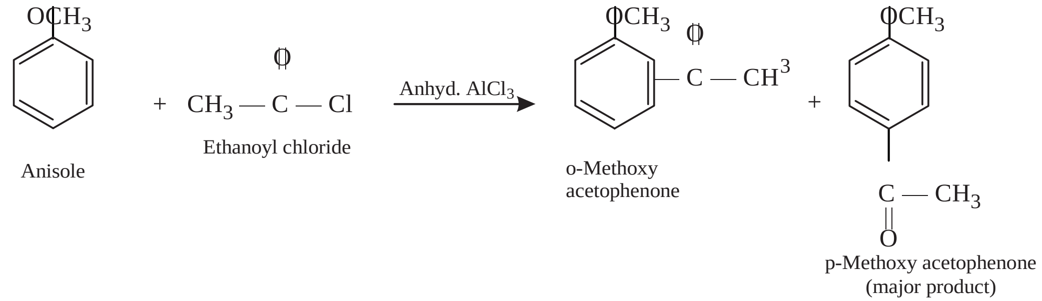
The higher stability of Cu^{2+} in aqueous solution may be attributed to its greater negative $\Delta_{hyd}H°$ than that of Cu^{+}. It compensates the second ionization enthalpy of Cu involved in the formation of Cu^{2+} ions.

(*ii*) Actinoids exhibit greater range of oxidation states than lanthanoids. This is because there is less energy difference between 5*f* and 6*d* orbitals belonging to actinoids than the energy difference between 4*f* and 5*d* orbitals in case of lanthanoids.

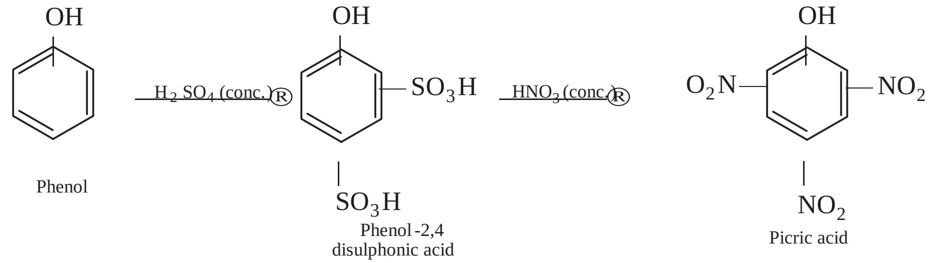
14. **(*i*) Reimer–Tiemann Reaction:** Treatment of phenol with chloroform in the presence of aqueous alkali at 340 K followed by hydrolysis of resulting product gives salicylaldehyde as a major product.



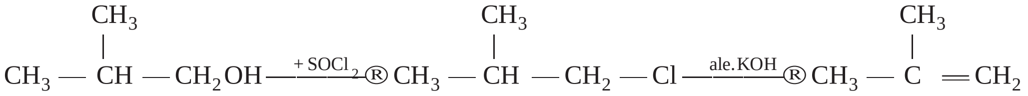
(*ii*) **Friedel–Crafts acylation of anisole:** Anisole on treatment with acylchloride in the presence of anhydrous $AlCl_3$ undergo electrophilic substitution in the ring at ortho and para positions. For example,



15. (*i*)



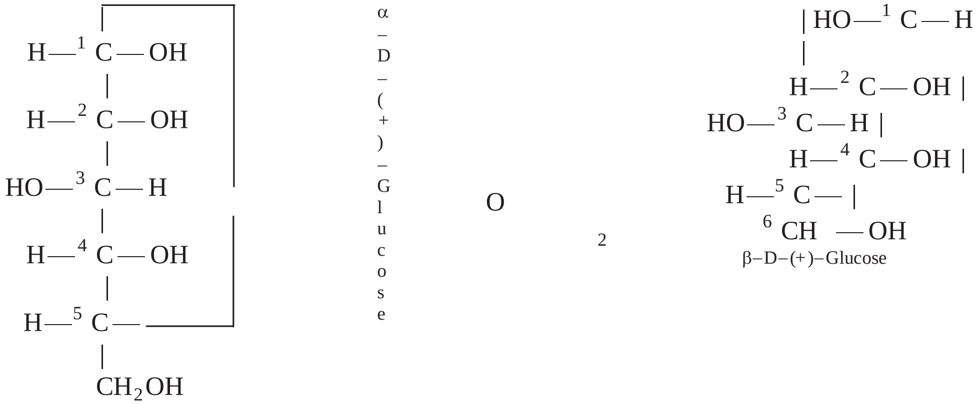
(*ii*)



$$CH_3-\overset{CH_3}{\overset{|}{C}H}-CH_2OH \xrightarrow{+SOCl_2} CH_3-\overset{CH_3}{\overset{|}{C}H}-CH_2-Cl \xrightarrow{ale.KOH} CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2$$

2-Methyl propanol 2-Methyl propene

16.



O

In α-D Glucose, the —OH group at C_1 is toward right whereas in β-glucose, the -OH group at C_1 is towards left. Such a pair of stereo-isomers which differ in the configuration only around C_1 are called anomers.

17. **Primary Structure:** The specific sequence in which the various α-amino acids present in a protein are linked to one another is called its primary structure. Any change in the primary structure creates a different protein.

Secondary Structure: The conformation which the polypeptide chain assumes as a result of hydrogen bonding is known as secondary structure. The two types of secondary structures are α-helix and β-pleated sheet structure.

In α-helix structure, the polypeptide chain forms all the possible hydrogen bonds by twisting into a right handed screw (helix) with the —NH groups of each amino acid residue hydrogen bonded to the $\rangle C{=}O$ groups of an adjacent turn of the helix. In β-pleated structure, all peptide chains are stretched out nearly to maximum extension and then laid side by side which are held together by hydrogen bonds.

18. (*i*) Bakelite is used for making combs, electrical switches, handles of various utensils and phonograph records.

(*ii*) Nylon-6 is used for making tyre cords, ropes and fabrics.

19. $a = 400$ pm

For fcc, $r = \frac{a}{2\sqrt{2}}$

$$\therefore \quad r = \frac{400}{2\sqrt{2}} = \frac{400}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{400\sqrt{2}}{4} = 100\sqrt{2}$$

⇒ $r = 100 \times 1.414 = 141.4$ pm

20. (*a*) When $t = 20$ min, $[A] = 0.289$ mol L^{-1}

Also, $[A]_0 = 0.400$ mol L^{-1}

For a first order reaction

$$k = \frac{2.303}{t}\log\frac{[A]_\circ}{[A]}$$

$$k = \qquad \log$$

⇒

∴ $\quad k = \qquad \log$

⇒

20

⇒

20

⇒

20

⇒

⇒

2.303

0.

.00706 = 0.016259 min^{-1} k = 1.6259 × 10^{-2} min^{-1}

400

2

0

0
.
2
8
9

2
.
3
0
3

4
.
0
0

20

2.

89

k = 2.303 [log 4.00 – log 2.89]

k = 2.303 [0.6021 – 0.4609]

k = 2.303 × 0.1412

k

=

2
.
3
0
3

×

0

(*b*) $t = \dfrac{2.303}{k} \log \dfrac{[A]_0}{[A]}$

Here, $[\text{A}]_0 = 0.400 \text{ mol}^{-1}$, $t = 100$ min, $k = 1.626 \times 10^{-2} \text{ min}^{-1}$

$$\therefore \qquad 100 = \frac{2.303}{1.626 \times 10^{-2}} \log \frac{0.400}{[A]}$$

$$\frac{100 \times 1.626 \times 10^{-2}}{2.303} = \log \frac{0.4}{[A]}$$

$$0.7060 = \log \frac{0.4}{[A]}$$

$$\text{Antilog } (0.7060) = \frac{0.4}{[A]}$$

$$5.082 = \frac{0.4}{[A]}$$

$$\Rightarrow \qquad [\text{A}] = \frac{0.4}{5.082} = 0.0787 \text{ M}$$

(*c*) Initial rate, *i.e.*, rate of reaction when $t = 0$

When, $t = 0.00$ min, $[\text{A}] = 0.400 \text{ mol L}^{-1}$

Also, $k = 1.626 \times 10^{-2} \text{ min}^{-1}$

$\therefore$ Initial rate $= k[\text{A}] = 1.626 \times 10^{-2} \text{ min}^{-1} \times 0.400 \text{ mol L}^{-1}$

$= 6.504 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1}$.

21. (***i***) **Production of Vacuum:** Adsorption can be successfully applied to create conditions of high vacuum. For this a bulb of charcoal cooled in liquid air, is connected to vessel which has already been exhausted as far as possible by vacuum pump. The remaining traces of air inspite of low pressure are adsorbed by the charcoal almost completely.

(***ii***) **Heterogeneous Catalysis:** There are many gaseous reactions of industrial importance involving solid catalyst. Manufacture of ammonia using iron as a catalyst, manufacture of H_2SO_4 by contact process using V_2O_5 catalyst and use of finely divided nickel in the hydrogenation of vegetable oils are the excellent examples. The gaseous reactants are adsorbed on the surface of the solid catalyst. As a result, the concentration of the reactants increases on the surface of the catalyst and hence the rate of reaction increases.

(***iii***) **Froth Floatation Process:** In froth floatation process the powdered ore is mixed with water. It is then mixed with pine oil (a frother). The oil particles are adsorbed on the surface of ore particles. Now, a stream of air is blown through the mixture from below when froth is formed at the water surface. The ore particles stick to the bubbles of the air rises to surface along with the foam while the gangue particles which are wetted by water settle at the bottom. The foam is separated out and is collected and in the course, the ore particles also settle down.

OR

(***i***) **Micelles:** There are some substances which at low concentration behave as normal strong electrolytes but at higher concentration exhibit colloidal behaviour due to formation of aggregated particles. The aggregated particles thus formed are called micelles. The formation of micelles takes place only above a particular temperature called **Kraft temperature** and above a particular concentration called **critical micelle concentration** (CMC). Surface active agents such as soap and synthetic detergents belong to this class.

(*ii*) **Peptization:** The process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of a small amount of suitable electrolyte is called peptization. During peptization, the precipitate absorbs one of the ions of the electrolyte on its surface. This causes development of positive or negative charge on precipitates, which ultimately break up into particles of colloidal dimension.

(*iii*) **Desorption:** The process of removing an adsorbed substance from a surface on which it is adsorbed is called desorption.

22. (*i*) **Vapour phase refining of a metal:** In this method, the metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal. For example, refining of nickel by Mond process.

$$Ni + 4CO \xrightarrow{330-350\ K} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$$

(*ii*) **Electrolytic refining of a metal:** In this method, the impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of same metal. When electric current is passed the metal from the anode goes into solution as ions due to oxidation while pure metal gets deposited at the cathode due to reduction of metal ions. The voltage applied for electrolysis is such that impurities of more electropositive metals remains in the solution as ions while impurities of the less electropositive metals settle down under the anode as anode mud.

At anode: $M \longrightarrow M^{n+} + n\bar{e}$

At cathode: $M^{n+} + n\bar{e} \longrightarrow M$

(*iii*) **Recovery of silver after silver ore was leached with NaCN:** During leaching Ag is oxidised to Ag^+ which then combines with CN^- ions to form soluble complex, $[Ag(CN)_2]^-$. Silver is then recovered from this complex by displacement method using more electropositive zinc metal.

$$2[Ag(CN)_2]^-(aq) + Zn(s) \longrightarrow 2Ag(s) + [Zn(CN)_4]^{2-}(aq)$$

23. (*i*)

$$\begin{array}{lll} MnO_4^- + 8H^+ + 5\bar{e} & \longrightarrow & Mn^{2+} + 4H_2O] \times 2 \\ C_2O_4^{2-} & \longrightarrow & 2CO_2 + 2\bar{e}\ ] \times 5 \\ \hline 2MnO_4^- + 5C_2O_4^{2-} + 16H^+ & \longrightarrow & 2Mn^{2+} + 10CO_2 + 8H_2O \\ \hline \end{array}$$

(*ii*) $2KMnO_4 \xrightarrow{heat} K_2MnO_4 + MnO_2 + O_2$

(*iii*)

$$\begin{array}{lll} Cr_2O_7^{2-} + 14H^+ + 6\bar{e} & \longrightarrow & 2Cr^{3+} + 7H_2O \\ H_2S & \longrightarrow & 2H^+ + S + 2e] \times 3 \\ \hline Cr_2O_7^{2-} + 3H_2S + 8H^+ & \longrightarrow & 2Cr^{3+} + 3S + 7H_2O \\ \hline \end{array}$$

24.

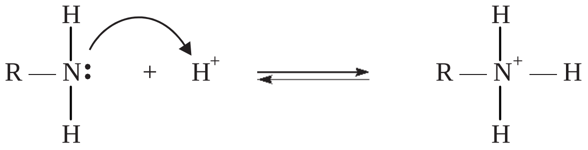
Name of the Complex	Hybridisation of metal ion involved	Geometry of complex	Magnetic behaviour
Potassium hexacyano manganate (II)	d^2sp^3	Octahedral	Paramagnetic
Pentaammine Chloridocobalt (III) Chloride	d^2sp^3	Octahedral	Diamagnetic
Potassium tetra cyanonikelate (II)	dsp^2	Square planar	Diamagnetic

25. (*i*) Haloalkanes dissolve in organic solvents because the new intermolecular attractions between haloalkanes and organic solvent molecules have much the same strength as ones being broken in the separate haloalkanes and solvent molecules.

(*ii*) An equimolar mixture of a pair of enantiomers is called racemic mixture. For example, butan-2-ol. A racemic mixture is optically inactive due to external compensation.

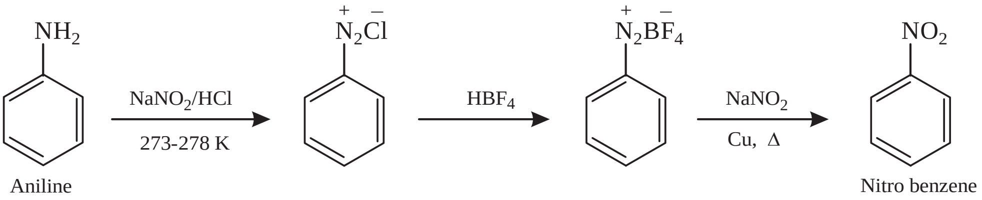
(*iii*) Of the two bromo derivatives, $C_6H_5CH(CH_3)Br$ and $C_6H_5CH(C_6H_5)Br$, the intermediate obtained from $C_6H_5CH\ (C_6H_5)\ Br$ is more stable than obtained from $C_6H_5CH(CH_3)\ Br$ because it is stabilised by two phenyl groups due to resonance. Therefore, $C_6H_5CH\ (C_6H_5)Br$ is more reactive than $C_6H_5(CH_3)\ Br$.

26. (*a*)

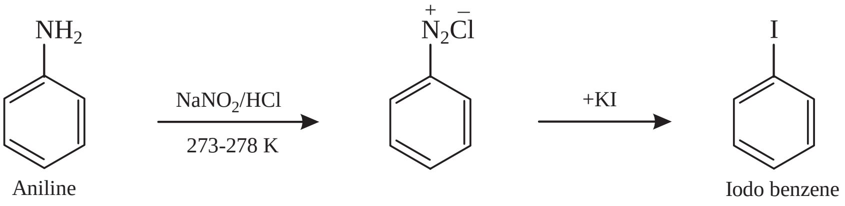


Due to electron releasing nature, the alkyl group (R) pushes electrons towards nitrogen in alkyl amine and thus makes the unshared electron pair more available for sharing with the proton of the acid. Therefore alkyl amine are more basic than ammonia.

(*b*) (*i*)



(*ii*)



27. (*i*) **Detergents:** Detergents are cleansing agents which have all the properties of soaps, but actually do not contain any soap *e.g.*, sodium dodecylbenzene sulphonate. These can be used both in soft and hard water as they give foam even in hard water. Detergents are mainly classified into three categories:

(*i*) Anionic detergents
(*ii*) Cationic detergents
(*iii*) Non-ionic detergents

(*ii*) Food Preservatives: These are the chemical substances which are added to the food materials to prevent their spoilage due to microbial growth and to retain their nutritive value for long time. Sodium benzoate, sodium metabisulphite are some common preservatives.

Preservatives prevent rancidity and kill or inhibit the growth of microorganism.

(*iii*) Antacids: These are the chemical substances which neutralize the excess acid and raise the pH to an appropriate level in the stomach. Sodium hydrogen carbonate or a mixture of aluminium and magnesium hydroxide are some common antacids.

28. (*a*) Molarity is the number of moles of solute dissolved in one litre of solution whereas molality is the number of moles of solute per kilogram of the solvent. Molarity decreases with increase in temperature as volume increases with increase in temperature. Molality is independent of temperature because mass does not depend on temperature.

(*b*) $$\Delta T_f = \frac{i \times K_f \times W_B \times 1000}{M_B \times W_A}$$

$i = 3$, $K_f = 1.86$ K kg mol^{-1}, $W_B = 10.5$ g

$M_B = 184$ g mol^{-1}, $W_A = 200$ g

Substituting these values in above equation, we get

$$\Delta T_f = \frac{3 \times 1.86\text{ K kg mol}^{-1} \times 10.5\text{ g} \times 1000\text{ g kg}^{-1}}{184\text{ g mol}^{-1} \times 200\text{ g}}$$

$$\Delta T_f = 1.59\text{ K}$$

Therefore, freezing of aqueous solution

$$= 273.15\text{ K} - 1.59\text{ K}$$
$$= 271.56\text{ K}$$

OR

(*a*) **Osmosis:** The spontaneous movement of the solvent molecules either from the pure solvent to the solution or from a less concentrated solution to a more concentrated solution through a semi-permeable membrane.

Osmotic Pressure: The minimum excess pressure that has to be applied on the solution to prevent the passage of solvent molecules into it through semipermeable membrane is called osmotic pressure.

Osmotic pressure is a colligative property as it depends on the number of moles of solute particles and not on their identity.

(*b*) $$\Delta T_b = \frac{i \times K_b \times W_B \times 1000}{M_B \times W_A}$$

$i = 2$, $K_b = 0.512$ K kg mol^{-1}, $W_B = 15$g

$M_B = 58.44$ g mol^{-1}, $W_A = 250$ g

Substituting these values in the above equation, We get

$$\Delta T_b = \frac{2 \times 0.512\ \text{K kg mol}^{-1} \times 15\ \text{g} \times 1000\ \text{g Kg}^{-1}}{58.44\ \text{g mol}^{-1} \times 250\ \text{g}} = 1.05\ \text{K}$$

Therefore, boiling point of aqueous solution

= 373.15K + 1.05 K

= 374.20 K

29. (*a*) (*i*) Propanal and propanone

Tollen's reagent test: Propanal being an aldehyde reduces Tollen's reagent to silver mirror but propanone being a ketone does not.

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + 2[Ag(NH_3)_2]^+ + 3\overline{O}H \longrightarrow CH_3CH_2\ CO\overline{O} + \underset{\text{Silver Mirror}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

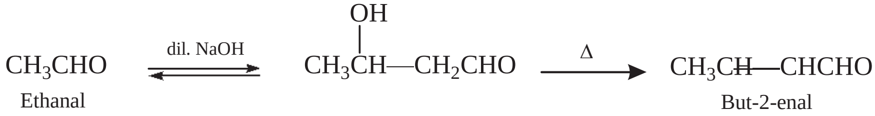
$$CH_3COCH_3 \xrightarrow[\text{reagent}]{\text{Tollen's}} \text{No silver mirror}$$

(*ii*) Benzaldehyde and acetophenone

Iodoform test: Acetophenone being a methyl ketone on treatment with I_2/NaOH undergoes Iodoform reaction to give yellow ppt. of iodoform but benzaldehyde does not.

$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \longrightarrow C_6H_5COONa + \underset{\substack{\text{Iodoform}\\ \text{(Yellow ppt.)}}}{CHI_3\downarrow} + 2NaOH$$

(*b*) (*i*)

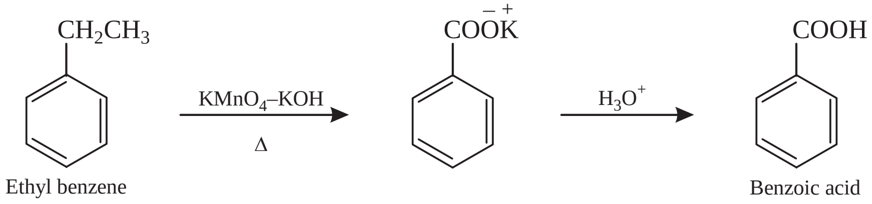


$$\underset{\text{Ethanal}}{CH_3CHO} \overset{\text{dil. NaOH}}{\rightleftharpoons} CH_3\overset{\overset{\text{OH}}{|}}{C}H{-}CH_2CHO \xrightarrow{\Delta} \underset{\text{But-2-enal}}{CH_3CH{=}CHCHO}$$

(*ii*) $CH_3CH_2CH_2CH_2OH \xrightarrow{CrO_3-H_2SO_4} CH_3CH_2CH_2COOH$

® Butan–1–ol　　　　　　Butanoic acid

(*iii*)



OR

(*a*) **(*i*)** **Cannizzaro reaction:** Aldehydes which do not have an α-hydrogen atom undergoes disproportionation reactions on treatment with concentrated alkali to give a mixture of carboxylic acid salt and alcohol.

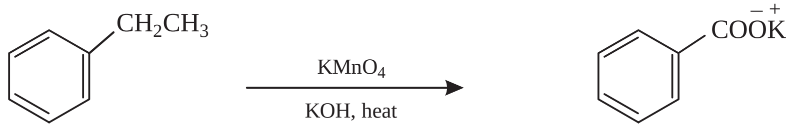
$$2\ HCHO \xrightarrow{\text{Conc. NaOH}} \underset{\text{Sod. formate}}{HCOO\overset{+}{Na}} + \underset{\text{Methyl alcohol}}{CH_3-OH}$$

® Formaldehyde

(*ii*) **Decarboxylation:** Carboxylic acids lose carbon dioxide to form hydrocarbons when their sodium salts are heated with sodalime.

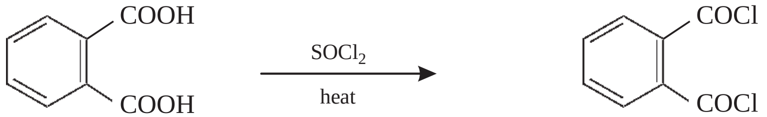
$$RCO\overset{-}{O}\overset{+}{Na} \xrightarrow[\Delta]{\text{NaOH and CaO}} RH + Na_2CO_3$$

(*b*) (*i*)



Ethyl benzene Pot. benzoate

(*ii*)



Phthalic acid Phthaloyl chloride

(*iii*) $\underset{\text{Benzamide}}{C_6H_5CONH_2} \xrightarrow[\text{heat}]{H_3O^+} \underset{\text{Benzoic acid}}{C_6H_5COOH} + NH_3$

30. (*a*) (*i*) This is because bond dissociation energy of F_2 is lower than Cl_2 Moreover, fluorine forms stronger bond with nitrogen due to comparable size.

(*ii*) Because of low F—F bond dissociation enthalpy.

(*b*) (*i*) $C + 2H_2SO_4 \text{ (conc.)} \longrightarrow CO_2 + 2SO_2 + 2H_2O$

(*ii*) $P_4 + 3NaOH + 3H_2O \longrightarrow \underset{\text{Phosphine}}{PH_3} + 3NaH_2PO_2$

(*iii*) $Cl_2 + \underset{\text{(excess)}}{3F_2} \xrightarrow{573\,K} 2ClF_3$

OR

(*a*) (*i*) As bond dissociation enthalpy of H—Cl bond is lower than H—S which is lower than P—H. The acidic strength decreases because of decrease in polarity of E—H bond from H—Cl to P—H which is due to decrease in electonegativity of E.

(*ii*) This is due to inert pair effect. The stability of +5 oxidation state decreases down the group in group 15.

(*b*) (*i*) $P_4 + 10SO_2Cl_2 \longrightarrow 4PCl_5 + 10SO_2$

(*ii*) $2Xe\,F_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

(*iii*) $2HNO_3 \text{ (conc.)} \longrightarrow H_2O + 2NO_2 + (O)] \times 5$

$I_2 + 5(O) \longrightarrow I_2O_5$

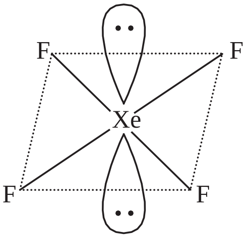
$I_2O_5 + H_2O \longrightarrow 2HIO_3$

$I_2 + 10HNO_3\text{(conc.)} \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$

CBSE (Delhi) SET - II

1. Interstitial defect

3. The catalytic reaction that depends upon the pore structure of the catalyst and the size of the reactant and product molecules is called shape-selective catalysis.



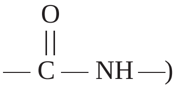
4. Total number of electron pairs in the valence shell of central

$$\text{Xe atom} = \frac{8+4}{2} = 6$$

No. of bond pairs = 4

No. of lone pairs = 2

Therefore, the shape of molecule would be square planar.



9. (*i*) **Peptide linkage:** The amide linkage ($-\overset{\displaystyle O}{\overset{\|}{C}}-NH-$) formed between two α–amino acid molecules with the loss of a water molecule in a polypeptide is called a peptide linkage.

(*ii*) **Glycosidic linkage:** The oxide linkage between two monosaccharides in oligosaccharides or polysaccharides is called glycosidic linkage.

10. The bases present in RNA are adenine (A), guanine (G), cytosine (C) and uracil (U). Uracil is not present in DNA.

22. (*i*) **CO in the extraction of nickel:** Impure nickel is heated in a stream of carbon monoxide when volatile nickel tetracarbonyl is formed and the impurities are left behind in the solid state. The vapour of nickel tetra carbonyl is taken to a decomposer chamber maintained at 450–470 K where it decomposes to give pure nickel metal and carbon monoxide.

$$\underset{\text{Impure nickel}}{\text{Ni}} + 4\text{CO} \xrightarrow{330-350\text{ K}} \underset{\text{Nickel tetracarbonyl}}{\text{Ni(CO)}_4} \xrightarrow{450-470\text{ K}} \underset{\text{Pure nickel}}{\text{Ni}} + \text{CO}$$

(*ii*) **Zinc in the extraction of silver:** Silver present in the ore is leached with dilute solution of NaCN in the presence of air or oxygen to form a soluble complex.

$$4\text{Ag}(s) + 8\text{CN}^-(aq) + 2\text{H}_2\text{O}(l) + \text{O}_2(g) \longrightarrow \underset{\text{Soluble Complex}}{4\,[\text{Ag (CN)}_2]^-} + 4\text{ OH}^-(aq)$$

Silver is then recovered from the complex by displacement method using complex using a more electropositive zinc metal.

$$2[\text{Ag(CN)}_2]^-\,(aq) + \text{Zn}(s) \longrightarrow 2\text{Ag}(s) + [\text{Zn(CN)}_4]^{2-}(aq)$$

(*iii*) **Silica in the extraction of copper:** During smelting and bessemerisation the impurity ferrous sulphide oxidised to ferrous oxide which is then reacted with silica (flux) to form slag ferrous silicate.

$$\text{FeO} + \underset{\text{Flux}}{\text{SiO}_2} \longrightarrow \underset{\text{Ferrous silicate(slag)}}{\text{FeSiO}_3}$$

24. (*i*) $[\text{Fe (en)}_2\ \text{Cl}_2]\text{Cl}$

$x + 0 \times 2 + (-1) \times 2 + (-1) \times 1 = 0 \qquad x = 3$

Oxidation number of iron = 3

(*ii*) d^2sp^3 hybridization, Octahedral

(*iii*) Paramagnetic

(*iv*) Two

(*v*) Yes, *cis*-$[\text{Fe(en)}_2\text{Cl}_2]$

(*vi*) Bis–(ethane-1, 2-diamine)–dichlorido iron (III) chloride

27. (*i*) Artificial sweetening agents are chemical substances which are sweet in taste but do not add calories to our body. For example, saccharin. Its use is of great value to diabetic persons as it is excreted from the body through urine as such.

(*ii*) **Enzymes:** Enzymes are catalysts of biological origin which accelerate various cellular reactions without themselves undergoing any apparent change during the course of action. Enzymes are highly specific in their action on substrate. Almost all the enzymes are globular proteins.

(*iii*) **Analgesics:** Analgesics are chemical compounds which are used for relieving pain. Analgesics relieves pain by acting on central nervous system or on peripheral pain mechanism, without significantly affecting consciousness. There are two types of analgesics:

Narcotics — Morphine, cocaine, heroine

Non-narcotics — Aspirin, ibuprofen etc.

28. (*a*) (*i*) **Henry's law:** It states that the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution and is expressed as:

$$P = K_H\, x$$

Where K_H is Henry's law constant

(*ii*) **Raoult's law:** It states that for any solution the partial pressure of each volatile component in the solution is directly proportional to its mole fraction.

(*b*)
$$M_B = \frac{W_B \times R \times T}{\pi \times V}$$

Here, $W_B = 8.95 \text{ mg} = 8.95 \times 10^{-3} \text{g}, \ R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$

$T = (25 + 273)\text{ K} = 298 \text{ K}, \ \pi = \frac{0.335}{760} \text{ atm}$

$V = 35 \times 10^{-3} \text{ L}$

Substituting these values in the above equation

We get,
$$M_B = \frac{8.95 \times 10^{-3} \text{ g} \times 0.0821 \text{ L atm K}^{-1} \text{mol}^{-1} \times 298 \text{ K}}{\frac{0.335}{760} \text{ atm} \times 35 \times 10^{-3} \text{ L}}$$

$$M_B = 14193.29 \text{ g mol}^{-1}$$

OR

(*a*) **Molarity (*M*):** It is defined as number of moles of solute dissolved in one litre of solution.

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution in litre}}$$

Unit of molarity is mol L^{-1} or M (molar). Molarity changes with change in temperature as volume changes with change in temperature.

Molality (*m*): It is defined as the number of moles of the solute dissolved in one kilogram (kg) of the solvent and is expressed as:

$$\text{Molality} = \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}}$$

$$= \frac{\text{Number of moles of solute}}{\text{Mass of solvent (in grams)}} \times 1000$$

Unit of molality is mol kg^{-1}.

Molality is independent of temperature.

(*b*)
$$M_B = \frac{K_b \times W_B \times 1000}{\Delta T_b \times W_A}$$

Here, $K_b = 3.63 \text{ K kg mol}^{-1}, \quad W_B = 6.21 \text{ g}$

$$\Delta T_b = 68.04°C - 61.7°C = 6.34°C,\ W_A = 24.0\text{ g}$$

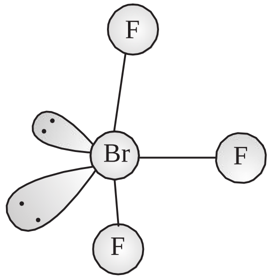
Substituting these values in the above equation, we get

$$M_B = \frac{3.63\ \text{K kg mol}^{-1} \times 6.21\text{ g} \times 1000\text{ g kg}^{-1}}{6.34\text{ K} \times 24.0\text{ g}}$$

$$M_B = 148.15\text{ g mol}^{-1}$$

CBSE (Delhi) SET - III

2. $\kappa\ (\text{conductivity}) = \dfrac{1}{\text{R (Resistance)}} \times \text{G (Cell constant)}$



4. Total number of electron pairs in the valence shell of central Br atom $= \dfrac{7+3}{2} = 5$

Number of bond pairs = 3

Number of lone pairs = 2

Therefore, the shape of molecule would be that of slightly bent-T.

8. In nylon-6, 6 both the monomers hexamethylene diamine and adipic acid contain six carbon atoms each.

9. Secondary cell.

At anode: $\text{Pb}(s) + \text{SO}_4^{2-}(aq) \longrightarrow \text{PbSO}_4(s) + 2\bar{e}$

At cathode: $\text{PbO}_2(s) + \text{SO}_4^{2-}(aq) + 4\text{H}^+(aq) + 2\bar{e} \longrightarrow \text{PbSO}_4(s) + 2\text{H}_2\text{O}(l)$

Cell reaction : $\text{Pb}(s) + \text{PbO}_2(s) + 2\text{H}_2\text{SO}_4(aq) \longrightarrow 2\text{PbSO}_4(s) + 2\text{H}_2\text{O}(l)$

10. At anode: $\text{Sn}^{2+}(aq) \longrightarrow \text{Sn}^{4+}(aq) + 2e^-] \times 5$

At cathode: $\text{MnO}_4^-(aq) + 8\text{H}^+(aq) + 5e^- \longrightarrow \text{Mn}^{2+}(aq) + 4\text{H}_2\text{O}(l)] \times 2$

Cell reaction : $2\text{MnO}_4^-(aq) + 5\text{Sn}^{2+}(aq) + 16\text{ H}^+(aq) \longrightarrow 2\text{Mn}^{2+}(aq) + 5\text{Sn}^{4+}(aq) + 8\text{H}_2\text{O}(l)$

$$E^{\circ}_{\text{Cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}} = 1.51\text{ V} - 0.15\text{ V}$$
$$= 1.36\text{ V}$$

As cell potential is positive therefore the reaction is product favoured.

13. (*i*) This is due to *d*-*d* transition. When visible (white) light falls on a transition metal compounds, they absorb certain radiation of visible light and transmit the remaining ones. The colour observed corresponds to complementary colour of the light absorbed.

(*ii*) As manganese has maximum number of unpaired electrons (5) in 3*d* subshell in addition to 2 electrons in the 4*s* subshell.

18. On the basis of magnitude of intermolecular forces polymers are classified into following four sub-groups:

(*i*) Elastomers
(*ii*) Fibers
(*iii*) Thermoplastic polymers
(*iv*) Thermosetting polymers

19. $d = \dfrac{Z \times M}{a^3 \times N_A} \quad \Rightarrow \quad a^3 = \dfrac{Z \times M}{d \times N_A}$ ...(i)

For fcc unit cell, Z = 4

$M = 207 \text{ g mol}^{-1} \quad N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

$d = 11.35 \text{ g cm}^{-3}$

Substituting these values in equation (i), we get

$$a^3 = \frac{4 \times 207 \text{ g mol}^{-1}}{11.35 \text{g cm}^{-3} \times 6.02 \times 10^{23} \text{ mol}^{-1}}$$

$$a^3 = \frac{4 \times 207 \times 10}{11.35 \times 6.02 \times 10^{24}} \text{ cm}^3 \quad \Rightarrow \quad a = \left(\frac{8280}{11.35 \times 6.02}\right)^{1/3} \times 10^{-8} \text{ cm}$$

Let $$x = \left(\frac{8280}{11.35 \times 6.02}\right)^{1/3}$$

$$\log x = \frac{1}{3}[\log 8280 - \log 11.35 - \log 6.02] = \frac{1}{3}[3.9180 - 1.0549 - 0.7796]$$

$$\log x = \frac{1}{3}[2.0835] = 0.6945$$

$$x = \text{Antilog } (0.6945) \quad \Rightarrow \quad x = 4.949$$

$\therefore$ $$a = 4.949 \times 10^{-8} \text{ cm} \quad \Rightarrow \quad a = 494.9 \text{ pm}$$

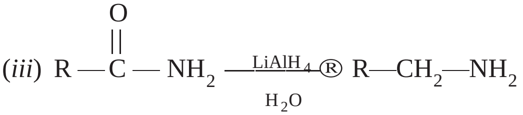
For fcc, $$r = \frac{a}{2\sqrt{2}}$$

$\therefore$ $$r = \frac{494.9}{2\sqrt{2}} \text{ pm} = \frac{494.9\sqrt{2}}{4} \text{ pm} = \frac{494.9 \times 1.414}{4} \text{ pm}$$

$\therefore$ $$r = 174.95 \text{ pm}$$

26. (*i*) $CH_3CH_2Cl \xrightarrow{NaCN} CH_3CH_2CN \xrightarrow[Ni/H_2]{Reduction} CH_3CH_2CH_2NH_2$

(*ii*) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow C_6H_6$

(*iii*) 

$R - \overset{\overset{\displaystyle O}{||}}{C} - NH_2 \xrightarrow[H_2O]{LiAlH_4} R—CH_2—NH_2$

27. (*i*) Hard water contains calcium and magnesium salts. In hard water, soaps get precipitated as calcium and magnesium soaps which being insoluble stick to the clothes as gummy mass.

(*ii*) Chloroxylenol and α-terpineol in a suitable solvent.

(*iii*) Antiseptics are chemical substances which prevent the growth of microorganisms and may even kill them but are not harmful to human or animal tissues. Examples are dettol and savlon. They are generally applied on wounds, ulcers, cuts and diseased skin surfaces. Furacin and soframycin are well-known antiseptic creams.

Disinfectants are chemical substances which kill microorganisms but are not safe to be applied to the living tissues. These are generally used to kill microorganisms present in the toilets, drains, floors, etc. Some common examples of disinfectants are phenol (≥1% solution) and chlorine (0.2 to 0.4 ppm).

CBSE EXAMINATION PAPERS

ALL INDIA–2011

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory*.

(*ii*) *Question numbers* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question numbers* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question numbers* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question numbers* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables, if necessary. Use of calculators is not allowed.*

CBSE (All India) SET–I

1. Define ‘order of a reaction’.

2. What is meant by ‘shape selective catalysis’?

3. Differentiate between a mineral and an ore.

4. What is meant by ‘lanthanoid contraction’?

5. Write the IUPAC name of the following compound:
$CH_2 = CHCH_2Br$

6. Draw the structure of 4-chloropentan-2-one.

7. How would you convert ethanol to ethene?

8. Rearrange the following in an increasing order of their basic strengths:
$C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_6H_5)_2$ NH and CH_3NH_2

9. Explain how you can determine the atomic mass of an unknown metal if you know its mass density and the dimensions of unit cell of its crystal.

10. Calculate the packing efficiency of a metal crystal for a simple cubic lattice.

11. State the following:

(*i*) Raoult’s law in its general form in reference to solutions.

(*ii*) Henry’s law about partial pressure of a gas in a mixture.

12. What do you understand by the rate law and rate constant of a reaction? Identify the order of a reaction if the units of its rate constant are:

(*i*) L^{-1} mol s^{-1}

(*ii*) L mol^{-1} s^{-1}.

13. The thermal decomposition of HCO_2H is a first order reaction with a rate constant of $2.4 \times 10^{-3}\ s^{-1}$ at a certain temperature. Calculate how long will it take for three-fourths of initial quantity of HCO_2H to decompose. (log 0.25 = – 0.6021)

14. Describe the principle controlling each of the following processes:

(*i*) Vapour phase refining of titanium metal.

(*ii*) Froth floatation method of concentration of a sulphide ore.

15. How would you account for the following:

(*i*) Cr^{2+} is reducing in nature while with the same d-orbital configuration (d^4) Mn^{3+} is an oxidising agent.

(*ii*) In a transition series of metals, the metal which exhibits the greatest number of oxidation occurs in the middle of the series.

16. Complete the following chemical equations:

(*i*) $MnO_4^-(aq)$ + $S_2O_3^{2-}(aq)$ + $H_2O(l)$

——® (*ii*) $Cr_2O_7^{2-}(aq)$ + $Fe^{2+}(aq)$ + $H^+(aq)$

——®

OR

State reasons for the following:

(*i*) Cu(I) ion is not stable in an aqueous solution.

(*ii*) Unlike Cr^{3+}, Mn^{2+}, Fe^{3+} and the subsequent other M^{2+} ions of the 3*d* series of elements, the 4*d* and the 5*d* series metals generally do not form stable cationic species.

17. Explain what is meant by the following:

(*i*) peptide linkage

(*ii*) pyranose structure of glucose.

18. Write the main structural difference between DNA and RNA. Of the four bases, name those which are common to both DNA and RNA.

19. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming that the gene fragment is a non-electrolyte, calculate its molar mass.

20. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes.

OR

Explain what is observed when

(*a*) an electric current is passed through a sol.

(*b*) a beam of light is passed through a sol.

(*c*) an electrolyte (say NaCl) is added to ferric hydroxide sol.

21. How would you account for the following:

(*i*) H_2S is more acidic than H_2O.

(*ii*) The N—O bond in NO_2^- is shorter than the N—O bond in NO_3^-.

(*iii*) Both O_2 and F_2 stabilise high oxidation states but the ability of oxygen to stablise the higher oxidation state exceeds that of fluorine.

22. Explain the following terms giving a suitable example in each case:

(*i*) Ambident ligand

(*ii*) Denticity of a ligand

(*iii*) Crystal field splitting in an octahedral field.

23. Rearrange the compounds of each of the following sets in order of reactivity towards S_N2 displacement:

(*i*) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane

(*ii*) 1-Bromo-3-methylbutane, 2-Bromo-2methylbutane,
3-Bromo-2-methylbutane

(*iii*) 1-Bromobutane, 1-Bromo-2, 2-dimethylpropane,
1-Bromo-2-methylbutane

24. How would you obtain the following:

(*i*) Benzoquinone from phenol

(*ii*) 2-Methylpropan-2-ol from methylmagnesium bromide

(*iii*) Propan-2-ol from propane

25. State reasons for the following:

(*i*) pK_b value for aniline is more than that for methylamine.

(*ii*) Ethylamine is soluble in water whereas aniline is not soluble in water.

(*iii*) Primary amines have higher boiling points than tertiary amines.

26. Draw the structures of the monomers of the following polymers:

(*i*) Polythene

(*ii*) PVC

(*iii*) Teflon

27. What are the following substances? Give one example of each.

(*i*) Food preservatives

(*ii*) Synthetic detergents

(*iii*) Antacids

28. (*a*) What type of a battery is lead storage battery? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery.

(*b*) Calculate the potential for half-cell containing
0.10M $K_2Cr_2O_7$ (aq), 0.20Mcr^{3+} (aq) and 1.0×10^{-4}MH$^+$(aq) The half cell reaction is
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$
and the standard electrode potential is given as E° =1.33V.

OR

(*a*) How many moles of mercury will be produced by electrolysing 1.0 M. $Hg(NO_3)_2$ solution with a current of 2.00 A for 3 hours?

(*b*) A voltaic cell is set up at 25° C with the following half-cells Al^{3+} (0.001 M) and Ni^{2+} (0.50 M). Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

(Given: $E^{o}_{Ni^{2+}/Ni} = -0.25$ V, $E^{o}_{Al^{3+}/Al} = -1.66$ V)

29. (*a*) Draw the structures of the following molecules:

(*i*) $(HPO_3)_3$

(*ii*) BrF_3

(*b*) Complete the following equations:

(*i*) $HgCl_2$ + PH_3 ——®
(*ii*) SO_3 + H_2SO_4
——® (*iii*) XeF_4 + H_2O
——®

OR

(*a*) What happens when

- (*i*) chlorine gas is passed through a hot concentrated solution of NaOH?
- (*ii*) sulphur dioxide gas is passed through an aqueous solution of a Fe (III) salt?

(*b*) Answer the following:

- (*i*) What is the basicity of H_3PO_3 and why?
- (*ii*) Why does fluorine not play the role of a central atom in interhalogen compounds?
- (*iii*) Why do noble gases have very low boiling points?

30. (*a*) Illustrate the following name reactions:

- (*i*) Cannizzaro's reaction
- (*ii*) Clemmensen reduction

(*b*) How would you obtain the following:

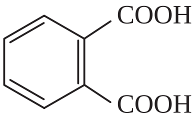
- (*i*) But-2-enal from ethanal
- (*ii*) Butanoic acid from butanol
- (*iii*) Benzoic acid from ethylbenzene

OR

(*a*) Give chemical tests to distinguish between the following:

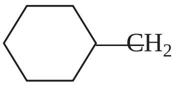
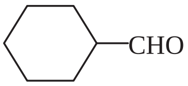
- (*i*) Benzoic acid and ethyl benzoate
- (*ii*) Benzaldehyde and acetophenone.

(*b*) Complete each synthesis by giving missing reagents or products in the following:

(*i*) 

$\xrightarrow[\text{heat}]{SOCl_2}$ ®

(*ii*) C_6H_5CHO $\xrightarrow{H_2NCONHNH_2}$ ®

(*iii*)  ——® 

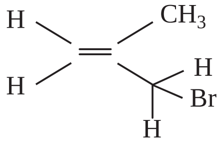
CBSE (All India) SET–II

Questions Uncommon to Set–I

2. What are lyophobic colloids? Give one example for them.

3. Why is it that only sulphide ores are concentrated by froth floatation process?

5. Write the IUPAC name of the following compound:



6. Draw the structure of 2, 6-Dimethylphenol.

9. Define the following terms in relation to crystalline solids:
(*i*) Unit cell
(*ii*) Coordination number
Give one example in each case.

12. A reaction is of second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is reduced to half? What is the unit of rate constant for such a reaction?

14. Describe the principle controlling each of the following processes:
(*i*) Zone refining of metals.
(*ii*) Electrolytic refining of metals.

15. Explain giving a suitable reason for each of the following:
(*i*) Transition metals and their compounds are generally found to be good catalysts.
(*ii*) Metal-metal bonding is more frequent for the 4*d* and the 5*d* series of transition metals than that for the 3*d* series.

19. What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.50°C? The freezing point depression constant (K_f) for water is 1.86 C/m. Assume van't Hoff factor for NaCl is 1.87. (Molar mass of NaCl = 58.5 g).

22. Write the structures and names of all the stereoisomers of the following compounds:
(*i*) $[Co(en)_3]Cl_3$
(*ii*) $[Pt(NH_3)_2Cl_2]$
(*iii*) $[Fe(NH_3)_4Cl_2]Cl$

CBSE (All India) SET–III

Questions Uncommon to Set-I and Set-II

1. Define 'activation energy' of a reaction.

2. What is meant by 'reverse osmosis'?

3. What type of ores can be concentrated by magnetic separation method?

11. Differentiate between molality and molality values for a solution. What is the effect of change in temperature on molarity and molality values?

14. Describe the principle controlling each of the following processes:
(*i*) Preparation of cast iron from pig iron.
(*ii*) Preparation of pure alumina (Al_2O_3) from bauxite ore.

15. Explain giving reasons:

(*i*) Transition metals and their compounds generally exhibit a paramagnetic behaviour.

(*ii*) The chemistry of actinoids is not as smooth as that of lanthanoids.

18. Write such reactions and facts about glucose which cannot be explained by open chain structure.

21. How would you account for the following:

(*i*) NF_3 is an exothermic compounds but NCl_3 is not.

(*ii*) The acidic strength of compounds increases in the order:

$PH_3 < H_2S < HCl$

(*iii*) SF_6 is kinetically inert.

22. Write the state of hybridization, the shape and the magnetic behaviour of the following complex entities:

(*i*) $[Cr(NH_3)_4 Cl_2]Cl$

(*ii*) $[Co(en)_3]Cl_3$

(*iii*) $K_2 [Ni (CN)_4]$

26. Write the names and structures of the monomers of the following polymers:

(*i*) Buna-S

(*ii*) Dacron

(*iii*) Neoprene

Solutions

CBSE (All India) SET–I

1. Order of a reaction may be defined as the sum of the powers of the concentration terms of the reactants in the rate law expression.

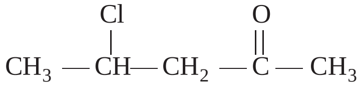
2. The catalysis in which the pore structure of the catalyst and the size of the reactant and product molecules are comparable is called shape selective catalysis.

3. The naturally occurring chemical substances present in the earth's crust which can be obtained by mining are called minerals, while mineral from which metals can be extracted economically are called ores.

4. The steady decrease in the atomic and ionic radii (having the same charge) with increase in atomic number as we move across the series from lanthanum to lutetium is known as lanthanoid contraction.

5. 3-Bromoprop-l-ene

6.



$$CH_3-\overset{\overset{\displaystyle Cl}{|}}{CH}-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$$

7. $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\text{ K}]{\text{conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + H_2O$

8. $(C_6H_5)_2 NH < C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2$

9. We can determine the atomic mass of an unknown metal by using the formula of density of its unit cell.

$$d \text{ (density)} = \frac{\text{Z (No. of atoms per unit cell)} \times \text{M (atomic mass)}}{\text{a}^3 \text{(cell edge)} \times \text{N}_\text{A} \text{ (Avogadro number)}}$$

By knowing d, Z, a and N_{A}, we can calculate M, the atomic mass of metal.

10. Packing efficiency $= \dfrac{\text{Z} \times \text{volume of one atom}}{\text{Volume of cubic unit cell}} \times 100$

$$= \frac{Z \times \frac{4}{3}\pi r^3}{a^3} \times 100$$

For a simple cubic lattice, $a = 2r$ and $Z = 1$

$$\therefore \quad \text{Packing efficiency} = \frac{1 \times \frac{4}{3}\pi r^3}{(2r)^3} \times 100 = \frac{\pi}{6} \times 100$$

$$= 52.36\% = 52.4\%$$

11. (*i*) Raoult's law: It states that for any solution, the partial pressure of each volatile component in the solution is directly proportional to its mole fraction.

(*ii*) Henry's law: It states that the partial pressure of a gas in vapour phase (P) is proportional to its mole fraction (x) in the solution.

12. An experimentally determined expression which relates the rate of reaction with the concentration of reactants is called rate law while the rate of reaction when concentration of each reactant is unity in a rate law expression is called rate constant.

(*i*) Comparing power of mole in $\text{L}^{-1} \text{ mol s}^{-1}$ and $(\text{mol L}^{-1})^{1-n} \text{ s}^{-1}$,

We get

$$1 = 1 - n \quad \Rightarrow \quad n = 0 \textit{ i.e.}, \text{ zero order reaction}$$

(*ii*) Again comparing power of mole in $\text{L mol}^{-1}\text{s}^{-1}$ and $(\text{mol L}^{-1})^{1-n} \text{ s}^{-1}$, we get

$$-1 = 1 - n \quad \Rightarrow \quad n = 2, \textit{ i.e.}, \text{ second order reaction}$$

13. For a first order reaction

$$\text{t} = \frac{2.303}{k} \log \frac{[\text{A}]_\text{o}}{[\text{A}]}$$

Here, $\quad \text{k} = 2.4 \times 10^{-3} \text{ s}^{-1}, [\text{A}] = [\text{A}]_\text{o} - \frac{3}{4}[\text{A}]_\text{o} = \frac{[A]_\text{o}}{4}, \text{ t} = ?$

Substituting these values in the equation, we get

$$\text{t} = \frac{2.303}{2.4 \times 10^{-3} \text{ s}^{-1}} \log \frac{[\text{A}]\text{o}}{[\text{A}]\text{o}/_4}$$

$$\text{t} = \frac{2.303}{2.4 \times 10^{-3} \text{ s}^{-1}} \log 4$$

$$= \frac{2.303}{2.4 \times 10^{-3}} \times 0.6021 \text{ s}$$

$$\text{t} = 577.7 \text{ s} = 578 \text{ s}$$

14. (*i*) In this method, the metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal.

$$\underset{\text{Impure metal}}{Ti} + 2I_2 \xrightarrow{500\text{ K}} TiI_4$$

$$TiI_4 \xrightarrow{1700\text{ K}} \underset{\text{Pure metal}}{Ti} + 2I_2$$

(*ii*) This method of concentration of ore is based upon the principle that the surface of sulphide ores is preferentially wetted by oils while that a gangue is preferentially wetted by water.

15. (*i*) Cr^{2+} is reducing as its configuration changes from d^4 to d^3, a more stable half filled t_{2g} configuration while Mn^{3+} is oxidising as Mn^{3+} to Mn^{2+}results a more stable half filled d^5 configuration.

(*ii*) It is due to greater number of unpaired electrons in $(n–1)d$ and ns orbitals at the middle of the series.

16. (*i*) $8MnO_4^-(aq) + 3S_2O_3^{2-}(aq) + H_2O\ (l) \longrightarrow 8MnO_2(s) + 6SO_4^{2-}(aq) + 2OH^-(aq)$

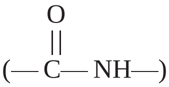
(*ii*) $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6Fe^{2+}(aq) \longrightarrow 2Cr^{3+}(aq) + 6Fe^{3+}(aq) + 7H_2O(l)$

OR

(*i*) This is because Cu(I) ion is unstable in aqueous solution and undergo disproportionation.

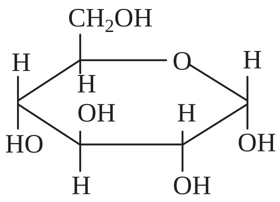
$$2Cu^+(aq) \longrightarrow Cu^{2+}(aq) + Cu(s)$$

(*ii*) This is because due to lanthanoid contraction the expected increase in size does not occur.



17. (*i*) Peptide linkage: The amide $(-\overset{\overset{O}{\|}}{C}-NH-)$ linkage between two α-amino acids formed with the loss of a water molecule is called a peptide linkage.

(*ii*) The six membered cyclic structure of glucose is called pyranose structure $(\alpha-\text{or}\,\beta-)$, in analogy with heterocylic compound pyran.



α – D – (+) – Glucopyranose

18. Structural difference between DNA and RNA

DNA	RNA
1. The sugar present in DNA is 2-deoxy D-(–) ribose.	1. The sugar present in RNA is D-(–)-ribose.
2. DNA has double stranded α-helix structure.	2. RNA has single α-helix structure.

The common bases present in both DNA and RNA are adenine (A), guanine (G) and cytosine (C).

19. $$M_B = \frac{W_B \times R \times T}{\pi \times V} \quad \text{....}(i)$$

Here, $W_B = 8.95 \text{ mg} = 8.95 \times 10^{-3}\text{g}$, $R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$

$T = 25°\text{C} = (25 + 273) \text{ K} = 298 \text{ K}$, $\pi = 0.335 \text{ torr} = \frac{0.335}{760} \text{ atm}$

$V = 35 \text{ mL} = 35 \times 10^{-3} \text{ L}$

Substituting these values in the equation (*i*), we get

$$M_B = \frac{8.95 \times 10^{-3} \text{ g} \times 0.0821 \text{ L atm mol}^{-1}\text{K}^{-1} \times 298\text{K} \times 760}{0.335 \text{ atm} \times 35 \times 10^{-3} \text{ L}} = 14193.3 \text{ g mol}^{-1}$$

20. These are of two types

(*i*) Hydrophilic

Stability: More stable as the stability is due to charge and water envelope surrounding the sol particles.

Nature: Reversible

Examples: Starch, gum, etc.

(*ii*) Hydrophobic

Stability: Less stable as the stability is due to charge only.

Nature: Irreversible

Examples: Metal hydroxide like $Fe(OH)_3$ and metal sulphide like As_2S_3.

OR

(*i*) On passing electric current through a sol, colloidal particles start moving towards oppositely charged electrode where they lose their charge and get coagulated (electrophoresis).

(*ii*) Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

(*iii*) The positively charged colloidal particles of ferric hydroxide sol get coagulated by the oppositely charged Cl^- ions provided by NaCl.

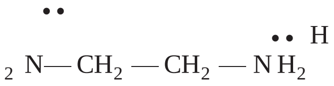
21. (*i*) This is because bond dissociation enthalpy of H—S bond is lower than that of H—O bond.

(*ii*) This is because two bonds share a double bond in the resonance hybrid structure of NO_2^- while three bonds share a double bond in the resonance hybrid structure of NO_3^-. This is because NO_2^- has bond order 1.5 while NO_3^- has bond order 1.33.

(*iii*) This is due to tendency of oxygen to form multiple bonds with metal atom.

22. (*i*) Ambidentate ligand: A ligand which can coordinate to central metal atom through two different atoms is called ambidentate ligand. For example NO_2^- ion can coordinate either through nitrogen or through oxygen to a central metal atom/ion.

(*ii*) Denticity: The number of coordinating groups present in ligand is called the denticity of ligand. For example, bidentate ligand ethane-1, 2-diamine has two donor nitrogen atoms which can link to central metal atom.



$$_2\overset{\bullet\bullet}{N}—CH_2—CH_2—\overset{\bullet\bullet}{N}H_2 \quad H$$

Ethane–1, 2–diamine

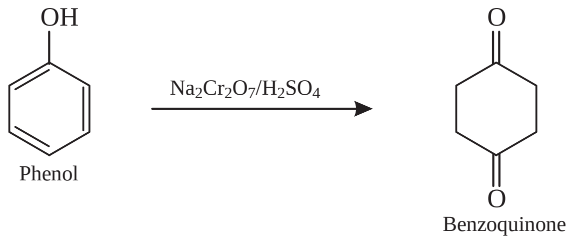
(*iii*) The spliting of the degenerated *d*-orbitals into three orbitals of lower energy, t_{2g} set and two orbitals of higher energy *eg*, set due to the presence of ligand in a octahedral crystal field is known as crystal spliting in a octahedral field.

23. (*i*) 1-Bromopentane > 2-Bromopentane > 2-Bromo-2methyl butane.

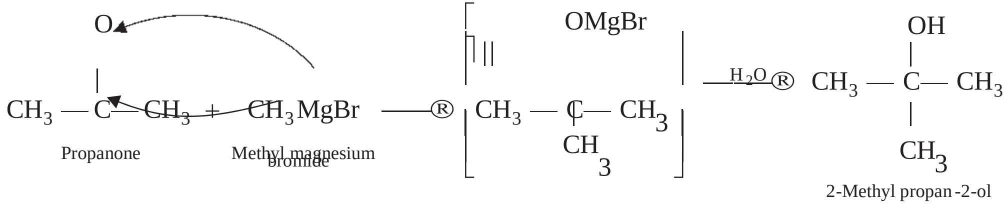
(*ii*) 1-Bromo-2-methyl butane > 3-Bromo-2-methyl butane > 2-Bromo-2-methyl butane

(*iii*) 1-Bromobutane > 1-Bromo-2-methylbutane > 1-Bromo-2,2-dimethyl butane.

24. (*i*)

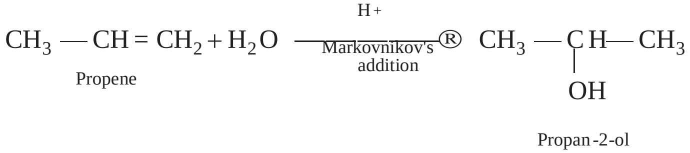


(*ii*)



$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3MgBr \longrightarrow \left[CH_3-\underset{CH_3}{\underset{|}{\overset{OMgBr}{\overset{|}{C}}}}-CH_3\right] \xrightarrow{H_2O} CH_3-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$$

(*iii*)



$$CH_3-CH=CH_2+H_2O \xrightarrow[\text{Markovnikov's addition}]{H^+} CH_3-\underset{OH}{\underset{|}{C}}H-CH_3$$

25. (*i*) In aniline, the lone pair of electrons on N-atom are delocalised over benzene ring due to resonance. As a result, electron density on the nitrogen atom decreases. In contrast, in methylamine, +I-effect of CH_3^- group increases electron density on the nitrogen atom. Therefore, aniline is a weaker base than methylamine, hence its pK_b value is more than that for methylamine.

(*ii*) Ethylamine is soluble in water due to formation of inter-molecular hydrogen bonds with water molecules. However, in aniline due to large hydrophobic part, *i.e.*, hydrocarbon part, the extent of hydrogen bonding decreases considerably and hence aniline is insoluble in water.

(*iii*) Due to the presence of two H-atoms on N-atom, primary amines undergo extensive intermolecular hydrogen bonding whereas tertiary amines have no H-atoms on the nitrogen atom, do not undergo H-bonding. As a result, primary amines have higher boiling points than tertiary amines.

26. (*i*)

Name of monomer	**Structure**
Ethene	$CH_2 = CH_2$
Vinyl chloride	$CH_2 = CH–Cl$
Tetrafluoroethene	$F_2C = CF_2$

27. **(*i*) Food Preservatives:** These are the chemical substances which are added to the food materials to prevent their spoilage due to microbial growth and to retain their nutritive value for long time. Sodium benzoate, sodium metabisulphite are some common preservatives.

Preservatives prevent rancidity and kill or inhibit the growth of microorganism.

(*ii*) **Synthetic Detergents:** Detergents are cleansing agents which have all the properties of soaps, but actually do not contain any soap *e.g.*, sodium dodecylbenzene sulphonate. These can be used both in soft and hard water as they give foam even in hard water. Detergents are mainly classified into three categories:

(*i*) Anionic detergents
(*ii*) Cationic detergents
(*iii*) Non-ionic detergents

(*iii*) **Antacids:** These are the chemical substances which neutralize the excess acid and raise the pH to an appropriate level in the stomach. Sodium hydrogen carbonate or a mixture of aluminium and magnesium hydroxide are some common antacids.

28. (*a*) The lead storage battery is a secondary cell.

The cell reactions when the battery is in use are given below

At anode: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

At cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$

Overall cell reaction: $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$

(*b*) For half cell reaction

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6\bar{e} \longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$$

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log\frac{[Cr^{3+}]^2}{[Cr_2O_7^{2-}][H^+]^{14}}$$

Here, $E^o_{Cell} = 1.33$ V, n = 6, $[Cr^{3+}] = 0.2$ M

$[Cr_2O_7^{2-}] = 0.1$ M, $[H^+] = 1 \times 10^{-14}$ M

Substituting these values in the above given expression, we get

$$E_{cell} = 1.33\text{ V} - \frac{0.0591}{6}\log\frac{(0.20)^2}{(0.1)(10^{-4})^{14}}$$

$$= 1.33\text{ V} - \frac{0.0591}{6}\log(4 \times 10^{-55})$$

$$= 1.33\text{ V} - \frac{0.0591}{6}[\log 4 + \log 10^{55}]$$

$$= 1.33\text{ V} - \frac{0.0591}{6}[2\log 2 + 55\log 10]$$

$$= 1.33\text{ V} - \frac{0.0591}{6}[2 \times 0.3010 + 55] = 1.33\text{ V} - 0.548\text{ V}$$

$$E_{cell} = 0.782\text{ V}$$

OR

(*a*) Mass of mercury produced at the cathode,

$$m = Z \times I \times t = \frac{M \times I \times t}{n \times F}$$

$$m = \frac{\text{M g mol}^{-1} \times 2\text{A} \times 3 \times 60 \times 60\text{ s}}{2 \times 96500\text{ C mol}^{-1}} = 0.119 \times \text{M g}$$

$$m = 0.119 \times \text{M g}$$

$$\text{No. of moles of mercury produced} = \frac{0.119 \times \text{M g}}{\text{M g mol}^{-1}} = 0.119\text{ mol}$$

(*b*) At anode: $Al\,(s)$ ——® $Al^{3+}\,(aq) + 3e^{-}\,] \times 2$

At cathode: $Ni^{2+} + 2\,e^{-}$ ——® $Ni\,(s)$ $] \times 3$

Cell reaction: $2Al(s) + 3Ni^{2+}(aq)$ ——® $2Al^{3+}(aq) + 3Ni(s)$

Applying Nerst equation to the above cell reaction

$$E_{cell} = E^{o}_{cell} - \frac{0.0591}{n} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

Here, $E^{o}_{cell} = E^{o}_{Ni^{2+}/Ni} - E^{o}_{Al^{3+}/Al} = -0.25\text{ V} - (-1.66\text{V}) = 1.41\text{V}, n = 6$

$\therefore$ $[Al^{3+}] = 1 \times 10^{-3}\text{M}, \left[Ni^{-2+}\right] = 0.5\text{ M}$

$\therefore$ $E_{cell} = 1.41\text{ V} - \frac{0.0591}{6} \log \frac{(10^{-3})^2}{(0.5)^3} = 1.41\text{ V} - \frac{0.0591}{6} \log\,(8 \times 10^{-6})$

$$= 1.41\text{ V} - \frac{0.0591}{6} (\log 2^3 + \log 10^{-6})$$

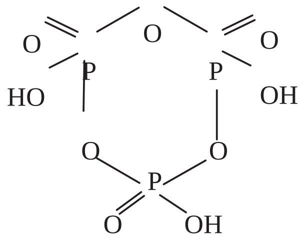
$$= 1.41\text{ V} - \frac{0.0591}{6} [\,3 \times \log 2 + (-\,67)\ \log 10]$$

$$= 1.41\text{ V} - \frac{0.0591}{6} [3 \times 0.3010 - 6]$$

$$= 1.41\text{ V} + 0.050\text{ V}$$

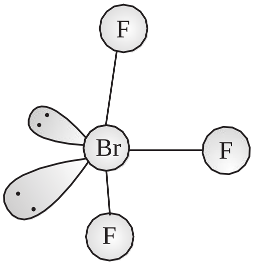
$$E_{cell} = 1.46\text{ V}$$

29. (*a*) (*i*)



$(HPO_3)_3$

(*ii*)



(*b*) (*i*) $3HgCl_2 + 2PH_3$ ——® $Hg_3P_2 + 6HCl$

(*ii*) $SO_3 + H_2SO_4$ ——®

——® (*iii*) $6XeF_4 + 12H_2O$

$H_2S_2O_7$

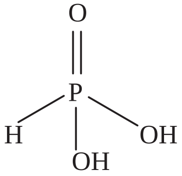
$4Xe + 2XeO_3 + 24HF + 3O_2$

OR

(*a*) (*i*) $3Cl_2 + \underset{\text{(Hot)}}{6NaOH\ (\text{conc.})} \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(*ii*) $2Fe^{3+} + SO_2 + 2H_2O \longrightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$

(*b*) (*i*)



Two, as the structure of H_3PO_4 has two P—OH bonds.

(*ii*) This is due to absence of *d*-orbitals in fluorine.

(*iii*) Noble gases being mono atomic gases have no interatomic forces except weak dispersion forces, therefore they have low boiling points.

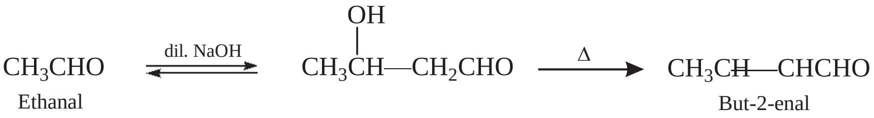
30 (*a*) **(*i*) Cannizzaro reaction:** Aldehydes which do not have an α-hydrogen atom undergoes disproportionation reactions on treatment with concentrated alkali to give a mixture of carboxylic acid salt and alcohol.

$$2\,\underset{\text{Formaldehyde}}{HCHO} \xrightarrow{\text{Conc. NaOH}} \underset{\text{Sod. formate}}{HCOO\overset{+}{Na}} + \underset{\text{Methyl alcohol}}{CH_3-OH}$$

(*ii*) Clemmensen reduction: The carbonyl group of aldehydes and ketones is reduced to CH_2 group on treatment with zinc-amalgam and concentrated hydrochloric acid.

$$\underset{\substack{\text{Aldehyde}\\ \text{or}\\ \text{Ketone}}}{>C=O} + 4(H) \xrightarrow[\text{HCl (conc.)}]{Zn-Hg} >CH_2 + H_2O$$

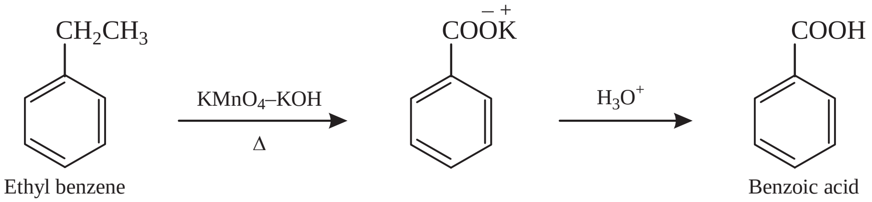
(*b*) (*i*)



$$\underset{\text{Ethanal}}{CH_3CHO} \overset{\text{dil. NaOH}}{\rightleftharpoons} CH_3\overset{\overset{OH}{|}}{C}H-CH_2CHO \xrightarrow{\Delta} \underset{\text{But-2-enal}}{CH_3CH=CHCHO}$$

(*ii*) $\underset{\text{Butan-1-ol}}{CH_3CH_2CH_2CH_2OH} \xrightarrow{CrO_3-H_2SO_4} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$

(*iii*)



OR

(*a*) (*i*) Benzoic acid on warming with sodium hydrogen carbonate gives brisk effervescence of CO_2 gas while ethyl benzoate does not respond to this test

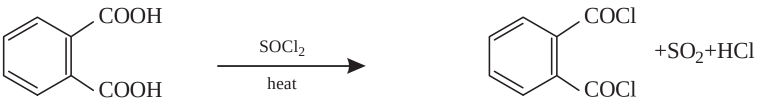
$$\underset{\text{Benzoic acid}}{C_6H_5COOH} + NaHCO_3 \longrightarrow C_6H_5CO\overset{-}{O}\overset{+}{Na} + \underset{\substack{\text{Brisk}\\ \text{effervescence}}}{CO_2\uparrow} + H_2O$$

(*ii*) Benzaldehyde and acetophenone

Iodoform test: Acetophenone being a methyl ketone on treatment with I_2/NaOH undergoes Iodoform reaction to give yellow ppt. of iodoform but benzaldehyde does not.

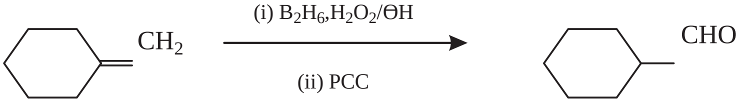
$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \longrightarrow C_6H_5COONa + \underset{\substack{\text{Iodoform}\\ \text{(Yellow ppt.)}}}{CHI_3\downarrow} + 2NaOH$$

(*b*) (*i*)



(*ii*) $C_6H_5—CHO \xrightarrow{H_2NCONHNH_2} C_6H_5CH = NNHCONH_2 + H_2O$

(*iii*)



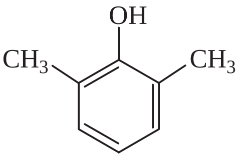
CBSE (All India) SET– II

2. Lyophobic sols are those sols in which the particles of the disperse phase have little affinity for the particles of the dispersion medium, *e.g.*, sols of metal and their sulphides and hydroxides.

3. This is because the sulphide ore particles are preferentially wetted by oil and gangue particles are preferentially wetted by water.

5. 3-Bromo-2-methylpropene

6.



9. **(*i*) Unit cell:** A unit cell is the smallest portion of a crystal lattice which, when repeated in different direction, generates the entire lattice.

(*ii*) Coordination number: The number of nearest neighbours of any constituent particle in a packing is called its coordination number. The coordination number of an atom in the bcc structure is 8.

12. Consider the reaction $nR \longrightarrow$ Products

As the reaction is of second order

$\therefore$ Rate, $r = k\,[R]^2$ ...(i)

If the concentration of the reactant reduced to half, then

Rate, $r' = k\left[\dfrac{R}{2}\right]^2$ ...(ii)

Dividing equation (ii) by (i), we get

$$\frac{r'}{r} = \frac{K\ [R]^2}{4K\ [R]^2} = \frac{1}{4}$$

$\therefore$ $\qquad r' = \frac{1}{4} r$ *i.e.*, rate of reaction becomes $\frac{1}{4^{\text{th}}}$ of the initial rate.

The unit of rate constant is $\text{mol}^{-1}\ \text{L s}^{-1}$.

14. (*i*) Zone refining is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal.

(*ii*) Electrolytic refining of a metal: In this method, the impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of same metal. When electric current is passed the metal from the anode goes into solution as ions due to oxidation while pure metal gets deposited at the cathode due to reduction of metal ions. The voltage applied for electrolysis is such that impurities of more electropositive metals remains in the solution as ions while impurities of the less electropositive metals settle down under the anode as anode mud.

At anode: $\quad M \longrightarrow M^{n+} + n\overset{-}{e}$

At cathode: $\quad M^{n+} + n\overset{-}{e} \longrightarrow M$

15. (*i*) The catalytic activity of transition metals and their compounds is attributed to the following reasons:

Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation for the reaction.

In some cases, the transition metal provides a suitable large surface area with free valencies on which reactants are adsorbed.

(*ii*) In general in the same group of *d* block elements, the 4*d* and 5*d* transition element has larger size than that of 3*d* elements. Thus, the valence electrons are less lightly held and hence can form metal-metal bond more frequently.

19.

$$\Delta T_f = \frac{i \times K_f \times W_B \times 1000}{M_B \times W_A}$$

Here, $\quad i = 1.87$, $W_A = 65.0$ g, $\Delta T_f = 7.50$ K

$K_f = 1.86\ \text{K kg mol}^{-1}$, $M_B = 58.5\ \text{g mol}^{-1}$

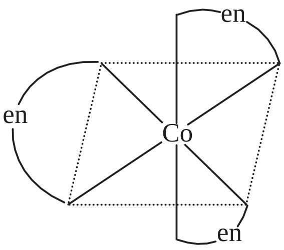
Substituting these values in the above equation, we get

$$7.5\ \text{K} = \frac{1.87 \times 1.86\ \text{K kg mol}^{-1} \times W_B \times 1000\ \text{g kg}^{-1}}{58.5\ \text{g mol}^{-1} \times 65.0\ \text{g}}$$

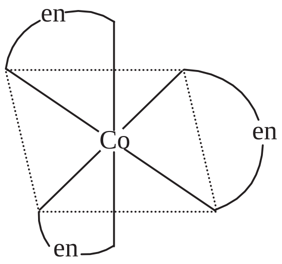
$$W_B = \frac{7.5 \times 58.5 \times 65.0}{1.87 \times 1.86 \times 1000}\ \text{g} = 8.199\ \text{g}$$

$$W_B = 8.2\ \text{g}$$

22. (*i*)

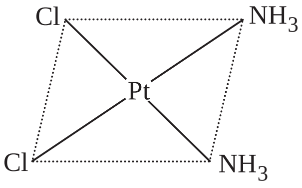


d-Tris-(ethane1,2-diamine)
cobalt (III)

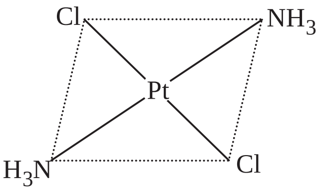


l-Tris-(ethane1,2-diamine)
cobalt (III)

(*ii*)

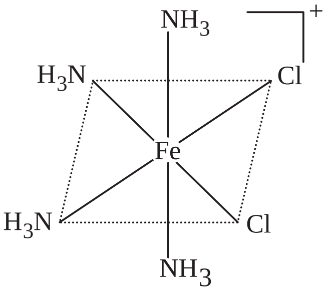


cis-Diamminedichloro
platinum (II)

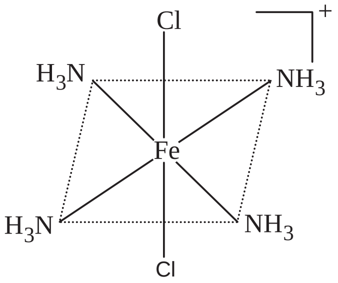


trans-Diamminedichloro
platinum (II)

(*iii*)



cis-Tetraamminedichloro
iron (III)



trans-Tetraamminedichloro
iron (III)

CBSE (All India) SET– III

1. The energy required to form the intermediate called activated complex is known as activation energy.

Activation energy = Threshold energy – Average energy of the reactants

2. **Reverse osmosis:** If a pressure larger than the osmotic pressure is applied on the solution side, the solvent starts to flow from the solution into the pure solvent through the semipermeable membrane. This phenomenon is called reverse osmosis.

3. If either the ore or the gangue is capable of being attracted by magnetic field, then such separation are carried out by magnetic separation.

11. Molarity is the number of moles of solute dissolved in one litre of solution whereas molality is the number of moles of solute per kilogram of the solvent. Molarity decreases with increase in temperature as volume increases with increase in temperature. Molality is independent of temperature because mass does not depend on temperature.

14. (*i*) Pig iron is melt with scrap iron and coke using hot air blast. Due to this, impurities such as C, S and P present in the pig iron are removed as CO_2, SO_2 and P_2O_5 and carbon content reduced to about 3%.

(*ii*) Bauxite is soluble in concentrated NaOH solution whereas impurities are not.

15. (*i*) This is due to presence of unpaired electrons in the (n–1) d orbitals of transition elements.

(*ii*) The chemistry of actinoids is not as smooth as lanthanoid because they are radioactive and show greater number of oxidation states due comparable energies of 5*f*, 6*d* and 7*s* orbitals.

18. The following facts and reactions cannot be explained by open chain structure of glucose.

(*i*) Despite having the aldehyde group, glucose does not give 2, 4-DNP test, Shiff's test and it does not form the hydrogen sulphite addition product with $NaHSO_{3.}$

(*ii*) The penta-acetate of glucose does not react with hydroxylamine indicating the absence of free aldehydic group.

21. (*i*) This is because bond dissociation energy of F_2 is lower than Cl_2 Moreover, fluorine forms stronger bond with nitrogen due to comparable size.

(*ii*) The acidic strength of compounds increases because of increase in polarity of E—H bond from P—H to H—Cl, which is due to increase in electronegativity of E.

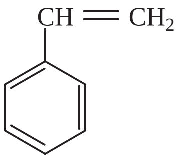
(*iii*) In SF_6, S atom is sterically protected by six F atoms and does not allow water molecules to attack the S atom. Further, F does not have *d*-orbitals to accept the electrons denoted by H_2O molecules. Due to these reasons, SF_6 is kinetically an inert substance.

22.

Complex ion	Central metal ion/atom	Hybridisation of metal ion involved	Geometry of the complex	Magnetic behaviour
$[Cr(NH_3)_4Cl_2]Cl$	Cr^{3+}	d^2sp^3	Octahedral	Paramagnetic
$[Co(en)_3]Cl_3$	Co^{3+}	d^2sp^3	Octahedral	Diamagnetic
$[Ni(CO)_4]$	Ni	sp^3	Tetrahedral	Diamagnetic

26. (*i*) $CH_2{=}CH{-}CH{=}CH_2$ and

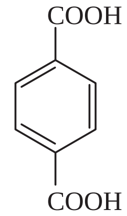
Buta-1, 3-diene



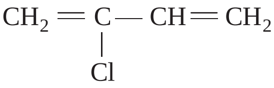
Styrene

(*ii*) $HO—CH_2—CH_2—OH$
Ethylene glycol

and



Terephthalic acid

(*iii*)


$$CH_2 = \underset{\displaystyle Cl}{\underset{|}{C}} — CH = CH_2$$

2-chloro-1, 3-butadiene

CBSE EXAMINATION PAPERS

FOREIGN–2011

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (Foreign) SET–I

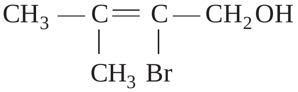
1. What is meant by an ‘intrinsic semiconductor’?

2. State Henry’s law about partial pressure of a gas in a mixture.

3. What do you understand by ‘denticity of a ligand’?

4. Which will react faster in S_N2 displacement, 1-bromopentane or 2-bromopentane, and why?

5. Give the IUPAC name of the following compound:



$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=\underset{\displaystyle Br}{\underset{|}{C}}-CH_2OH$$

6. Write the structure of the following compound : 3-oxopentanal.

7. Why is an alkylamine more basic than ammonia?

8. What is meant by a ‘broad spectrum antibiotic’?

9. Differentiate between molarity and molality of a solution. Explain how molarity value of a solution can be converted into its molality.

10. A 0.561 m solution of an unknown electrolyte depresses the freezing point of water by 2.93°C. What is Van’t Hoff factor for this electrolyte? The freezing point depression constant (K_f) for water is $1.86°C\ kg\ mol^{-1}$.

11. Determine the values of equilibrium constant (K_c) and $\Delta G°$ for the following reaction:

$$Ni(s) + 2Ag^+(aq) \longrightarrow Ni^{2+}(aq) + 2Ag(s), \quad E° = 1.05\ V\ (F = 96500\ C)$$

12. Define the following terms giving an example of each:

(*i*) Emulsion (*ii*) Hydrosol

13. Explain how to phenomenon of adsorption finds application in the following processes:

(*i*) Production of vacuum (*ii*) Heterogeneous catalysis

14. How would you account for the following:

(*i*) The following order of increase in strength of acids:

$$PH_3 < H_2S < HCI$$

(*ii*) The oxidising power of oxoacids of chlorine follows the order:

$$HClO_4 < HClO_3 < HClO_2 < HClO$$

15. Name the following coordination compounds and draw their structures:

(*i*) $[CoCl_2(en)_2]Cl$

(*ii*) $[Pt(NH_3)_2Cl(NO_2)]$

(At. no. Co = 27, Pt = 78)

16. Explain what is meant by the following:

(*i*) Peptide linkage

(*ii*) Pyranose structure of glucose

17. Name the products of hydrolysis of (*i*) sucrose and (*ii*) lactose.

OR

Mention three such properties of glucose which cannot be explained by its open chain structure.

18. State the reason in each of the following cases:

(*i*) Soaps do not work well in hard water.

(*ii*) Synthetic detergents are better than soaps.

19. Aluminium crystallises in a cubic close-packed structure. Radius of the atom in the metal is 125 pm.

(*i*) What is the length of the side of the unit cell?

(*ii*) How many unit cells are there in 1 cm^3 of aluminium?

20. A voltaic cell is set up at 25°C with the following half-cells, Al^{3+} (0.001 M) and Ni^{2+} (0.50 M). Write the cell reaction when the cell generates an electric current and determine the cell potential.
(Given : $E^o_{Ni^{2+}/Ni} = -0.25$ V, $E^o_{Al^{3+}/Al} = -1.66$ V)

21. State the principle on which each of the following processes operates:

(*i*) Recovery of silver after the silver ore has been leached with NaCN.

(*ii*) Electrolytic refining of a metal.

(*iii*) Vapour phase refining of a metal.

22. Complete the following chemical equations:

(*i*) $\underset{\text{(hot and conc.)}}{NaOH} + Cl_2 \longrightarrow$

(*ii*) $XeF_4 + O_2F_2 \xrightarrow{143\ K}$

(*iii*) $Br_2 + \underset{\text{(excess)}}{F_2} \longrightarrow$

23. (*a*) Mention the optimum conditions for the industrial manufacture of ammonia by Haber's process.

(*b*) Explain the following giving appropriate reasons:

(*i*) Sulphur vapour exhibits paramagnetic behaviour.

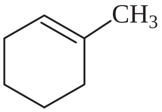
(*ii*) Red phosphorus is less reactive than white phosphorus.

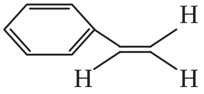
OR

Draw the structures of the following molecules:

(*i*) NF_3 (*ii*) $H_2S_2O_8$ (*iii*) H_3PO_3

24. Complete the following reaction equations:

(*i*)  + HI ——®

(*ii*)  + HBr ——®

(*iii*) $CH_3CH_2CH = CH_2$ + HBr ——®

25. Illustrate the following reactions giving a chemical equation in each case:

(*i*) Gabriel phthalimide synthesis

(*ii*) A coupling reaction

(*iii*) Hoffmann's bromamide reaction

26. How would you obtain

(*i*) Benzoquinone from phenol?

(*ii*) Propan-2-ol from propene?

(*iii*) 2-Methylpropan-2-ol from methyl magnesium bromide?

27. Mention two important uses for each of the following polymers:

(*i*) Bakelite (*ii*) Nylon 6,6 (*iii*) PVC

28. (*a*) Express clearly what you understand by 'rate expression' and 'rate constant' of a reaction.

(*b*) Nitrogen pentoxide decomposes according to the equation

$2N_2O_5(g)$ ——® $4NO_2(g) + O_2(g)$

This first order reaction was allowed to proceed at 40°C and the data given below were collected:

$[N_2O_5]$(M)	Time (min)
0.400	0.00
0.289	20.00
0.209	40.00
0.151	60.00
0.109	80.00

(*i*) Calculate the rate constant for the reaction. Include units with your answer.

(*ii*) Calculate the initial rate of reaction.

(*iii*) After how many minutes will $[N_2O_5]$ be equal to 0.350 M?

OR

(*a*) Define

(*i*) Order of a reaction.

(*ii*) Elementary step in a reaction

(*b*) A first order reaction has a rate constant value of 0.00510 min^{-1}.

If we begin with 0.10 M concentration of the reactant, how much of the reactant will remain after 3.0 hours?

29. (*a*) Complete the following reactions in an aqueous medium:

(*i*) $MnO_4^- + C_2O_4^{2-} + H^+$ ——®

(*ii*) $Cr_2O_7^{2-} + H_2S + H^+$ ——®

(*b*) How would you account for the following:

(*i*) Metal-metal bonding is more extensive in the 4d and 5d series of transition elements than the 3d series.

(*ii*) Mn (III) undergoes disproportionation reaction easily.

(*iii*) Co (II) is easily oxidised in the presence of strong ligands.

OR

(*a*) Complete the following chemical equations:

(*i*) $Fe^{3+} + I^-$ ——®

(*ii*) $CrO_4^{2-} + H^+$ ——®

(*b*) Explain the following:

(*i*) Copper (I) ion is not stable in an aqueous solution.

(*ii*) With same (d^4) configuration Cr (II) is reducing whereas Mn (III) is oxidising.

(*iii*) Transition metals in general act as good catalysts.

30. (*a*) Give simple chemical tests to distinguish between the following:

(*i*) Propanal and propanone

(*ii*) Benzaldehyde and acetophenone

(*b*) How would you obtain

(*i*) But-2-enal from ethanal?

(*ii*) Butanoic acid from butanol?

(*iii*) Benzoic acid from ethylbenzene?

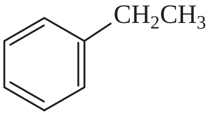
OR

(*a*) Describe the following reactions giving a chemical equation in each case:

(*i*) Cannizzaro's reaction

(*ii*) Decarboxylation reaction

(*b*) Complete the following chemical equations:

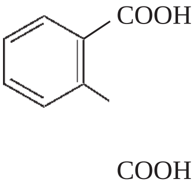
(*i*) 

$KMnO_4$

—

——® K

OH, Heat

(*ii*) 

$SOCl_2$

—

——®

Heat

(*iii*) $C_6H_5CONH_2 \xrightarrow[\text{heat}]{H_3O^+}$

CBSE (Foreign) SET–II

Questions uncommon to Set-I

1. "Crystalline solids are anisotropic in nature." What does it mean?

2. State Henry's law about partial pressure of a gas in a mixture.

3. Why is CO a stronger ligand than Cl^-?

8. What are antiseptics? Give an example.

12. Write four distinguishing features operative between chemisorption and physisorption.

16. State what you understand by primary and secondary structures of proteins.

17. Draw the structures of isomers, if any, and write the names of the following complexes :
(*i*) $[Cr(NH_3)_4Cl_2]^+$
(*ii*) $[Co(en)_3]^{3+}$

18. Explain the following terms giving an example of each:
(*i*) Antacids
(*ii*) Sweetening agents

21. Write the reactions involved in the following processes:
(*i*) Leachiing of bauxite ore to prepare pure alumina.
(*ii*) Refining of zirconium by van Arkel method.
(*iii*) Recovery of gold after gold ore has been leached with NaCN solution.

22. Complete the following chemical equations:
(*i*) $P_4 + SO_2Cl_2$
——® (*ii*) $Fe^{3+} + SO_2 + H_2O$
——®
(*iii*) $XeF_6 + H_2O$
——®
(excess)

27. (*a*) What does the designation '6,6' in nylon 6, 6 polymer mean?
(*b*) Which polymer is obtained when free radical polymerisation of chloroprene occurs? Write the structure of the polymer thus obtained.

CBSE (Foreign) SET–III

Questions uncommon to Set-I and Set-II

1. How many atoms are there in one unit cell of a body centred cubic crystal?

2. State Raoult's law in its general form with respect to solutions.

3. Name the following coordination compound:
$K_3[CrF_6]$

4. Which will react faster in S_N1 displacement, 1-bromobutane or 2-bromobutane, and why?

12. Define the following terms:

(*i*) Aerosol
(*ii*) Coagulation of colloids

14. Explain giving a reason for each of the following situation:

(*i*) In aqueous medium, HCl is a stronger acid than HF.

(*ii*) White phosphorus is more reactive than red phosphorous.

15. Give the name, the stereochemistry and the magnetic behaviour of the following complexes:

(*i*) $[Co(NH_3)_5Cl]Cl_2$

(*ii*) $K_2[Ni(CN)_4]$

19. Silver crystallises with face-centred cubic unit cell. Each side of this unit cell has a length of 409 pm. What is the radius of silver atom? Assume the atoms just touch each other on the diagonal across the face of the unit cell.

22. Complete the following chemical equations:

(*i*) $C + H_2SO_4$ (conc.) ——®

(*ii*) $P_4 + NaOH + H_2O$ ——®

(*iii*) Cl_2 + F

——® (excess)

26. How would you obtain

(*i*) Benzoquinone from phenol?

(*ii*) Propan-2-ol from propene?

(*iii*) 2- Methylpropan-2-ol from methyl magnesium bromide?

27. What are addition polymers? How are the two types of addition polymers different from each other? Give one example of each type.

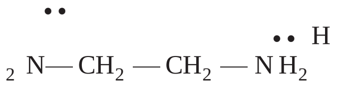
Solutions

CBSE (Foreign) SET–I

1. Pure substances exhibiting conductivity similar to that of silicon and germanium are called intrinsic semiconductors.

2. **Henry's law:** It states that the partial pressure of a gas in vapour phase (*P*) is proportional to its mole fraction (*x*) in the solution.

3. Denticity: The number of coordinating groups present in ligand is called the denticity of ligand. For example, bidentate ligand ethane-1, 2-diamine has two donor nitrogen atoms which can link to central metal atom.



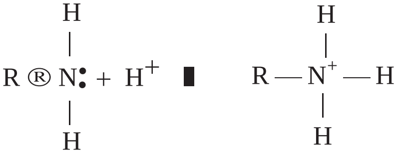
$_2\overset{\bullet\bullet}{N}—CH_2—CH_2—\overset{\bullet\bullet\ H}{N}H_2$

Ethane–1, 2–diamine

4. 1–Bromopentane, as it is a primary alkyl halide.

5. 2–Bromo –3– methyl-but –2–en–1–ol.

6. $\mathrm{CH_3 - CH_2 - C - CH_2 - C - H}$

7. 

$$R \rightarrow \overset{\displaystyle H}{\underset{\displaystyle H}{\ddot{N}}} + H^{+} \rightleftharpoons R - \overset{\displaystyle H}{\underset{\displaystyle H}{N^{+}}} - H$$

Due to +I effect alkyl group pushes electron towards nitrogen and thus makes the lone pair of electrons more available for sharing with the proton of the acid. Hence alkyl amine is more basic than ammonia.

8. The antibiotic which is effective against a wide range of microorganisms is known as broad spectrum antibiotic. For example, chlorophenicol.

9. Molarity (M) is the number of moles of solute dissolved in one litre of solution whereas molality (m) is the number of moles of the solute per thousand grams of solvent.

If M_B is the molar mass of solute, d is the density of solution then molarity (M) value of a solution can be converted into its molality (m) by using the following for formula.

$$m = \frac{1000 \times M}{1000 \times d - M \times M_B}$$

10. $\Delta T_f = K_f \times m$

$K_f = 1.86°C\ kg\ mol^{-1}$, $m = 0.561\ mol\ kg^{-1}$

Substituting these values in the above equation,

We get,

$$\Delta T_f = 1.86\ ^{o}C\ kg\ mol^{-1} \times 0.561\ mol\ kg^{-1} = 1.04^{o}C$$

$$(\Delta T_f)\ \text{Calculated} = 1.04\ °C,\ (\Delta T_f)\ \text{Observed} = 2.93\ °C$$

$$i = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}} = \frac{(\Delta T_f)\ \text{observed}}{(\Delta T_f)\ \text{calculated}}$$

$$i = \frac{2.93\ ^{o}C}{1.04\ ^{o}C} = 2.82.$$

11. $Ni(s) + 2Ag^{+}(aq) \longrightarrow Ni^{2+}(aq) + 2Ag(s);\ E° = 1.05\ V$

Here, $n = 2$

$$\log K_c = \frac{n}{0.059}\ E^{o}_{cell}$$

$$\log K_c = \frac{2}{0.059} \times 1.05 = 39.5932$$

$$K_c = \text{antilog}\ 39.5932 = 3.919 \times 10^{39}$$

$$K_c = 3.92 \times 10^{39}$$

$$\Delta G^{o} = -nFE^{o}_{cell}$$

$$\Delta G^{o} = -2 \times 96500 \times 1.05 = -202650\ J$$

$$\Delta G^{o} = -202.65\ kJ$$

12. **(*i*) Emulsion:** An emulsion is a colloidal system in which both the dispersed phase and the dispersion medium are liquids (e.g., milk, Cod liver, oil, etc.)

(*ii*) Hydrosol: A sol in which solid is the dispersed phase and water in dispersion medium is called hydrosol.

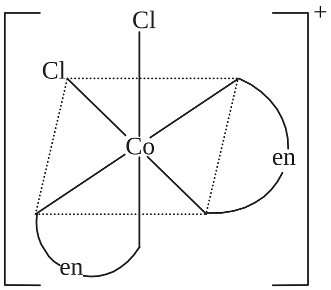
13. **(*i*) Production of Vacuum:** Adsorption can be successfully applied to create conditions of high vacuum. For this a bulb of charcoal cooled in liquid air, is connected to vessel which has already been exhausted as far as possible by vacuum pump. The remaining traces of air inspite of low pressure are adsorbed by the charcoal almost completely.

    (*ii*) Heterogeneous Catalysis: There are many gaseous reactions of industrial importance involving solid catalyst. Manufacture of ammonia using iron as a catalyst, manufacture of H_2SO_4 by contact process using V_2O_5 catalyst and use of finely divided nickel in the hydrogenation of vegetable oils are the excellent examples. The gaseous reactants are adsorbed on the surface of the solid catalyst. As a result, the concentration of the reactants increases on the surface of the catalyst and hence the rate of reaction increases.

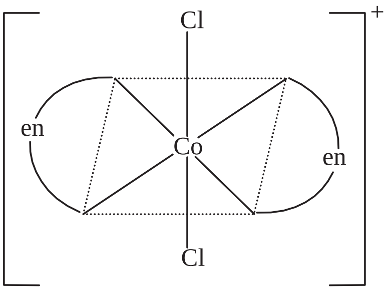
14. (*i*) Larger the difference in electronegativity greater will be polarity and hence greater will be acidic character.

    (*ii*) As $HClO_4$ is most stable and tendency to give oxygen is least while HClO is least-stable and gives oxygen most easily.

15. (*i*) Dichloridobis - (ethane–1, 2–diamine) cobalt (III) chloride

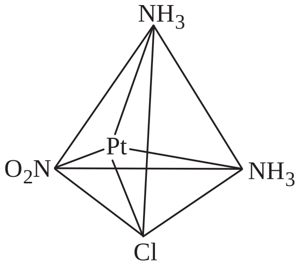


Octahedral
cis-$[CoCl_2(en)_2]^+$

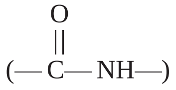


Octahedral
trans-$[CoCl_2(en)_2]^+$

    (*ii*) Diamminechloridonitrito- N platinum (II)

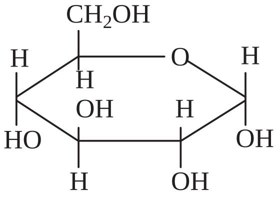


Tetrahedral



16. (*i*) Peptide linkage: The amide $(\text{—}\overset{\overset{\displaystyle O}{||}}{C}\text{—NH—})$ linkage between two α-amino acids formed with the loss of a water molecule is called a peptide linkage.

    (*ii*) The six membered cyclic structure of glucose is called pyranose structure (α – or β –), in analogy with heterocylic compound pyran.



α – D – (+) – Glucopyranose

17. (*i*) $\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or invertase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$

(*ii*) $\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Lactase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Galactose}}{C_6H_{12}O_6}$

OR

The following facts and reactions cannot be explained by open chain structure of glucose.

(*i*) Despite having the aldehyde group, glucose does give 2, 4-DNP test, Shiff's test and it does not form the hydrogen sulphite addition product with $NaHSO_3$.

(*ii*) The penta-acetate of glucose does not react with hydroxylamine indicating the absence of free aldehydic group.

18. (*i*) Hard water contains calcium and magnesium salts. In hard water, soaps get precipitated as calcium and magnesium soaps which being insoluble stick to the clothes as gummy mass.

(*ii*) As synthetic detergents can be used in hard water as well as acidic solutions.

19. (*i*) For fcc (or ccp), $a = 2\sqrt{2}r = 2 \times 1.414 \times 125$ pm

$= 354$ pm

(*ii*) $a = 354 \text{ pm} = 3.54 \times 10^{-8}$ cm

Volume of one unit cell $= a^3 = (3.54\times 10^{-8} \text{ cm})^3 = 4.436 \times 10^{-23}\text{cm}^3 = 4.44 \text{ cm}^3$

$$\text{Number of unit cells} = \frac{\text{Total volume}}{\text{Volume of one unit cell}}$$

$$= \frac{1 \text{ cm}^3}{4.44 \times 10^{-23} \text{ cm}^3} = 2.25 \times 10^{22}$$

20. At anode: $Al\,(s) \longrightarrow Al^{3+}\,(aq) + 3e^-\;] \times 2$

At cathode: $Ni^{2+} + 2\,e^- \longrightarrow N_i(s)\;] \times 3$

Cell reaction: $2Al(s) + 3Ni^{2+}\,(aq) \longrightarrow 2Al^{3+}(aq) + 3Ni\,(s)$

Applying Nerst equation to the above cell reaction

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

Here, $E^o_{cell} = E^o_{Ni^{2+}/Ni} - E^o_{Al^{3+}/Al} = -0.25 \text{ V} - (-1.66\text{V}) = 1.41\text{V}, n = 6$

$\therefore \quad [Al^{3+}] = 1\times10^{-3}\text{M}, \left[Ni^{2+}\right] = 0.5 \text{ M}$

$$\therefore \quad E_{cell} = 1.41\text{ V} - \frac{0.0591}{6}\log\frac{(10^{-3})^2}{(0.5)^3} = 1.41\text{ V} - \frac{0.0591}{6}\log(8\times10^{-6})$$

$$= 1.41\text{ V} - \frac{0.0591}{6}(\log 2^3 + \log 10^{-6})$$

$$= 1.41\text{ V} - \frac{0.0591}{6}[\,3\times\log 2 + (-67)\ \log 10]$$

$$= 1.41\text{ V} - \frac{0.0591}{6}[3\times0.3010 - 6]$$

$$= 1.41\text{ V} + 0.050\text{ V}$$

$$E_{cell} = 1.46\text{ V}$$

21. (*i*) **Recovery of silver after silver ore was leached with NaCN:** During leaching Ag is oxidised to Ag^+ which then combines with CN^- ions to form soluble complex, $[Ag(CN)_2]^-$. Silver is then recovered from this complex by displacement method using more electropositive zinc metal.

$$2[Ag(CN)_2]^-(aq) + Zn(s) \longrightarrow 2Ag(s) + [Zn(CN)_4]^{2-}(aq)$$

(*ii*) **Electrolytic refining of a metal:** In this method, the impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of same metal. When electric current is passed the metal from the anode goes into solution as ions due to oxidation while pure metal gets deposited at the cathode due to reduction of metal ions. The voltage applied for electrolysis is such that impurities of more electropositive metals remains in the solution as ions while impurities of the less electropositive metals settle down under the anode as anode mud.

At anode: $M \longrightarrow M^{n+} + n\bar{e}$

At cathode: $M^{n+} + n\bar{e} \longrightarrow M$

(*iii*) **Vapour phase refining of a metal:** In this method, the metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal. For example, refining of nickel by Mond process.

$$Ni + 4CO \xrightarrow{330-350\text{ K}} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450-470\text{ K}} Ni + 4CO$$

22. (*i*) $\underset{\text{Hot and conc.}}{6NaOH} + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(*ii*) $XeF_4 + O_2F_2 \xrightarrow{143\text{ K}} XeF_6 + O_2$

(*iii*) $Br_2 + \underset{\text{(excess)}}{5F_2} \longrightarrow 2\,BrF_5$

23. (*a*) Optimum conditions for the industrial manufacture of ammonia by Haber's process.

Pressure: 200 bar

Temperature: 723–773 K

Catalyst: Finely divided iron and molybdenum as promoter.

(*b*) (*i*) In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding π^* molecular orbitals like O_2 and, hence exhibits paramagnetic behaviour.

(*ii*) White phosphorus is more reactive than red phosphorus due to its discrete tetrahedral structure and angular strain. Red phosphorus is less reactive due its polymeric structure.

OR

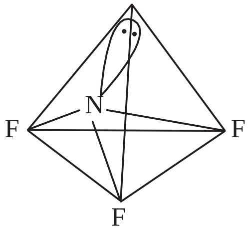
(*i*) Total no. of electron pairs around

The central N atom = $\frac{1}{2}(5+3) = 4$

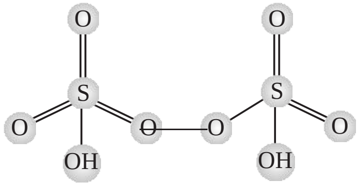
No. of bond pairs = 3

No. of lone pairs = 1

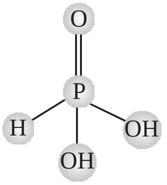
Therefore, according to VSEPR theory; NF_3 should be pyramidal.



(*ii*)



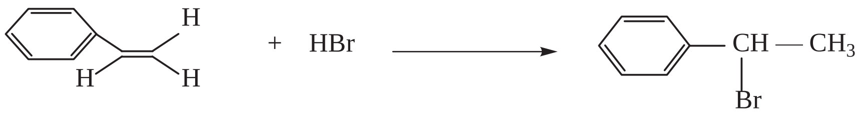
Peroxodisulphuric acid
($H_2S_2O_8$)



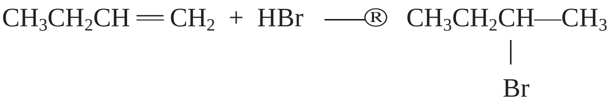
Orthophosphorous acid
(H_3PO_3)

24. (*i*)

(*ii*)

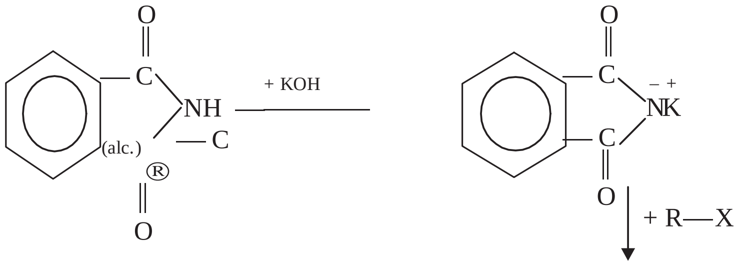


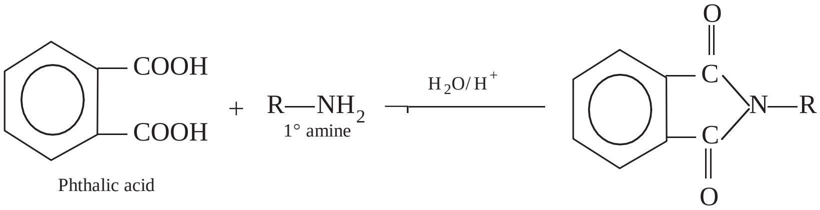
(*iii*)



$$CH_3CH_2CH{=}CH_2 + HBr \longrightarrow CH_3CH_2\underset{\displaystyle Br}{\underset{|}{C}}H{-}CH_3$$

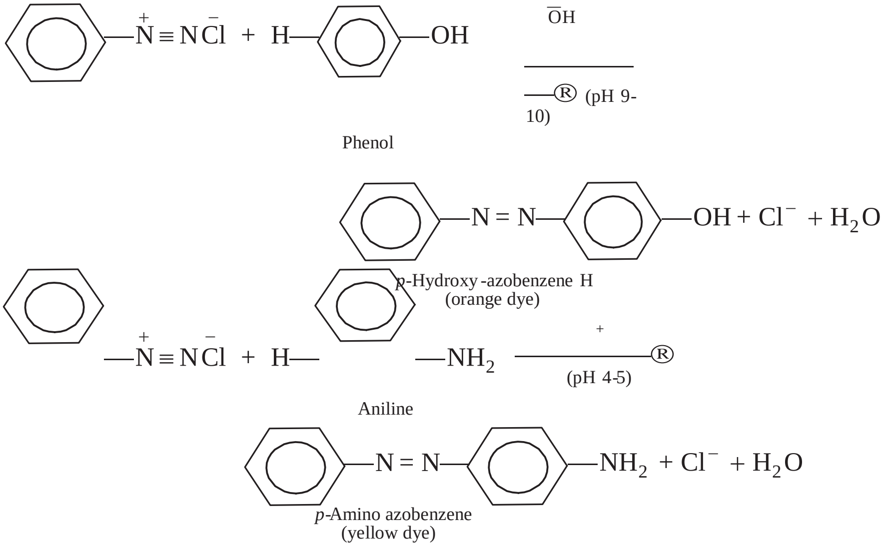
25. (*i*) **Gabriel phthalimide synthesis:** This reaction is used for the preparation of aliphatic primary amines. In this reaction, phthalimide is first of all treated with ethanolic KOH to form potassium phthalimide. Potassium phthalimide on treatment with alkyl halide gives N-alkyl phthalimide, which on hydrolysis with dilute hydrochloric acid gives a primary amine as the product.





(*ii*) Coupling reactions:

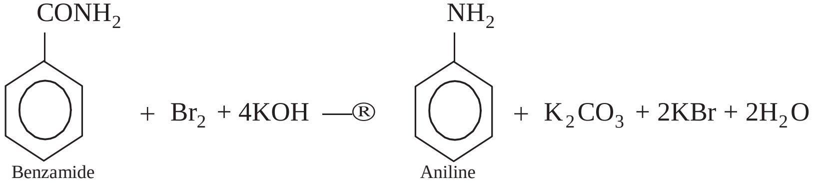
Diazonium salts react with aromatic amines in weakly acidic medium and phenols in weakly alkaline medium to form coloured compounds called azo dyes by coupling at *p*-position of amines or phenol. The mechanism is basically that of electrophilic aromatic substitutions where the diazonium ion is electrophile.



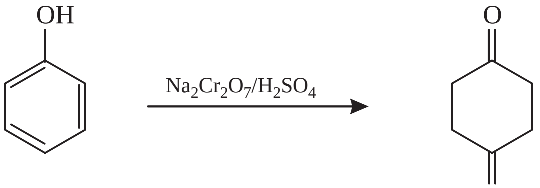
(*iii*) Hoffman's bromamide reaction:

When a primary acid amide is heated with an aqueous or ethanolic solution of NaOH or KOH and bromine (i.e., NaOBr or KOBr), it gives a primary amine with one carbon atom less.

$$\underset{\text{Acid amide}}{R—CONH_2} + Br_2 + 4NaOH \longrightarrow \underset{1° \text{ amine}}{R—NH_2} + Na_2CO_3 + 2NaBr + 2H_2O$$



26. (*i*)

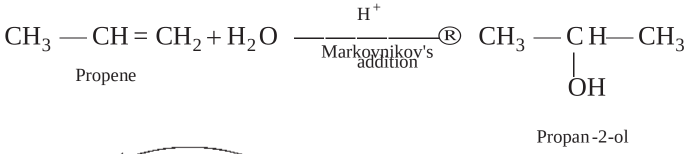


Phenol

O

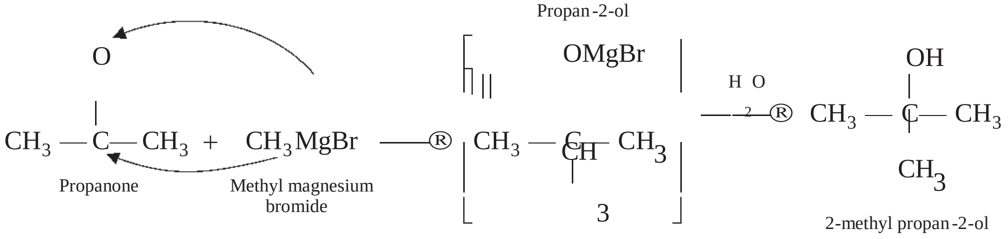
Benzoquinone

(*ii*)



$$CH_3-CH=CH_2+H_2O \xrightarrow[\text{Markovnikov's addition}]{H^+} CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$$

(*iii*)



$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + CH_3MgBr \longrightarrow \left[CH_3-\overset{\overset{OMgBr}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3\right] \xrightarrow{H_2O} CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$$

27. (*i*) It is used for making combs, fountain pen barrels, phonograph records.

It is used widely in making electrical goods such as switches, plugs, handles of various utensils.

(*ii*) It is used in making bristles for brushes, ropes.

It is used for making carpets and fabrics in textile industry.

(*iii*) It is used in the manufacture of rain coats, hand bags, water pipes, vinyl flooring.

It is used for insulating electric wires.

28. (*a*) An experimentally determined expression which relates the rate of reaction with the concentration of reactants is called rate law while the rate of reaction when concentration of each reactant is unity in a rate law expression is called rate constant.

(*i*) Comparing power of mole in L^{-1} mol s^{-1} and $(mol\ L^{-1})^{1-n}\ s^{-1}$,

We get

$1 = 1 - n \quad \Rightarrow \quad n = 0$ *i.e.*, zero order reaction

(*ii*) Again comparing power of mole in L $mol^{-1}s^{-1}$ and $(mol\ L^{-1})^{1-n}\ s^{-1}$, we get

$-1 = 1 - n \quad \Rightarrow \quad n = 2$, *i.e.*, second order reaction

(*b*) (*i*) When $t = 20$ min, $[A] = 0.289$ mol L^{-1}

Also, $[A]_0 = 0.400$ mol L^{-1}

For a first order reaction

$$k = \frac{2.303}{t}\log\frac{[A]_\circ}{[A]}$$

$k =$ log

$\Rightarrow$

$\therefore$

$k =$ log

$\Rightarrow$

$\Rightarrow$ 20

$\Rightarrow$ 20

$\Rightarrow$ 20

$\Rightarrow$

2.303
0.
400
2
0

0
.
2
8
9

2
.
3
0
3

4
.
0
0
20
2.8
9

k = 2.303 [log 4.00 – log 2.89]

k = 2.303 [0.6021 – 0.4609]

k = 2.303 × 0.1412

$k = 2.303 \times 0.00706 = 0.016259\ \text{min}^{-1}$

$k = 1.6259 \times 10^{-2}\ \text{min}^{-1}$

(*ii*) Initial rate, *i.e.*, rate of reaction when $t = 0$

When, $t = 0.00$ min, $[A] = 0.400 \text{ mol L}^{-1}$

Also, $k = 1.626 \times 10^{-2} \text{ min}^{-1}$

$\therefore$ Initial rate $= k\,[A] = 1.626 \times 10^{-2} \text{ min}^{-1} \times 0.400 \text{ mol L}^{-1}$

$= 6.504 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1}$.

(*iii*) $t = \dfrac{2.303}{k} \log \dfrac{[A]_o}{[A]}$

Here, $k = 1.6259 \times 10^{-2} \text{ min}^{-1}$, $[A]_o = 0.400$ M, $[A] = 0.350$ M

Substituting these values in the above equation, we get

$$t = \frac{2.303}{1.6259 \times 10^{-2}} \log \frac{0.400}{0.350} = \frac{2.303}{1.6259 \times 10^{-2}} [\log 40 - \log 35]$$

$$= 141.583\,[1.6021 - 1.5441]$$

$$= 141.583 \times 0.0580$$

$$= 141.583 \times 0.0580 = 8.21 \text{ min.}$$

OR

(*a*) (*i*) Order of a reaction may be defined as the sum of the powers of the concentration terms of the reactants in the rate law expression.

(*ii*) Elementary step: Each step of a complex reaction is called an elementary step.

(*b*) $t = \dfrac{2.303}{K} \log \dfrac{[A]_o}{[A]}$

Here, $K = 5.10 \times 10^{-3} \text{ min}^{-1}$, $t = 3 \times 60 \times 60$ min$=$ 10800 min

$[A]_o = 0.1$ M

Substituting these values in the above equation,

We get

$$10800 \text{ min} = \frac{2.303}{5.1 \times 10^{-3} \text{ min}^{-1}} \log \frac{0.1}{[A]}$$

$$\log \frac{0.1}{[A]} = \frac{10800 \times 5.1 \times 10^{-3}}{2.303} = 23.9166$$

$$\frac{0.1}{[A]} = \text{Antilog } 23.9166 = 8.255 \times 10^{23}$$

$$[A] = \frac{0.1}{8.255 \times 10^{23}} = 1.21 \times 10^{-25} \text{M}$$

29. (*a*) (*i*)

$$\begin{aligned} MnO_4^- + 8H^+ + 5\bar{e} &\longrightarrow Mn^{2+} + 4H_2O] \times 2 \\ C_2O_4^{2-} &\longrightarrow 2CO_2 + 2\bar{e}\,] \times 5 \\ \hline 2MnO_4^- + 5C_2O_4^{2-} + 16H^+ &\longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O \end{aligned}$$

(*ii*)

$$\begin{aligned} Cr_2O_7^{2-} + 14H^+ + 6\bar{e} &\longrightarrow 2Cr^{3+} + 7H_2O \\ H_2S &\longrightarrow 2H^+ + S + 2e^-] \times 3 \\ \hline Cr_2O_7^{2-} + 3H_2S + 8H^+ &\longrightarrow 2Cr^{3+} + 3S + 7H_2O \end{aligned}$$

(*b*) (*i*) The catalytic activity of transition metals and their compounds is attributed to the following reasons:

Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation for the reaction.

In some cases, the transition metal provides a suitable large surface area with free valencies on which reactants are adsorbed.

In general in the same group of *d* block elements, the 4*d* and 5*d* transition element has larger size than that of 3*d* elements. Thus, the valence electrons are less lightly held and hence can form metal-metal bond more frequently.

(*ii*) Mn^{3+} is less stable and changes to Mn^{2+} which is more stable due to half filled d-orbital configuration. That is why, Mn^{3+} undergoes disproportionation reaction.

(*iii*) Co (III) has electric configuration 3*d*, 4*s*, *i.e.*, it has three unpaired electron. In the presence of strong ligands, two unpaired electrons in 3d subshell pair up and third unpaired electron shift to higher energy subshell from where it can be easily lost and hence oxidised to Co(III).

OR

(*a*) (*i*) $2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$

(*ii*) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

(*b*) (*i*) In aqueous solution Cu^+ undergoes disproportionation to form a more stable Cu^{2+} ion.

$$2\,Cu^+(aq) \longrightarrow 2\,Cu^{2+}(aq) + Cu(s)$$

The higher stability of Cu^{2+} in aqueous solution may be attributed to its greater negative $\Delta_{hyd}H°$ than that of Cu^+. It compensates the second ionization enthalpy of Cu involved in the formation of Cu^{2+} ions.

(*ii*) Cr^{2+} is reducing as its configuration changes from d^4 to d^3, a more stable half filled t_{2g} configuration while Mn^{3+} is oxidising as Mn^{3+} to Mn^{2+}results a more stable half filled d^5 configuration.

(*iii*) The catalytic activity of transition metals and their compounds is attributed to the following reasons:

Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation for the reaction.

In some cases, the transition metal provides a suitable large surface area with free valencies on which reactants are adsorbed.

30. (*a*) (*i*) Propanal and propanone

Tollen's reagent test: Propanal being an aldehyde reduces Tollen's reagent to silver mirror but propanone being a ketone does not.

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + 2[Ag(NH_3)_2]^+ + 3\overline{O}H \longrightarrow CH_3CH_2\ CO\bar{O} + \underset{\text{Silver Mirror}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

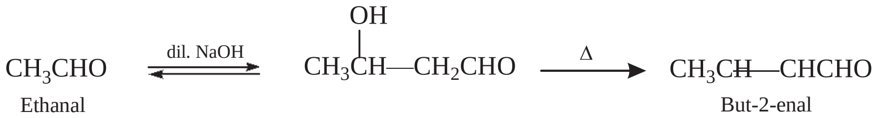
$$CH_3COCH_3 \xrightarrow[\text{reagent}]{\text{Tollen's}} \text{No silver mirror}$$

(*ii*) Benzaldehyde and acetophenone

Iodoform test: Acetophenone being a methyl ketone on treatment with I_2/NaOH undergoes Iodoform reaction to give yellow ppt. of iodoform but benzaldehyde does not.

$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \longrightarrow C_6H_5COONa + \underset{\substack{\text{Iodoform}\\\text{(Yellow ppt.)}}}{CHI_3\downarrow} + 2NaOH$$

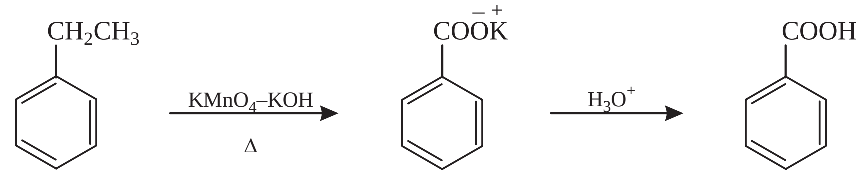
(*b*) (*i*)



$$\underset{\text{Ethanal}}{CH_3CHO} \overset{\text{dil. NaOH}}{\rightleftharpoons} CH_3\overset{\overset{OH}{|}}{C}H—CH_2CHO \xrightarrow{\Delta} \underset{\text{But-2-enal}}{CH_3CH=CHCHO}$$

(*ii*) $$\underset{\text{Butan-1-ol}}{CH_3CH_2CH_2CH_2OH} \xrightarrow{CrO_3-H_2SO_4} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$$

(*iii*)



Ethyl benzene — Benzoic acid

OR

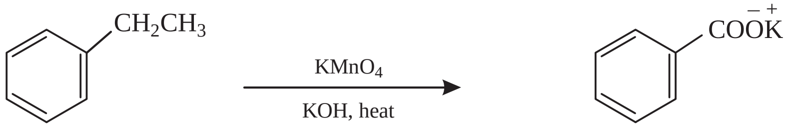
(***a***) (***i***) **Cannizzaro reaction:** Aldehydes which do not have an α-hydrogen atom undergoes disproportionation reactions on treatment with concentrated alkali to give a mixture of carboxylic acid salt and alcohol.

$$\underset{\text{Formaldehyde}}{2\ HCHO} \xrightarrow{\text{Conc. NaOH}} \underset{\text{Sod. formate}}{HCOO\overset{+}{Na}} + \underset{\text{Methyl alcohol}}{CH_3-OH}$$

(***ii***) **Decarboxylation:** Carboxylic acids lose carbon dioxide to form hydrocarbons when their sodium salts are heated with sodalime.

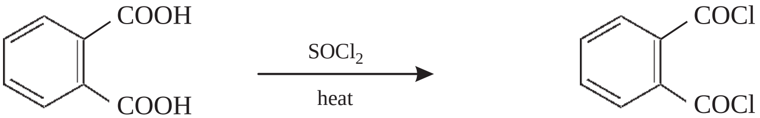
$$RCO\overset{-}{O}\overset{-}{Na} \xrightarrow[\Delta]{\text{NaOH and CaO}} RH + Na_2CO_3$$

(*b*) (*i*)



Ethyl benzene — Pot. benzoate

(*ii*)



Phthalic acid — Phthaloyl chloride

(*iii*) $$C_6H_5CONH_2 \xrightarrow[\text{heat}]{H_3O^+} C_6H_5COOH + NH_3$$

CBSE (Foreign) SET–II

1. Crystalline solids are anisotropic in nature means some of their physical properties like electrical conductivity, refractive index, etc., are different in different directions.

2. **Henry's law :** It states that "the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution" and is expressed as

$$p = K_H x$$

where, K_H is the Henry's law constant.

Significance of K_H. Higher the value of Henry's law constant K_H, the lower is the solubility of the gas in the liquid.

3. Because CO has π bonds.

8. Chemical substances which prevent the growth of microorganisms or kill them but are not harmful to living tissues are called antiseptics.

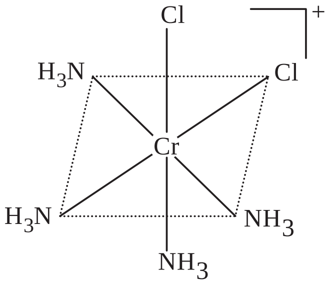
For example, Dettol, Savlon, etc.

12.

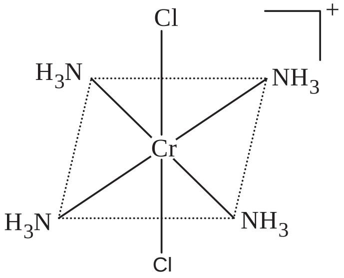
Chemisorption	Physisorption
It arises due to chemical bond formation.	It arises because of van der waals' forces.
It is irreversible in nature.	It is reversible.
It is highly specific in nature.	It is not specific in nature.
It results into unimolecular layers on adsorbent surface.	It results into multimolecular layers on adsorbent surface under high pressure.

16. Primary structure refers to the sequence in which various amino acids are arranged in a protein while secondary structure refers to the shape in which a long polypeptide chain can exist as a result of regular folding of the backbone of the polypeptide chain due to hydrogen bonding between $-\overset{\overset{\text{O}}{\|}}{\text{C}}-$ and —NH—groups of the peptide bond.

17. (*i*) Geometrical isomers of $[Cr(NH_3)_4Cl_2]^+$

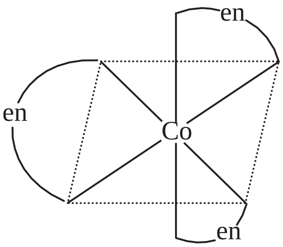


cis-Tetraamminedichlorido chromium (III) ion

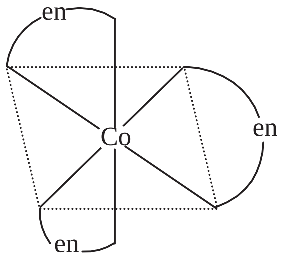


trans-Tetraamminedichlorido chromium (III) ion

(*ii*) Optical isomers of $[Co(en)_3]^{3+}$



dextro-Tris-(ethane-1,2,-diamine)
cobalt (III) ion



laevo-Tris-(ethane-1,2-diamine)
cobalt (III) ion

18. **(*i*)** **Antacids:** These are the chemical substances which neutralize the excess acid and raise the pH to an appropriate level in the stomach. Sodium hydrogen carbonate or a mixture of aluminium and magnesium hydroxide are some common antacids.

(*ii*) **Detergents:** Detergents are cleansing agents which have all the properties of soaps, but actually do not contain any soap, *e.g.,* sodium dodecylbenzene sulphonate. These can be used both in soft and hard water as they give foam even in hard water. Detergents are mainly classified into three categories:

(*a*) Anionic detergents
(*b*) Cationic detergents
(*c*) Non-ionic detergents

21. (*i*) Leaching of bauxite ore to prepare pure alumina:

$$Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \longrightarrow 2Na[Al\ (OH)_4]\ (aq)$$
$$2Na[Al(OH)_4](aq) + CO_2(g) \longrightarrow Al_2O_3.xH_2O(s) + 2NaHCO_3\ (aq)$$
$$Al_2O_3.xH_2O(s) \xrightarrow{1470K} Al_2O_3(s) + xH_2O(g)$$

(*ii*) Refining of zirconium by van Arkel method.

$$\underset{\text{(impure)}}{Zr(s)} + 2I_2(g) \xrightarrow{870K} ZrI_4\ (g)$$

$$ZrI_4\ (g) \xrightarrow[\text{Tungsten filament}]{2075\text{ K}} \underset{\text{(Pure)}}{Zr(s)} + 2I_2$$

(*iii*) Extraction of gold:

$$4Au(s) + 8CN^-(aq) + 2H_2O(l) + O_2(g) \longrightarrow 4[Au(CN)_2]^-(aq) + 4\overset{-}{O}H\ (aq)$$

Gold is recovered from [Au (CN_2)] Complex by displacement method using a more eletropositive metal zinc.

$$2[Au\ (CN)_2]^-\ (aq) + Zn\ (s) \longrightarrow 2\ Au\ (s) + [Zn\ (CN^{4+})]^{2-}\ (aq)$$

22. (*i*) $P_4 + 10SO_2Cl_2 \longrightarrow 4\ PCl_5 + 10SO_2$

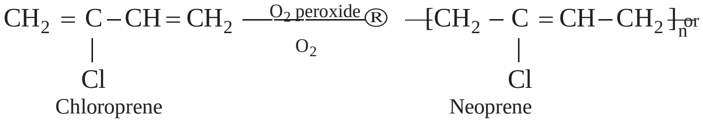
(*ii*) $2Fe^{3+} + XeO_3 + 6HFSO_2 + 2H_2O \longrightarrow 2Fe^{2+} + 4H^+ + SO_4^{2-}$

(*iii*) $XeF_6 + 3H_2O$

$\longrightarrow$ (excess)

27. (*a*) In nylon-6, 6 both the monomers hexamethylene diamine and adipic acid contain six carbon atoms each.

(*b*) Neoprene is obtained by free radical polymerisation of chloroprene.



$$CH_2=\underset{\underset{Cl}{|}}{C}-CH=CH_2 \xrightarrow[O_2]{O_2\text{ peroxide}} -\!\!\left[CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2\right]_n\!\!- \text{ or}$$

Chloroprene Neoprene

CBSE (Foreign) SET–III

1. 2

2. **Raoult's law:** It states that for any solution the partial pressure of each volatile component in the solution is directly proportional to its mole fraction.

3. Potassium fluorido chromate (III).

4. 2-bromobutane as secondary carbocation formed is more stable as compared to the primary carbocation in case of 1-bromobutane.

12. **(*i*)** **Aerosols:** These are the colloidal systems in which dispersion medium is gas and dispsed, phase is either solid or liquid *e.g.*, smoke, insecticide sprays.

(*ii*) **Coagulation:** The process of aggregating together the charged colloidal particles so as to change them into large sized particle which ultimately settle as down under the force of gravity as a precipitate is called coagulation.

14. (*i*) Because bond dissociation enthalpy of H—Cl is lower than H—F.

(*ii*) White phosphorus is more reactive than red phosphorus due to its discrete tetrahedral structure and angular strain. Red phosphorus is less reactive due its polymeric structure.

15. (*i*) $[Co(NH_3)_5Cl_1]Cl_2$: Pentaamminechlorido cobalt (III) chloride

Co(III): [Ar] $3d^6\ 4s^o$ —d^2sp^3 hybridisation leads to octahedral shape.

Magnetic behaviour: Diamagnetic.

(*ii*) $K_2[Ni(CN)_4]$: Potassium tetracyano nickelate (II)

Ni(II): [Ar] $3d^8\ 4s^\circ$ —dsp^2 hybridisation leads to square planar shape.

Magnetic behaviour: Diamagnetic.

19. As the atoms just touch each other on the diagonal across the face of unit cell, therefore

$$b^2 = a^2 + a^2 = 2a^2$$

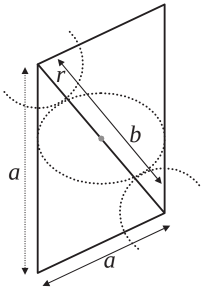
$$b = \sqrt{2}a \qquad \text{....}(i)$$

Also, $b = r + 2r + r = 4r \qquad \text{....}(ii)$

From (*i*) and (*ii*), we get

$$4r = \sqrt{2}a \quad \Rightarrow \quad r = \frac{\sqrt{2}}{4}a$$

$$r = \frac{1.414 \times 409 \text{ pm}}{4} = 144.58 \text{ pm}$$

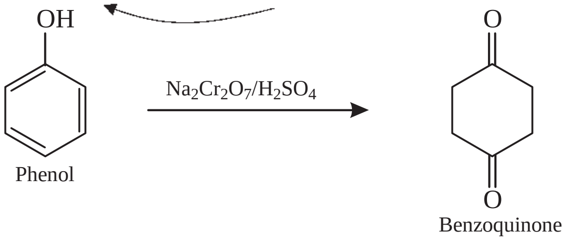


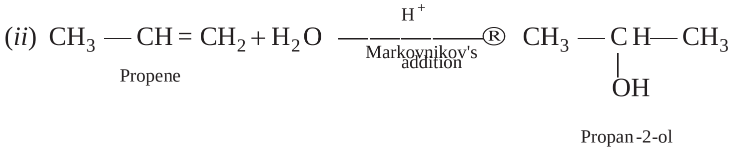
22. (*i*) $C + 2H_2SO_4\ (\text{conc.}) \longrightarrow CO_2(g) + 2H_2O\ (l) + 2SO_2(g)$

(*ii*) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2\ PO_2$

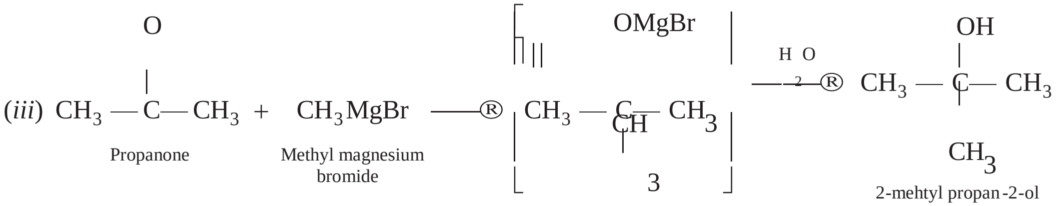
(*iii*) $Cl_2 + \underset{\text{(excess)}}{3F_2} \xrightarrow{573K} 2ClF_3$

26. (*i*)





(*ii*) $\underset{\text{Propene}}{CH_3-CH=CH_2} + H_2O \xrightarrow[\text{Markovnikov's addition}]{H^+} \underset{\text{Propan-2-ol}}{CH_3-\underset{|}{\underset{OH}{C}}H-CH_3}$



(*iii*) $\underset{\text{Propanone}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3} + \underset{\text{Methyl magnesium bromide}}{CH_3MgBr} \longrightarrow \left[CH_3-\overset{OMgBr}{\overset{|}{\underset{|}{\underset{CH_3}{C}}}}-CH_3\right] \xrightarrow{H_2O} \underset{\text{2-mehtyl propan-2-ol}}{CH_3-\overset{OH}{\overset{|}{\underset{|}{\underset{CH_3}{C}}}}-CH_3}$

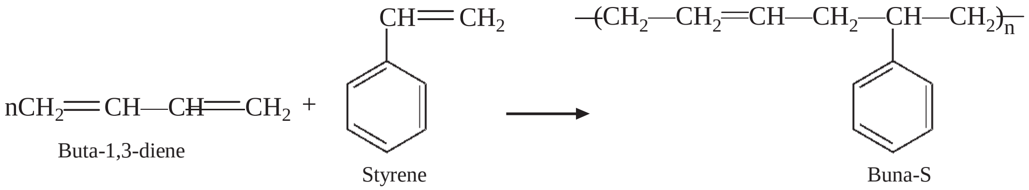
27. Polymers which are formed by the repeated addition of monomers molecules possessing double or triple bonds are called the addition polymers.

The two types of addition polymers are:

(i) Homopolymers: The addition polymers formed by the polymerisation of a single monomeric species are called homopolymers, *e.g.*, polyethene.

$$n\underset{\text{Ethene}}{CH_2-CH_2} \longrightarrow \underset{\text{Polyethene}}{-(CH_2-CH_2)_n-}$$

(*ii*) Copolymers: The polymers made by addition polymerisation from two different monomers are known as copolymers. *e.g.*, Buna-s.



CBSE EXAMINATION PAPERS

DELHI–2012

Time allowed : 3 hours **Maximum marks: 70**

General Instructions:

(*i*) *All questions are compulsory.*

(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*

(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*

(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*

(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*

(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

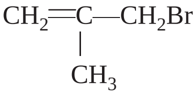
CBSE (Delhi) SET–I

1. What is meant by 'doping' in a semiconductor?

2. What is the role of graphite in the electrometallurgy of aluminium?

3. Which one of PCl_4^+ and PCl_4^- is not likely to exist and why?

4. Give the IUPAC name of the following compound:



$$CH_2{=}\underset{\displaystyle CH_3}{\underset{|}{C}}{-}CH_2Br$$

5. Draw the structural formula of 2-methylpropan-2-ol molecule.

6. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions: ethanal, propanal, propanone, butanone.

7. Arrange the following in decreasing order of their basic strength in aqueous solutions:

CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$ and NH_3

8. Define the term 'homopolymerisation' giving an example.

9. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C. Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = 0.512 K kg mol^{-1})

OR

Define the following terms:

(*i*) Mole fraction

(*ii*) Isotonic solutions

(*iii*) Van't Hoff factor

(*iv*) Ideal solution

10. What do you understand by the 'order of a reaction'? Identify the reaction order from each of the following units of reaction rate constant:

(*i*) L^{-1} mol s^{-1}

(*ii*) L mol^{-1} s^{-1}.

11. Name the two groups into which phenomenon of catalysis can be divided. Give an example of each group with the chemical equation involved.

12. What is meant by coagulation of a colloidal solution? Describe briefly any three methods by which coagulation of lyophobic sols can be carried out.

13. Describe the principle involved in each of the following processes.

(*i*) Mond process for refining of Nickel.

(*ii*) Column chromatography for purification of rare elements.

14. Explain the following giving an appropriate reason in each case.

(*i*) O_2 and F_2 both stabilise higher oxidation states of metals but O_2 exceeds F_2 in doing so.

(*ii*) Structures of Xenon fluorides cannot be explained by Valence Bond approach.

15. Complete the following chemical equations:

(*i*) $Cr_2O_7^{2-} + H^+ + I^- \longrightarrow$

(*ii*) $MnO_4^- + NO_2^- + H^+ \longrightarrow$

16. What is meant by (*i*) peptide linkage (*ii*) biocatalysts?

17. Write any two reactions of glucose which cannot be explained by the open chain structure of glucose molecules.

18. Draw the structure of the monomer for each of the following polymers:

(*i*) Nylon-6

(*ii*) Polypropene

19. Tungsten crystallises in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of tungsten atom?

OR

Iron has a body centred cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Avogadro's number. (At. mass of Fe = 55.845 u)

20. Calculate the amount of KCl which must be added to 1 kg of water so that the freezing point is depressed by 2 K. (K_f for water = 1.86 K kg mol^{-1})

21. For the reaction

$$2NO(g) + Cl_2(g) \longrightarrow 2NOCl(g),$$

the following data were collected. All the measurements were taken at 263 K:

Experiment No.	**Initial [NO] (M)**	**Initial [Cl_2] (M)**	**Initial rate of disappearance of Cl_2 (M/min)**
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

(*a*) Write the expression for rate law.

(*b*) Calculate the value of rate constant and specify its units.

(*c*) What is the initial rate of disappearance of Cl_2 in experiment 4?

22. How would you account for the following?

(*i*) Many of the transition elements are known to form interstitial compounds.

(*ii*) The metallic radii of the third (5*d*) series of transition metals are virtually the same as those of the corresponding group members of the second (4*d*) series.

(*iii*) Lanthanoids form primarily +3 ions, while the actinoids usually have higher oxidation states in their compounds, +4 or even +6 being typical.

23. Give the formula of each of the following coordination entities:

(*i*) Co^{3+} ion is bound to one Cl^-, one NH_3 molecule and two bidentate ethylene diamine (en) molecules.

(*ii*) Ni^{2+} ion is bound to two water molecules and two oxalate ions.

Write the name and magnetic behaviour of each of the above coordination entities.

(At. nos. Co = 27, Ni = 28)

24. Although chlorine is an electron withdrawing group, yet it is ortho-, para-directing in electrophilic aromatic substitution reactions. Explain why it is so?

25. Draw the structure and name the product formed if the following alcohols are oxidized. Assume that an excess of oxidizing agent is used.

(*i*) $CH_3CH_2CH_2CH_2OH$

(*ii*) 2-butenol

(*iii*) 2-methyl-1-propanol

26. Write chemical equations for the following conversions:

(*i*) Nitrobenzene to benzoic acid

(*ii*) Benzyl chloride to 2-phenylethanamine

(*iii*) Aniline to benzyl alcohol

27. What are the following substances? Give one example of each one of them:

(*i*) Tranquillisers

(*ii*) Food preservatives

(*iii*) Synthetic detergents

28. (*a*) What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it.

(*b*) In the button cell, widely used in watches, the following reaction takes place

$$Zn(s) + Ag_2O(s) + H_2O(l) \longrightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$$

Determine E^o and ΔG^o for the reaction.

(Given: $E^o_{Ag^+/Ag} = +\ 0.80$ V, $E^o_{Zn^{2+}/Zn} = -\ 0.76$ V)

OR

(*a*) Define molar conductivity of a solution and explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.

(*b*) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1}?

29. (*a*) Complete the following chemical reaction equations:

(*i*) $P_4 + SO_2Cl_2 \longrightarrow$

(*ii*) $XeF_6 + H_2O \longrightarrow$

(*b*) Predict the shape and the asked angle (90° or more or less) in each of the following cases:

(*i*) SO_3^{2-} and the angle O—S—O

(*ii*) ClF_3 and the angle F—Cl—F

(*iii*) XeF_2 and the angle F—Xe—F

OR

(*a*) Complete the following chemical equations:

(*i*) $\underset{\text{(hot and conc.)}}{NaOH} + Cl_2 \longrightarrow$

(*ii*) $XeF_4 + O_2F_2 \longrightarrow$

(*b*) Draw the structures of the following molecules:

(*i*) H_3PO_2

(*ii*) $H_2S_2O_7$

(*iii*) $XeOF_4$

30. (*a*) Illustrate the following name reactions giving suitable example in each case:

(*i*) Clemmensen reduction

(*ii*) Hell-Volhard-Zelinsky reaction

(*b*) How are the following conversions carried out?

(*i*) Ethylcyanide to ethanoic acid

(*ii*) Butan-1-ol to butanoic acid

(*iii*) Benzoic acid to m-bromobenzoic acid

OR

(*a*) Illustrate the following reactions giving a suitable example for each:

(*i*) Cross aldol condensation

(*ii*) Decarboxylation

(*b*) Give simple tests to distinguish between the following pairs of compounds

(*i*) Pentan-2-one and Pentan-3-one

(*ii*) Benzaldehyde and Acetophenone

(*iii*) Phenol and Benzoic acid

CBSE (Delhi) SET–II

Questions Uncommon to Set–I

1. Write a point of distinction between a metallic solid and an ionic solid other than metallic lustre.

11. Describe a conspicuous change observed when

(*i*) a solution of NaCl is added to a sol of hydrated ferric oxide.

(*ii*) a beam of light is passed through a solution of NaCl and then through a sol.

13. Describe the following:

(*i*) The role of cryolite in electrometallurgy of aluminium.

(*ii*) The role of carbon monoxide in the refining of crude nickel.

18. Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA?

20. A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42 °C while pure water boils at 100 °C. What mass of glycerol was dissolved to make the solution?

(K_b for water = 0.512 K kg mol^{-1})

22. State a reason for each of the following situations:

(*i*) Co^{2+} is easily oxidized to Co^{3+} in the presence of a strong ligand.

(*ii*) CO is a stronger complexing reagent than NH_3.

(*iii*) The molecular shape of $Ni(CO)_4$ is not the same as that of $[Ni(CN)_4]^{2-}$.

23. How would you account for the following?

(*i*) With the same *d*-orbital configuration (d^4) Cr^{2+} is a reducing agent while Mn^{3+} is an oxidizing agent.

(*ii*) The actinoids exhibit a larger number of oxidation states than the corresponding members in the lanthanoid series.

(*iii*) Most of the transition metal ions exhibit characteristic colours in aqueous solutions.

30. (*a*) Give a possible explanation for each one of the following:

(*i*) There are two —NH_2 groups in semicarbazide. However, only one such group is involved in the formation of semicarbazones.

(*ii*) Cyclohexanone forms cyanohydrin in good yield but 2, 4, 6-trimethylcyclohexanone does not.

(*b*) An organic compound with molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1,2-benzene-di-carboxylic acid. Identify the compound.

OR

(*a*) Give chemical tests to distinguish between

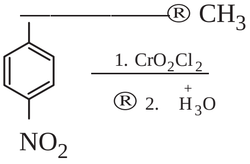
(*i*) Phenol and Benzoic acid

(*ii*) Benzophenone and Acetophenone

(*b*) Write the structures of the main products of following reactions:

(*i*) 

(*ii*) $H_3C—C\equiv C—H \xrightarrow{Hg^{2+},\ H_2SO_4}$

(*iii*) 

CBSE (Delhi) SET–III

Questions Uncommon to Set-I and II

5. Draw the structure of hex-1-en-3-ol compound.

20. 15.0 g of an unknown molecular material was dissolved in 450 g of water. The resulting solution was found to freeze at – 0.34 °C. What is the molar mass of this material? (K_f for water = 1.86 K kg mol^{-1})

22. Explain the following observations giving an appropriate reason for each.

(*i*) The enthalpies of atomization of transition elements are quite high.

(*ii*) There occurs much more frequent metal-metal bonding in compounds of heavy transition metals (*i.e.*, 3rd series).

(*iii*) Mn^{2+} is much more resistant than Fe^{2+} towards oxidation.

23. Write the name, the structure and the magnetic behaviour of each one of the following complexes:

(*i*) $[Pt(NH_3)Cl(NO_2)]$

(*ii*) $[Co(NH_3)_4Cl_2]Cl$

(*iii*) $Ni(CO)_4$

(At. nos. Co = 27, Ni = 28, Pt = 78)

27. Explain the following terms giving one example of each type:

(*i*) Antacids

(*ii*) Disinfectants

(*iii*) Enzymes

30. (*a*) Draw the molecular structures of following compounds:

(*i*) XeF_6

(*ii*) $H_2S_2O_8$

(*b*) Explain the following observations:

(*i*) The molecules NH_3 and NF_3 have dipole moments which are of opposite directions.

(*ii*) All the bonds in PCl_5 molecule are not equivalent.

(*iii*) Sulphur in vapour state exhibits paramagnetism.

OR

(*a*) Complete the following chemical equations:

(*i*) $XeF_4 + SbF_5$ ——®

(*ii*) $Cl_2 + F_2$(excess)

——® (*b*) Explain each of the following:

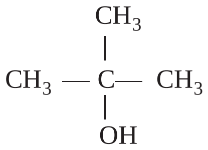
(*i*) Nitrogen is much less reactive than phosphorus.

(*ii*) The stability of +5 oxidation state decreases down group 15.

(*iii*) The bond angles (O—N—O) are not of the same value in NO_2^- and NO_2^+.

Solutions

CBSE (Delhi) SET–I

1. The process of addition of an appropriate amount of suitable impurity to an intrinsic semiconductor to enhance its conductivity is called doping.
2. Graphite is used as electrodes in the electrometallurgy of aluminium. The electrode reactions are:
   Cathode: $Al^{3+}\text{(melt)} + 3e^- \longrightarrow Al(l)$
   Anode: $C(s) + O^{2-}\text{(melt)} \longrightarrow CO(g) + 2e^-;$
   $C(s) + 2O^{2-}\text{(melt)} \longrightarrow CO_2(g) + 4e^-$
3. PCl_4^-, as phosphorus has 10 electrons which can't be accommodated in sp^3 hybrid orbitals.
4. 3-Bromo-2-methylpropene
5. 
   $$CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$$
6. Butanone < Propanone < Propanal < Ethanal
7. $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$
8. Homopolymerisation is a polymerisation reaction in which monomers of one kind are allowed to polymerise and form a homopolymer.

   $$n\,CH_2{=}CH_2 \xrightarrow{\text{Polymerization}} \left(CH_2-CH_2 \right)_n$$

   Ethene Polyethene (Homopolymer)
9. $\Delta T_b = 100.18°C - 100°C = 0.18°C$ or 0.18 K; $K_b = 0.512\ \text{K kg mol}^{-1}$; $m = 1\ \text{mol kg}^{-1}$

   $$\Delta T_b = i\,K_b\,m$$
   $$0.18\ \text{K} = i \times 0.512\ \text{K kg mol}^{-1} \times 1\ \text{mol kg}^{-1}$$
   $$i = \frac{0.18}{0.512} = 0.35$$

   OR

   (*i*) Mole fraction of a component in a solution may be defined as the ratio of moles of that component to the total number of moles of all the components present in the solution.
   (*ii*) The solutions of the same osmotic pressure at a given temperature are called isotonic solutions.
   (*iii*) van't Hoff's factor (*i*) may be defined as the ratio of normal molecular mass to observed molecular mass or the ratio of observed colligative property to normal colligative property.
   (*iv*) A solution which obeys Raoult's law over the entire range of concentration is called an ideal solution.
10. The sum of powers of the concentration of the reactants in the rate law expression is called order of reaction.
    For a general reaction: $aA + bB \longrightarrow \text{Products}$

If rate = $k[A]^m [B]^n$; order of reaction = $m + n$

(*i*) General unit of rate constant, $k = (\text{mol L}^{-1})^{1-n}\ \text{s}^{-1}$

$$\therefore \quad \text{L}^{-1}\ \text{mol s}^{-1} = (\text{mol L}^{-1})^{1-n}\ \text{s}^{-1}$$

$$-1 = -1 + n \quad \Rightarrow \quad n = 0 \ \text{ or } \ 1 = 1 - n \quad \Rightarrow n = 0 \quad \therefore \text{ Reaction order} = 0$$

(*ii*)
$$\text{L mol}^{-1}\ \text{s}^{-1} = (\text{mol L}^{-1})^{1-n}\ \text{s}^{-1}$$

$$1 = -1 + n \quad \Rightarrow \quad n = 2 \ \text{ or } -1 = 1 - n \quad \Rightarrow n = 2 \quad \therefore \text{ Reaction order} = 2$$

11. The two groups into which phenomenon of catalysis can be divided are:

(*i*) Homogeneous catalysis: When the reactants and the catalyst are in the same phase, the catalysis is said to be homogeneous catalysis. For example, SO_2 is oxidized to SO_3 in the presence of nitric oxide, NO as catalyst.

$$2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$$

(*ii*) Heterogeneous catalysis: When the reactants are in a different phase than the catalyst, the catalysis is said to be heterogeneous. For example, the combination of dinitrogen and dihydrogen to form ammonia in the presence of finally divided iron as a catalyst.

$$N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$$

12. The process of settling of colloidal particles through induced aggregation by the addition of some suitable electrolyte is known as coagulation. Three methods by which coagulation of lyophobic sols can be carried out are:

(*i*) Electrophoresis: During electrophoresis the colloidal particles move towards oppositely charged electrodes, get discharged and coagulated.

(*ii*) Boiling: On boiling a sol, the adsorbed layer is disturbed due to increased collision with the molecules of dispersion medium. This reduces the charge on the particles which ultimately settle down in the form of a precipitate.

(*iii*) Addition of Electrolytes: When excess of an electrolyte is added to a colloidal solution, the colloids interact with ions carrying charge opposite to that present on themselves. This causes neutralisation leading to their coagulation.

13. (*i*) In Mond process, nickel is converted into its volatile complex, teracarbonyl nickel and gets collected elsewhere. It is then decomposed to give pure nickel.

$$\underset{\substack{\text{Impure}\\ \text{nickel}}}{\text{Ni}} + 4CO \xrightarrow{330-350\text{ K}} \underset{\substack{\text{Tetracarbonyl}\\ \text{nickel (volatile)}}}{Ni(CO)_4}; \quad Ni(CO)_4 \xrightarrow{450-470\text{ K}} \underset{\substack{\text{Pure}\\ \text{nickel}}}{\text{Ni}} + 4CO$$

(*ii*) Column chromatography is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. In purification of rare earth elements ion-exchange is used as an adsorbent.

14. (*i*) It is due to the ability of oxygen to form multiple bonds with metals.

(*ii*) This is because the energy required for the promotion of electrons in xenon is very high.

15. (*i*)

$$\begin{array}{rcl} Cr_2O_7^{2-} + 14H^+ + 6e^- & \longrightarrow & 2Cr^{3+} + 7H_2O \\ 2I^- & \longrightarrow & I_2 + 2e^-]\times 3 \\ \hline Cr_2O_7^{2-} + 6I^- + 14H^+ & \longrightarrow & 2Cr^{3+} + 3I_2 + 7H_2O \\ \hline \end{array}$$

(*ii*)

$$\begin{array}{lll} MnO_4^- + 8H^+ + 5e^- & \longrightarrow & Mn^{2+} + 4H_2O]\times 2 \\ NO_2^- + H_2O & \longrightarrow & NO_3^- + 2H^+ + 2e^-]\times 5 \\ \hline 2MnO_4^- + 5NO_2^- + 6H^+ & \longrightarrow & 2Mn^{2+} + 5NO_3^- + 3H_2O \\ \hline \end{array}$$

16. (*i*) Peptide linkage is an amide (—$CONH_2$) linkage formed between —COOH group of one α-amino acid and —NH_2 group of other α-amino acid by the loss of a water molecule in a peptide.

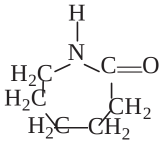
(*ii*) A number of reactions that occur in the bodies of animals and plants to maintain the life process are catalysed by enzymes. The enzymes are thus termed as biocatalysts. Almost all the enzymes are globular proteins. An enzyme catalyses a biochemical reaction by providing alternate lower activation path thereby increasing the rate of the biochemical reaction. For example, activation energy for acid hydrolysis of sucrose is 6.22 kJ mol^{-1} while the activation energy is only 2.15 kJ mol^{-1} when hydrolyzed in the presence of enzyme sucrose.

17. (*i*) The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free —CHO group.

(*ii*) D—(+)—glucose when heated with methly alcohol in the presence of dry HCl gas forms a mixture containing methyl α-D-glucoside and methyl β-D-glucoside.

$$\underset{\text{D-glucose}}{C_6H_{12}O_6} + \underset{\text{Methyl alcohol}}{CH_3—OH} \xrightarrow{H^+} \underset{\substack{\text{Methyl-}\alpha\text{-and}\\ \beta\text{-D-glucosides}}}{(C_6H_{11}O_5)OCH_3} + H_2O$$

18.

(*i*) 

Caprolactum

(*ii*) $CH_3—CH{=}CH_2$

Propene

19. a = 316.5 pm

For *bcc* unit cell, $$r = \frac{\sqrt{3}}{4}a$$

$$\therefore \qquad r = \frac{\sqrt{3}}{4} \times 316.5 \text{ pm} = 137.04 \text{ pm}$$

OR

a = 286.65 pm = 286.65 × 10^{-10} cm; M = 55.845 g mol^{-1}; d = 7.874 g cm^{-3}

For *bcc* unit cell, z = 2

Substituting the values in the expression, $N_A = \frac{z \times M}{a^3 \times d}$, we get

$$N_A = \frac{2 \times 55.845 \text{ g mol}^{-1}}{(286.65 \times 10^{-10} \text{ cm})^3 \times 7.874 \text{ g cm}^{-3}}$$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

20. $i = 2$, $W_A = 1$ kg = 1000 g; $\Delta T_f = 2$K; $K_f = 1.86$ K kg mol^{-1}; $M_B = 74.5$ g mol^{-1}

Substituting these values in the expression,

$$W_B = \frac{\Delta T_f \times M_B \times W_A}{i \times K_f \times 1000}$$

$$W_B = \frac{2\,\text{K} \times 74.5\,\text{g mol}^{-1} \times 1000\,\text{g}}{2 \times 1.86\,\text{K kg mol}^{-1} \times 1000\,\text{g kg}^{-1}} = 40.05\text{ g}$$

21. Suppose order w.r.t. NO is m and order w.r.t. Cl_2 is n. Then the rate will be

$$\text{Rate} = k[\text{NO}]^m[\text{Cl}_2]^n$$

Substituting the values of experiment 1 to 3 in the rate expression, we get

$$0.60 = k(0.15)^m\,(0.15)^n \quad ...(i)$$

$$1.20 = k(0.15)^m\,(0.30)^n \quad ...(ii)$$

$$2.40 = k(0.30)^m\,(0.15)^n \quad ...(iii)$$

Dividing equation (*iii*) by (*i*), we get

$$\frac{2.40}{0.60} = \frac{k(0.30)^m\,(0.15)^n}{k(0.15)^m\,(0.15)^n}$$

$$4 = 2^m \quad \text{or} \quad 2^2 = 2^m \quad \text{or} \quad m = 2$$

Dividing equation (*ii*) by (*i*), we get

$$\frac{1.20}{0.60} = \frac{k(0.15)^m\,(0.30)^n}{k(0.15)^m\,(0.15)^n}$$

$$2 = 2^n \quad \text{or} \quad n = 1$$

(*a*) Rate law expression is, Rate = $k[\text{NO}]^2\,[\text{Cl}_2]$

(*b*) $0.60\text{ mol L}^{-1}\text{ min}^{-1} = k(0.15\text{ mol L}^{-1})^2\,(0.15\text{ mol L}^{-1})$

$$\therefore \quad k = 177.77\text{ mol}^{-2}\text{ L}^2\text{ min}^{-1}$$

(*c*)

$$\text{Rate} = 177.77\text{ mol}^{-2}\text{ L}^2\text{ min}^{-1} \times (0.25\text{ mol L}^{-1})^2\,(0.25\text{ mol L}^{-1})$$
$$= 2.778\text{ mol L}^{-1}\text{ min}^{-1}$$

22. (*i*) Interstitial compounds are well known for many of the transition elements because the transition elements are capable of entrapping small sized atoms such as H, C and N in the interstitial sites in their crystal lattices. These trapped atoms get bonded to the atoms of transition elements. TiC, Fe_3H, Mn_4N, etc. are some interstitial compounds

(*ii*) This is due to filling of 4*f* orbitals which have poor shielding effect.

(*iii*) This is due to very small energy gaps between 5*f*, 6*d* and 7*s* subshells in actinoids.

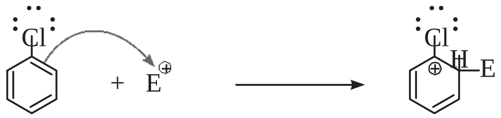
23. (*i*) $[Co(NH_3)Cl(en)_2]^{2+}$: Amminechloridobis (ethane-1, 2-diamine)-cobalt(III) ion

Magnetic behaviour : Diamagnetic

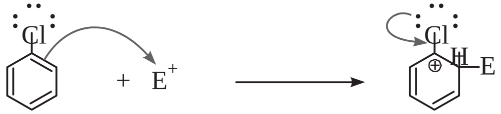
(*ii*) $[Ni(H_2O)_2(OX)_2]^{2-}$: Diaquadioxalatonickelate (II) ion

Magnetic behaviour : Paramagnetic

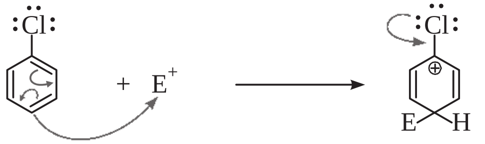
24. Chlorine withdraws electrons through negative inductive effect and releases electron through resonance. Through negative inductive effect, chlorine destabilizes the intermediate carbocation formed during the electrophilic substitution. Through resonance effect, chlorine tends to stabilize the carbocation and the effect is more pronounced at ortho and para-positions



Inductive effect destabilizes the intermediate carbocation



(Attack at ortho-position)



(Attack at para-position)

Resonance effect stabilizes the intermediate carbocation

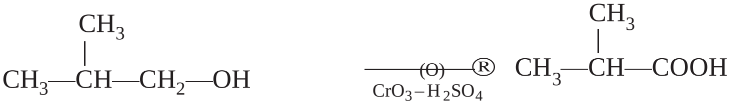
The negative inductive effect is stronger than resonance effect and causes net electron withdrawal and thus causes net deactivation. The resonance effect tends to oppose the inductive effect for the attack at ortho and para positions and hence makes the deactivation less for ortho and para attack. Thus the electrophilic substitution takes place at ortho and para positions..

25. (*i*) $CH_3—CH_2—CH_2—CH_2—OH \xrightarrow[CrO_3-H_2SO_4]{(O)} CH_3—CH_2—CH_2—COOH$

Butan-1-ol Butanoic acid

(*ii*) $CH_3—CH{=}CH—CH_2—OH \xrightarrow[PCC]{(O)} CH_3—CH{=}CH—CHO$

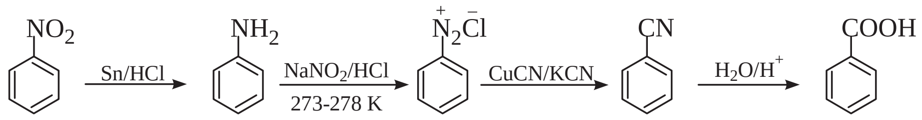
But-2-enol But-2-enal

(*iii*)


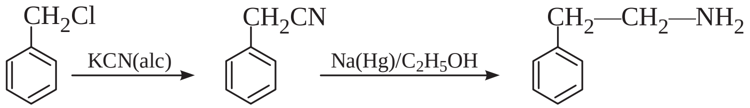
$$\underset{\displaystyle\text{2-Methylpropan-1-ol}}{CH_3—\overset{\displaystyle CH_3}{\overset{|}{C}H}—CH_2—OH} \xrightarrow[CrO_3-H_2SO_4]{(O)} \underset{\displaystyle\text{2-Methylpropanoic acid}}{CH_3—\overset{\displaystyle CH_3}{\overset{|}{C}H}—COOH}$$

2-Methylpropan-1-ol 2-Methylpropanoic acid

26.

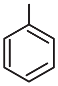
(*i*)


Nitrobenzene Benzoic acid

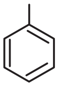
(*ii*)


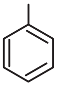
Benzyl chloride 2-Phenylethanamine

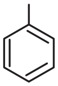
(*iii*) $\overset{\displaystyle NH_2}{} \xrightarrow[273-278\ K]{NaNO_2/HCl} \overset{+\ \ -}{N_2Cl} \xrightarrow{CuCN/KCN} CN \xrightarrow{H_2O/H^+} COOH \xrightarrow{LiAlH_4} CH_2OH$

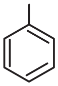


Aniline



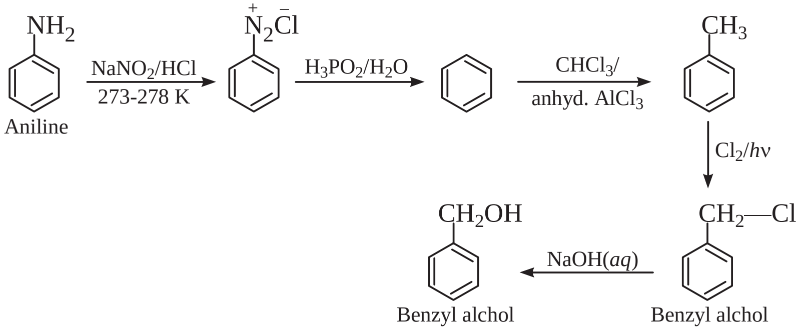






Benzyl alcohol

Alternatively,



27. (*i*) Tranquilizers are a class of chemical compounds used for the treatment of stress, fatigue, and mild or even severe mental diseases. These relieve anxiety, stress, irritability or excitement by inducing a sense of well-being, *e.g.*, iproniazid, chlordiazopoxide, equanil, luminal, etc.

(*ii*) Food preservatives are the chemical substances which are added to food materials to prevent their spoilage due to microbial growth and to retain their nutritive value for long periods. Preservatives prevent the rancidity of food and inhibit growth or kill the microorganisms. The most-common preservatives used are sugar, vegetable oil, sodium benzoate, salts of ascorbic acid and propanoic acid.

(*iii*) Synthetic detergents are cleansing agents, which have all the properties of soaps but actually do not contain any soap. These can be used in both soft water and hard water as they produce foam even in hard water. These are mainly classified into three categories:

- Anionic detergents, *e.g.*, sodium dodecylbenzene sulphonate
- Cationic detergents, *e.g.*, cetyltrimethyl ammonium bromide
- Non-ionic detergents, *e.g.*, polyethylene glycol stearate

28. (*a*) Lead storage battery is a secondary battery. The reactions occurring in lead storage battery when current is drawn from it are:

Anode: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e- \longrightarrow PbSO_4(s) + 2H_2O(l)$

Overall reaction: $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$

(*b*) **Anode:** $Zn \longrightarrow Zn^{2+} + 2e^-$

Cathode: $Ag_2O + H_2O + 2e^- \longrightarrow 2Ag + 2OH^-$

Cell reaction: $Zn + Ag_2O + H_2O \longrightarrow Zn^{2+} + 2Ag + 2OH^-;$ $n = 2$

$$E^o_{cell} = E^o_{cathode} - E^o_{anode} = E^o_{Ag^+/Ag} - E^o_{Zn^{2+}/Zn}$$

$$= 0.80 \text{ V} - (-0.76 \text{ V})$$

$$E^o_{cell} = 1.56 \text{ V}$$

$$\Delta G^o = -nF\,E^o_{cell}$$

$$\therefore \quad \Delta G^o = -2 \times 96500 \text{ C mol}^{-1} \times 1.56 \text{ V} = -301080 \text{ J mol}^{-1}$$

$$\Delta G^o = -301.08 \text{ kJ mol}^{-1}$$

OR

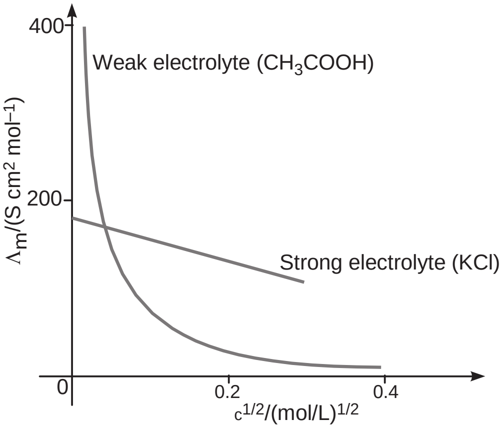
(*a*) Molar conductivity of a solution at a given concentration is the conductance of the volume V of the solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length.

$$\Lambda_m = \kappa \times V = \frac{\kappa \times 1000}{c}$$

where κ is the conductivity and *V* is the volume of solution containing one mole of the electrolyte and *c* is the molar concentration.

Molar conductivity increases with decrease in concentration or increase in dilution as the number of ions as well as the mobility of ions increases with increase in dilution.

For strong electrolytes, the number of ions does not increase appreciably on dilution and only mobility of ions increases due to decrease in interionic attractions. Therefore, Λ_m increases a little as shown in figure by a straight line. For weak electrolytes, number of ions as well as mobility of ions increases on dilution which results in a very large increase in molar conductivity, especially at infinite dilution (*i.e.*, concentration, $c \rightarrow 0$) as shown by curve in figure.



(*b*) $R = 1500\ \Omega$; $\kappa = 0.146 \times 10^{-3}$ S cm^{-1}

Substituting the values in the expression,

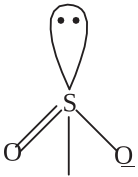
Cell constant = κ × *R*

Cell constant = 0.146×10^{-3} S cm^{-1} × 1500

$\Omega = 0.219$ cm^{-1}

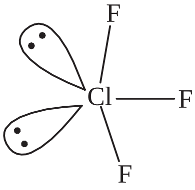
29. (*a*) (*i*) $P_4 + 10SO_2Cl_2 \longrightarrow 4PCl_5 + 10SO_2$

(*ii*) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$



SO_3^{2-}

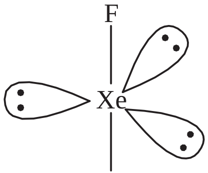
(*b*) (*i*) There are three bond pairs and one lone pair of electrons around S atoms in SO_3^{2-}. Therefore according to VSEPR theory, SO_3^{2-} should be pyramidal. The angle O—S—O is greater than 90°.



ClF_3

(*ii*) There are three bond pairs and two lone pairs of electrons around Cl atom in ClF_3. Therefore according to VSEPR theory, ClF_3 should be bent T-shaped. The angle F—Cl—F is less than 90°.

(*iii*) There are two bond pairs and three lone pairs of electrons around Xe atoms in XeF_2. Therefore according to VSEPR theory, XeF_2 should be linear. The angle F—Xe—F is greater than 90°.



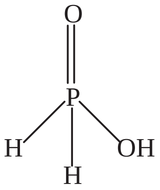
XeF_2

OR

(*a*) (*i*) $\underset{\text{(hot and conc)}}{6NaOH} + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

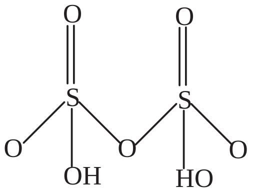
(*ii*) $XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$

(*b*) (*i*)



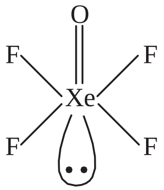
H_3PO_2

(*ii*)



$H_2S_2O_7$

(*iii*)



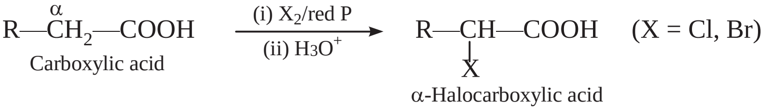
$XeOF_4$

30. (*a*) (*i*) The carbonyl group of aldehydes and ketones is reduced to CH_2 group on treatment with zinc-amalgam and concentrated hydrochloric acid. The reaction is known as Clemmensen reduction

$$\rangle C{=}O \xrightarrow[\text{HCl}]{\text{Zn–Hg}} \rangle CH_2 + H_2O$$

$$\underset{\text{Acetone}}{CH_3COCH_3} + 4(H) \xrightarrow[\text{HCl}]{\text{Zn–Hg}} \underset{\text{Propane}}{CH_3CH_2CH_3} + H_2O$$

(*ii*) Carboxylic acids having an α-hydrogen are halogenated at the α-position on treatment with chlorine or bromine in the presence of small amount of red phosphorus to give α-halocarboxylic acids. This reaction is called Hell–Volhard–Zelinsky reaction.



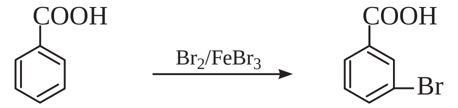
$$\underset{\text{Carboxylic acid}}{R{-}\overset{\alpha}{C}H_2{-}COOH} \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } X_2\text{/red P}} \underset{\alpha\text{-Halocarboxylic acid}}{R{-}\underset{X}{CH}{-}COOH} \quad (X = Cl, Br)$$

(*b*) (*i*)

$$\begin{tikzcd}
\underset{\text{Ethyl cyanide}}{CH_3CH_2CN} \arrow[r, "H_3O^+", "\Delta"'] & CH_3CH_2COOH \arrow[r, "+NH_3", "\Delta"'] & CH_3CH_2CONH_2 \arrow[d, "Br_2/KOH"] \\
\underset{\text{Ethanoic acid}}{CH_3COOH} & CH_3CH_2OH \arrow[l, "K_2Cr_2O_7/H_2SO_4"'] & CH_3CH_2NH_2 \arrow[l, "HNO_2"']
\end{tikzcd}$$

(*ii*) $$\underset{\text{Butan-1-ol}}{CH_3{-}CH_2{-}CH_2{-}CH_2{-}OH} \xrightarrow[\text{(Jones reagent)}]{CrO_3-H_2SO_4} \underset{\text{Butanoic acid}}{CH_3{-}CH_2{-}CH_2{-}COOH}$$

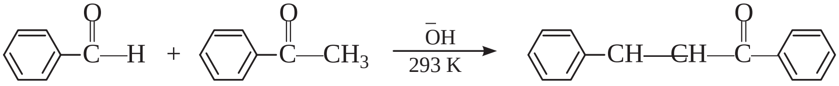
(*iii*)



Benzoic acid *m*-Bromobenzoic acid

OR

(*a*) (*i*) When aldol condensation is carried out between two different aldehydes and/or ketones, it is called cross aldol condensation.



Benzaldehyde

Benzalacetophenone (Major product)

(*ii*) Sodium salt of carboxylic acids on heating with soda lime lose carbon dioxide and form hydrocarbons. This reaction is called decarboxylation.

$$\underset{\text{Sodium carboxylate}}{R-CO\overset{-}{O}\overset{+}{Na}} \xrightarrow[\Delta]{\text{NaOH and CaO}} \underset{\text{Hydrocarbon}}{R-H} + Na_2CO_3$$

(*b*) (*i*) Pentan-2-one when treated with NaOI (I_2/NaOH) gives yellow precipitate of iodoform but pentan-3-one does not give this test.

$$\underset{\text{Pentan-2-one}}{CH_3-CH_2-CH_2-COCH_3} + \underset{\text{Sodium hypoiodite}}{3NaOI} \longrightarrow CH_3CH_2CH_2COONa + \underset{\text{Iodoform (Yellow ppt.)}}{CHI_3\downarrow} + 2NaOH$$

(*ii*) Benzaldehyde being an aldehyde gives silver mirror with Tollen's reagent but acetophenone being a ketone does not give this test.

$$\underset{\text{Benzaldehyde}}{C_6H_6CHO} + \underset{\text{Tollen's reagent}}{2[Ag(NH_3)_2]^+} + 3OH^- \longrightarrow C_6H_5COO^- + \underset{\text{Silver mirror}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

(*iii*) Benzoic acid produces brisk effervescence with sodium bicarbonate solution while phenol does not.

$$\underset{\text{Benzoic acid}}{C_6H_5COOH} + \underset{\text{Sodium bicarbonate}}{NaHCO_3} \longrightarrow C_6H_5COONa + CO_2\uparrow + H_2O$$

CBSE (Delhi) SET–II

1. Metallic solids conduct electricity in solid state while ionic solids are insulators in solid state.

11. (*i*) The positively charged colloidal particles of $Fe(OH)_3$ get coagulated by negatively charged Cl^- ions provided by electrolyte sodium chloride.

(*ii*) The path of light is not visible when light is passed through NaCl solution but visible when light is passed through a sol due to scattering of light by colloidal particles.

13. (*i*) The role of electrolyte is two-fold:

- It covers the melting point of the mixture to about 1250 K.
- It increases the electrical conductivity of the mixture.

(*ii*) When nickel is heated with carbon monoxide it forms a volatile compound tetracarbonyl nickel, $Ni(CO)_4$ which on further heating at higher temperature decomposes to give pure nickel.

$$\underset{\text{Impure nickel}}{Ni} + 4CO \xrightarrow{330-350K} Ni(CO)_4;\quad Ni(CO)_4 \xrightarrow{450-470K} \underset{\text{Pure nickel}}{Ni} + 4CO$$

18. **Structural difference**

DNA	RNA
1. The sugar present in DNA is 2-deoxy-D-(–)-ribose.	1. The sugar present in RNA is D-(–)-ribose.
2. DNA has double stranded α-helix structure.	2. RNA has single stranded α-helix structure.
3. DNA contains cytosine and thymine as pyrimidine bases.	3. RNA contains cytosine and uracil as pyrimidine bases.
4. DNA molecules are very large and their molecular mass may vary from $6 \times 10^6 - 16 \times 10^6$ u.	4. RNA molecules are much smaller and their molecular may vary from 20,000–40,000 u.

Thymine is present in DNA.

20. $\Delta T_b = 100.42°\text{C} - 100.00°\text{C} = 0.42°\text{C}$ or 0.42 K; $W_A = 500$ g

$K_b = 0.52 \text{ K kg mol}^{-1}$; $M_B = 92 \text{ g mol}^{-1}$

Substituting these values in the expression,

$$W_B = \frac{\Delta T_b \times M_B \times W_A}{K_b \times 1000}, \text{ we get}$$

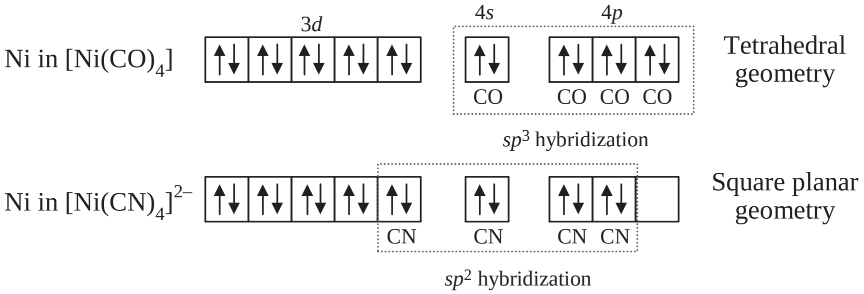
$$W_B = \frac{0.42 \text{ K} \times 92 \text{ g mol}^{-1} \times 500 \text{ g}}{0.512 \text{ K kg mol}^{-1} \times 1000 \text{ g kg}^{-1}} = 37.73 \text{ g}$$

22. (*i*) Because strong ligand causes spin pairing giving rise to diamagnetic octahedral complex which are very stable and have very large crystal field stabilization energy. This splitting energy overcomes the ionization enthalpy.

(*ii*) CO is capable of accepting an appreciable amount of electron density from a filled metal *d*-orbital into vacant antibonding π*-orbital of its own.This type of π interaction increases the value of crystal field stabilization energy. This explain why CO is a stronger complexing reagent than NH_3.

(*iii*) Ni in $[Ni(CO)_4]$ is sp^3 hybridized. Hence, it is tetrahedral.

In $[Ni(CN)_4]^{2-}$, the Ni^{2+} is dsp^2 hybridized. Hence, it has square planar geometry.

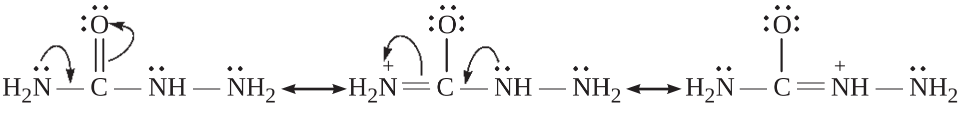


23. (*i*) Cr^{2+} is a reducing agent as its configuration changes from d^4 to d^3, the later having a half-filled t_{2g} level. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the extra stable half-filled (d^5) configuration and hence Mn^{3+} is an oxidizing agent.

(*ii*) This is due to very small energy gaps between 5*f*, 6*d* and 7*s* subshells in actinoids.

(*iii*) In aqueous solutions, the transition metal ions which have partially filled *d*-orbitals undergo *d*-*d* transition by absorbing light from visible region and radiate complementary colour.

30. (*a*) (*i*)



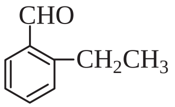
$$H_2\ddot{N}-\overset{\ddot{O}}{\overset{\|}{C}}-\ddot{N}H-\ddot{N}H_2 \longleftrightarrow H_2\overset{+}{N}=\overset{\ddot{O}^-}{\overset{|}{C}}-\ddot{N}H-\ddot{N}H_2 \longleftrightarrow H_2\ddot{N}-\overset{\ddot{O}^-}{\overset{|}{C}}=\overset{+}{N}H-\ddot{N}H_2$$

Semicarbazide

Although semicarbazide has two —NH_2 group but one which is directly attached to C═O is involved in the resonance as shown above. Consequently, electron density on this —NH_2 group decreases and hence it does not act as a nucleophile. On the other hand, the lone pair of electrons on the other —NH_2 group is not involved in resonance and hence is available for nucleophilic attack on the C═O group of aldehydes and ketones.

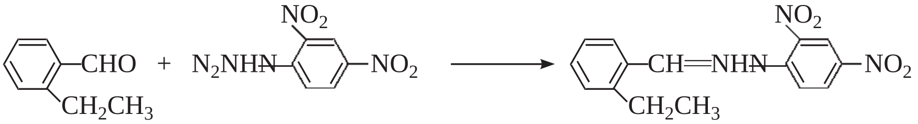
(*ii*) Due to presence of three methyl groups, the nucleophilic attack by CN^- ion does not occur due to steric hindrance in 2, 4, 6-trimethyl cylcohexanone. As there is no such steric hindrance in cyclohexanone so nucleophilic attack by the CN^- ion occurs readily and hence cyclohexanone cyanohydrin is obtained in good yield.

(*b*) The compound is

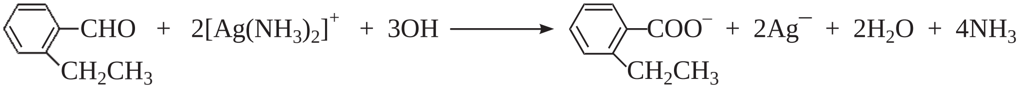


2-ethyl benzaldehyde

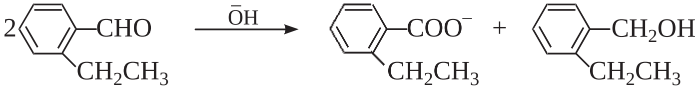
The reactions involved in the question are:

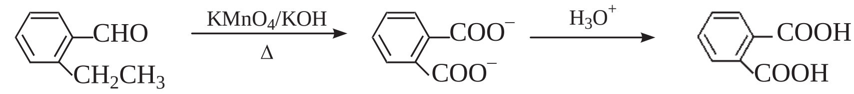


2-Ethylbenzaldehyde 2, 4-DNP 2, 4-DNP derivative



Tollen's reagent Silver mirror





2-Ethyl benzaldehyde 1, 2-Benzenedicarboxylic acid

OR

(*a*) (*i*) Phenol gives a violet colouration with neutral $FeCl_3$ solution while benzoic acid gives buff coloured precipitate of ferric benzoate.

$6C_6H_5OH + FeCl_3 \longrightarrow [Fe(OC_6H_5)_6]^{3-} + 3H^+ + 3HCl$

Violet complex

$3C_6H_5COOH + FeCl_3 \longrightarrow (C_6H_5COO)_3Fe + 3HCl$

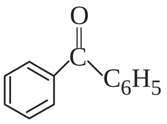
Benzoic acid Buff coloured ppt.

(*ii*) Acetophenone being a methyl ketone when treated with NaOI(I_2/NaOH) gives yellow precipitate of iodoform while benzophenone does not give this test.

$C_6H_5COCH_3$ + 3NaOI ——® C_6H_5COONa + CHI_3 + 2NaOH

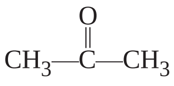
Acetophenone Sodium benzoate Iodoform (Yellow ppt.)

(*b*) (*i*)



Bezophenone

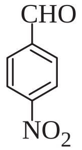
(*ii*)



$CH_3—\overset{\overset{\displaystyle O}{\|}}{C}—CH_3$

Acetone

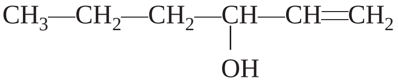
(*iii*)



p-Nitro benzaldehyde

CBSE (Delhi) SET–III

5.



$CH_3—CH_2—CH_2—\underset{\underset{\displaystyle OH}{|}}{CH}—CH{=}CH_2$

20. ΔT_f = 0°C – (– 0.34 °C) = 0.34 °C or 0.34 K

$W_B = 15.0$ g; $W_A = 450$ g; $K_f = 1.86$ K kg mol^{-1}

Substituting these values in the expression,

$$M_B = \frac{K_f \times W_B \times 1000}{\Delta T_f \times W_A}, \text{ we get}$$

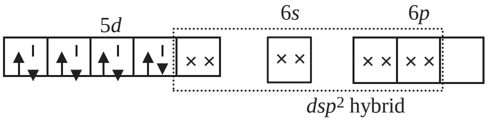
$$M_B = \frac{1.86\text{ K kg mol}^{-1} \times 15.0\text{ g} \times 1000\text{ g kg}^{-1}}{0.34\text{ K} \times 450\text{ g}} = 182.35\text{ g mol}^{-1}$$

22. (*i*) Because of large number of unpaired electrons in their atoms, the transition metals have strong interatomic interactions and hence stronger bonding between atoms, resulting in higher enthalpies of atomization.

(*ii*) In the same group of *d*-block elements, the 4*d* and 5*d* transition elements are larger in size than than those of 3*d* elements. Hence, the valence electrons are less tightly held and form metal–metal bond more frequently.

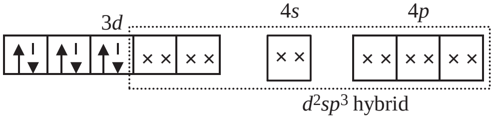
(*iii*) $Mn^{3+}(d^4)$ is less stable than Mn^{2+} (d^5, half filled) while Fe^{3+} (d^5, half filled) is more stable than Fe^{2+} (d^4). That is why Mn^{2+} is more resistance than Fe^{2+} towards oxidation.

23. (*i*) $[Pt(NH_3)_2ClNO_2]$: Diamminechloridonitrito-N-platinum (II); $Pt^{2+} = 5d^8$



× × = Electron pair from the NH_3, Cl^- and NO_2

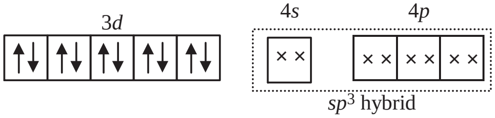
Structure = Square planar; Magnetic behaviour : Diamagnetic (*ii*) $[CO(NH_3)_4Cl_2]Cl$: Tetraamminedichloridocobalt (III) chloride; $Co^{3+} = 3d^6$



× × = Electron pair from ligands NH_3 and Cl^-

Structure = Octahedral; Magnetic behaviour : Diamagnetic

(*iii*) $Ni(CO)_4$: Tetracrabonyl nickel(o); $Ni = 3d^8\ 4s^2$



× × = Electron pair from ligand CO

Structure = Tetrahedral; Magnetic behaviour : Diamagnetic

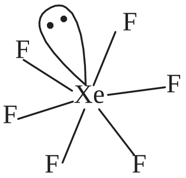
27. **(*i*) Antacids:** Chemical substances which remove excess acid in the stomach and raise the pH to appropriate level, *e.g.*, sodium hydrogencarbonate, a mixture of aluminium and magnesium hydroxide, ranitidine, etc.

(*ii*) Disinfectants: These are the chemical substances which kill microorganisms or stop their growth but are harmful to human tissues, *e.g.*, phenol (1%), chlorine in concentration of 0.2 to 0.4 pm in aqueous solution, SO_2, etc.

(*iii*) Enzymes: Enzymes are globular proteins with high molecular mass ranging from 15,000 to 1,000,000 g mol^{-1}, which form colloidal solution in water. A number of reactions that occur in the body of animals and plants to maintain the life processes are catalyzed by enzymes, therefore enzymes are termed as biochemical catalysts.

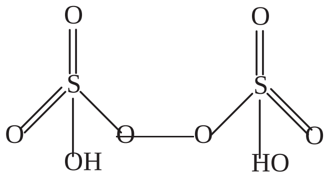
30.

(*a*) (*i*)



Distorted octahedral
XeF_6

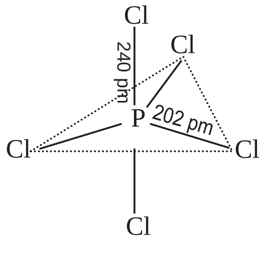
(*ii*)



Peroxodisulphuric acid
$(H_2S_2O_8)$

(*b*) (*i*) This is because in NH_3 nitrogen is more electronegative than hydrogen while in NF_3, nitrogen is less electronegative than fluorine.

(*ii*) In gaseous and liquid phases PCl_5 has a trigonal bipyramidal structure. The three equatorial P—Cl bonds are equivalent, while the two axial bonds are longer then equitorial bonds. This is due to the fact that the axial bond pairs suffer greater repulsion as compared to equatorial bond pairs.



(*iii*) In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding π^* orbitals like O_2 and hence it exhibits paramagnetism.

OR

(*a*) (*i*) $XeF_4 + SbF_5 \longrightarrow [XeF_3]^+[SbF_6]^-$

(*ii*) $Cl_2 + 3F_2(\text{excess}) \xrightarrow{573\,K} 2ClF_3$

(*b*) (*i*) As $N\equiv N$ triple bond (941.4 kJ mol^{-1}) is much stronger than P—P single bond (213 k J mol^{-1}), therefore nitrogen is much less reactive than phosphorus.

(*ii*) Due to inert pair effect stability of +5 oxidation decreases down the group 15.

(*iii*) In NO_2^-, nitrogen has a lone pair of electrons. As lone pair-bond pair repulsion is greater than bond pair-bond repulsion, thus O—N—O bond angle in NO_2^- is less than NO_2^+.

z z z

CBSE EXAMINATION PAPERS

ALL INDIA–2012

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*
(*ii*) *Question numbers **1** to **8** are very short answer questions and carry **1** mark each.*
(*iii*) *Question numbers **9** to **18** are short answer questions and carry **2** marks each.*
(*iv*) *Question numbers **19** to **27** are also short answer questions and carry **3** marks each.*
(*v*) *Question numbers **28** to **30** are long answer questions and carry **5** marks each.*
(*vi*) *Use log tables, if necessary. Use of calculators is not allowed.*

CBSE (All India) SET–I

1. How may the conductivity of an intrinsic semiconductor be increased?

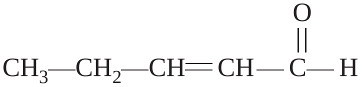
2. Define ‘peptization’.

3. How is copper extracted from a low grade ore of it?

4. Which is a stronger reducing agent, SbH_3 or BiH_3, and why?

5. What happens when bromine attacks $CH_2{=}CH{-}CH_2{-}C{\equiv}CH$?

6. Write the IUPAC name of the following:



$$CH_3-CH_2-CH=CH-\overset{\overset{\displaystyle O}{||}}{C}-H$$

7. Write the structure of the product obtained when glucose is oxidised with nitric acid.

8. Differentiate between disinfectants and antiseptics.

9. Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity?

OR

The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1}. Calculate the conductivity of this solution.

10. A reaction is of second order with respect to a reactant. How is its rate affected if the concentration of the reactant is (*i*) doubled (*ii*) reduced to half?

11. Which methods are usually employed for purifying the following metals

(*i*) Nickel
(*ii*) Germanium

Mention the principle behind each of them.

12. Explain the following facts giving appropriate reason in each case:

(*i*) NF_3 is an exothermic compound whereas NCl_3 is not.
(*ii*) All the bonds in SF_4 are not equivalent.

13. Complete the following chemical reaction equations:

(*i*) $Cr_2O_7^{2-} + I^- + H^+ \longrightarrow$

(*ii*) $MnO_4^- + NO_2^- + H^+ \longrightarrow$

14. Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol.

15. Explain the following behaviours:

(*i*) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.

(*ii*) Ortho-nitrophenol is more acidic than ortho-methoxyphenol.

16. Describe the following, giving the relevant chemical equation in each case:

(*i*) Carbylamine reaction

(*ii*) Hoffmann's bromamide reaction

17. Complete the following reaction equations:

(*i*) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$

(*ii*) $C_6H_5NH_2 + Br_2(aq) \longrightarrow$

18. What are food preservatives? Name two such substances.

19. Copper crystallises with face centred cubic unit cell. If the radius of copper atom is 127.8 pm, calculate the density of copper metal.

(Atomic mass of Cu = 63.55 u and Avogadro's number $N_A = 6.02 \times 10^{23}\ mol^{-1}$)

OR

Iron has a body centred cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.87 g cm^{-3}. Use this information to calculate Avogadro's number. (At. mass of Fe = 56.0 u)

20. The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.

21. The reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ contributes to air pollution whenever a fuel is burnt in air at a high temperature. At 1500 K, equilibrium constant K for it is 1.0×10^{-5}. Suppose in a case $[N_2]$= 0.80 mol L^{-1} and $[O_2]$ = 0.20 mol L^{-1} before any reaction occurs. Calculate the equilibrium concentrations of the reactants and the product after the mixture has been heated to 1500 K.

22. Explain the following terms giving a suitable example for each:

(*i*) Aerosol (*ii*) Emulsion

(*iii*) Micelle

23. How would you account for the following:

(*i*) Among lanthanoids, Ln (III) compounds are predominant. However, occasionally in solutions or in solid compounds, +2 and +4 ions are also obtained.

(*ii*) The $E^o_{M^{2+}/M}$ for copper is positive (0.34 V). Copper is the only metal in the first series of transition elements showing this behaviour.

(*iii*) The metallic radii of the third (5d) series of transition metals are nearly the same as those of the corresponding members of the second series.

24. Name the following coordination entities and draw the structures of their stereoisomers:

(*i*) $[Co(en)_2Cl_2]^+$ (en = ethan-1, 2-diamine)

(*ii*) $[Cr(C_2O_4)_3]^{3-}$

(*iii*) $[Co(NH_3)_3\ Cl_3]$

(Atomic numbers: Cr = 24, Co = 27)

25. Answer the following questions:

(*i*) What is meant by chirality of a compound? Give an example.

(*ii*) Which one of the following compounds is more easily hydrolysed by KOH and why?

$CH_3CHClCH_2CH_3$ or $CH_3CH_2CH_2Cl$

(*iii*) Which one undergoes S_N2 substitution reaction faster and why?

or

26. What is essentially the difference between α-glucose and β-glucose? What is meant by pyranose structure of glucose?

27. Differentiate between thermoplastic and thermosetting polymers. Give one example of each.

28. (*a*) Define the following terms:

(*i*) Mole fraction (*ii*) Ideal solution

(*b*) 15.0 g of an unknown molecular material is dissolved in 450 g of water. The resulting solution freezes at – 0.34°C. What is the molar mass of the material? (K_f for water = 1.86 K kg mol^{-1})

OR

(*a*) Explain the following:

(*i*) Henry's law about dissolution of a gas in a liquid.

(*ii*) Boiling point elevation constant for a solvent.

(*b*) A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42°C. What mass of glycerol was dissolved to make this solution? (K_b for water = 0.512 K kg mol^{-1})

29. (*a*) Draw the molecular structures of the following compounds

(*i*) N_2O_5 (*ii*) $XeOF_4$

(*b*) Explain the following observations:

(*i*) Sulphur has a greater tendency for catenation than oxygen.

(*ii*) ICl is more reactive than I_2.

(*iii*) Despite lower value of its electron gain enthalpy with negative sign, fluorine (F_2) is a stronger oxidising agent than Cl_2.

OR

(*a*) Complete the following chemical equations:

(*i*) $Cu + HNO_3$ (dilute) $\longrightarrow$

(*ii*) $XeF_4 + O_2F_2 \longrightarrow$

(*b*) Explain the following observations:

(*i*) Phosphorus has a greater tendency for catenation than nitrogen.

(*ii*) Oxygen is a gas but sulphur a solid.

(*iii*) The halogens are coloured.

30. (*a*) Write a suitable chemical equation to complete each of the following transformations:

(*i*) Butan-1-ol to butanoic acid

(*ii*) 4-Methylacetophenone to benzene-1, 4-dicarboxlylic acid.

(*b*) An organic compound with molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1,2-benzenedicarboxylic acid. Identify the compound.

OR

(*a*) Give chemical tests to distinguish between
  (*i*) Propanol and propanone
  (*ii*) Benzaldehyde and acetophenone

(*b*) Arrange the following compounds in increasing order of their property as indicated:
  (*i*) Acetaldehyde, Acetone, Methyl tert-butyl ketone (reactivity towards HCN)
  (*ii*) Benzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxybenzoic acid (acid strength)
  (*iii*) $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$ (acid strength)

CBSE (All India) SET–II

Questions Uncommon to Set–I

1. Which stoichiometric defect increases the density of a solid?

2. What is meant by 'shape selective catalysis'?

3. What is the role of collectors in Froth Floatation process?

6. Write the IUPAC name of Ph—CH═CH—CHO.

17. Explain the cleaning action of soap. Why do soaps not work in hard water?

20. A voltaic cell is set up at 25°C with the following half cells:

Al/Al^{3+} (0.001 M) and Ni/Ni^{2+} (0.50 M)

Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

$E^{o}_{Ni^{2+}/Ni} = -0.25$ V; $E^{o}_{Al^{3+}/Al} = -1.66$ V. ($\log 8 \times 10^{-6} = -0.54$)

23. Explain the following observations:
  (*i*) Many of the transition elements are known to form interstitial compounds.
  (*ii*) There is a general increase in density from titanium (Z = 22) to copper (Z = 29).
  (*iii*) The members of the actinoid series exhibit a larger number of oxidation states than the corresponding members of the lanthanoid series.

27. Explain the following terms giving a suitable example for each:
  (*i*) Elastomers (*ii*) Condensation polymers
  (*iii*) Addition polymers

30. (*a*) Draw the structures of the following molecules:
  (*i*) H_3PO_2 (*ii*) ClF_3

(*b*) Explain the following observations:
  (*i*) Nitrogen is much less reactive than phosphorus.
  (*ii*) Despite having greater polarity, hydrogen fluoride boils at a lower temperature than water.
  (*iii*) Sulphur has a greater tendency for catenation than oxygen in the same group.

OR

(*a*) Draw the structures of the following molecules:

(*i*) N_2O_5 (*ii*) $HClO_4$

(*b*) Explain the following observations:

(*i*) H_2S is more acidic than H_2O.

(*ii*) Fluorine does not exhibit any positive oxidation state.

(*iii*) Helium forms no real chemical compound.

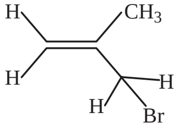
CBSE (All India) SET–III

Questions Uncommon to Set–I and II

1. What are *n*-type semiconductors?

4. What is the basicity of H_3PO_2 acid and why?

5. Write the IUPAC name of the following:



7. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain.

8. What is the cause of a feeling of depression in human beings? Name a drug which can be useful in treating this depression.

11. Explain the role of each of the following:

(*i*) NaCN in the extraction of silver.

(*ii*) SiO_2 in the extraction of copper.

18. Differentiate between disinfectants and antiseptics. Give one example of each group.

22. Write three distinct features of chemisorptions which are not found in physisorptions.

23. Explain each of the following observations:

(*i*) With the same *d*-orbital configuration (d^4), Cr^{2+} is a reducing agent while Mn^{3+} is an oxidising agent.

(*ii*) Actinoids exhibit a much larger number of oxidation states than the lanthanoids.

(*iii*) There is hardly any increase in atomic size with increasing atomic numbers in a series of transition metals.

24. Name the following coordination entities and describe their structures:

(*i*) $[Fe(CN)_6]^{4-}$ (*ii*) $[Cr(NH_3)_4Cl_2]^+$

(*iii*) $[Ni(CN)_4]^{2-}$

(Atomic Numbers Fe = 26, Cr = 24, Ni = 28)

26. Define the following as related to proteins:

(*i*) Peptide linkage

(*ii*) Primary structure

(*iii*) Denaturation

Solutions

CBSE (All India) SET–I

1. The conductivity is increased by adding an appropriate amount of impurity which is electron rich or election deficient as compared to intrinsic semiconductor.

2. The process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of small amount of electrolyte is called peptisation .

3. Copper is extracted by hydrometallurgy from low grade copper ores. It is leached out using acid or bacteria. The solution containing Cu^{2+} ion is treated with scrap iron or H_2.

$$Cu^{2+}(aq) + Fe(s) \longrightarrow Fe^{2+}(aq) + Cu(s)$$

OR

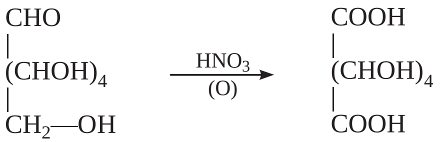
$$Cu^{2+}(aq) + H_2(g) \longrightarrow Cu(s) + 2H^+(aq)$$

4. BiH_3, as BiH_3 has lower bond dissociation enthalpy than SbH_3.

5. The reddish brown colour of bromine is discharged.

6. Pent-2-enal

7.



$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2—OH \end{array} \xrightarrow[(O)]{HNO_3} \begin{array}{l} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \end{array}$$

Glucose Saccharic acid

8. Disinfectants are applied to non-living objects whereas antiseptics are applied to living tissues.

9. $\text{Conductivity } (\kappa) = \dfrac{1}{\text{Resistance } (R)} \times \text{Cell constant}$

$$\text{Molar Conductivity } (\Lambda_m) = \frac{\text{Conductivity } (\kappa) \times 1000}{\text{Molarity } (M)}$$

OR

$$\Lambda_m = \frac{\kappa \times 1000}{M} = \frac{\Lambda_m \times M}{1000}$$

$$\kappa = \frac{138.95\ cm^2\ mol^{-1} \times 1.5\ mol\ L^{-1}}{1000\ cm^3\ L^{-1}} = 0.208355\ cm^{-1}$$

10. Rate $= k[R]^2$

(*i*) If $[R]$ is doubled, Rate $= k[2R]^2 = 4k[R]^2 = 4$ times

(*ii*) If $[R]$ is reduced to $\dfrac{[R]}{2}$, Rate $= k\left[\dfrac{R}{2}\right]^2 = \dfrac{1}{4}k[R]^2 = \dfrac{1}{4}$th

11. (i) Nickel is purified by vapour phase refining. In this method nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl ($Ni(CO)_4$), which on further heating decomposes to give pure nickel.

$$Ni + 4CO \xrightarrow{330-350K} Ni(CO)_4;$$
$$Ni(CO)_4 \xrightarrow{450-470K} Ni + 4CO$$

(ii) Germanium is purified by zone refining. This method is based on the principle that the impurities are more soluble in molten state than in the solid state of the metal.

12. (*i*) This is due to lower bond dissociation enthalpy of fluorine than chlorine and small and strong bond formed by fluorine with nitrogen.

(*ii*) SF_4 has trigonal bipyramidal structure in which one of the equatorial positions is occupied by a lone pair of electrons. The two equatorial S–F bonds are equivalent, while the two axial S–F bonds are longer than equatorial bonds. This is because the axial bond pairs suffer more repulsion as compared to equatorial bond pairs.

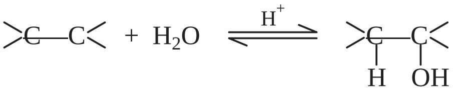
13. (*i*)

$$\begin{array}{lcl} Cr_2O_7^{2-} + 14H^+ + 6e^- & \longrightarrow & 2Cr^{3+} + 7H_2O \\ 2I^- & \longrightarrow & I_2 + 2e^-]\times 3 \\ \hline Cr_2O_7^{2-} + 6I^- + 14H^+ & \longrightarrow & 2Cr^{3+} + 3I_2 + 7H_2O \\ \hline \end{array}$$

(*ii*)

$$\begin{array}{lcl} MnO_4^- + 8H^+ + 5e^- & \longrightarrow & Mn^{2+} + 4H_2O]\times 2 \\ NO_2^- + H_2O & \longrightarrow & NO_3^- + 2H^+ + 2e^-]\times 5 \\ \hline 2MnO_4^- + 5NO_2^- + 6H^+ & \longrightarrow & 2Mn^{2+} + 5NO_3^- + 3H_2O \\ \hline \end{array}$$

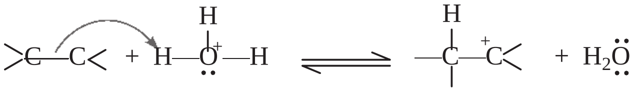
14.



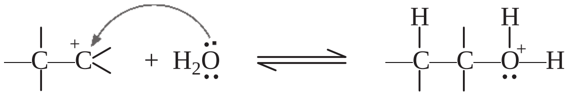
The mechanism of the reaction involves the following three steps:

(*i*) Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.

$$H_2\ddot{O} + H^+ \longrightarrow H_3\overset{+}{\ddot{O}}\ ;$$



(*ii*) Nucleophilic attack of water on carbocation.



(*iii*) Deprotonation to form an alcohol.

15. (*i*) This is due to their ability to form hydrogen bonds with water molecules.

(*ii*) Due to —R and —I effect of —NO_2 group, the electron density in the O—H bond decreases in ortho-nitrophenol and hence the release of H^+ ion becomes easy. On the other hand, due to +R effect of the —OCH_3 group, the electron density in the O—H bond in ortho-methoxyphenol increases, thereby making the release of H^+ ion difficult.

16. (*i*) Carbylamine reaction: Aliphatic and aromatic primary amines when heated with chloroform and ethanolic potassium hydroxide form carbylamines or isocyanides which are foul smelling substances. Secondary and tertiary amines do not show this reaction.

$$R—NH_2 + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} RNC + 3KCl + 3H_2O$$

$$\underset{\text{Aniline}}{C_6H_5NH_2} + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} \underset{\text{Phenyl isocyanide}}{C_6H_5NC} + 3KCl + 3H_2O$$

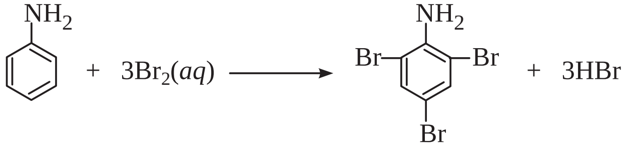
(*ii*) Hoffmann's bromamide reaction: When a primary acid amide is heated with bromine in an aqueous or ethanolic solution of NaOH, a primary amine is obtained. The amine so obtained contains one carbon less than that present in the amide.

$$\underset{\text{Acid amide}}{RCONH_2} + Br_2 + 4NaOH \longrightarrow R—NH_2 + Na_2\,CO_3 + 2NaBr + 2H_2O$$

$$\underset{\text{Benzamide}}{C_6H_5CONH_2} + Br_2 + 4NaOH \longrightarrow \underset{\text{Aniline}}{C_6H_5NH_2} + Na_2CO_3 + 2NaBr + 2H_2O$$

17. (*i*) $$\underset{\text{Benzene diazonium chloride}}{C_6H_5N_2Cl} + H_3PO_2 + H_2O \longrightarrow \underset{\text{Benzene}}{C_6H_6} + N_2 + H_3PO_3 + HCl$$

(*ii*)



Aniline 2,4,6-Tribromoaniline

18. Food preservatives are the chemical substances which are added to food materials to prevent their spoilage and to retain their nutritive value for long periods. Preservatives prevent the rancidity of food and inhibit the growth of or kill the microorganisms. Two such substances are sodium benzoate and salts of ascorbic acid.

19. For *fcc*, $a = 2\sqrt{2}r$

$\therefore$ $a = 2\sqrt{2} \times 127.8$ pm = 361.4 pm = 361.4×10^{-10} cm

Here, $z = 4$; $M = 63.55$ g mol^{-1}; $a = 3.614 \times 10^{-8}$ cm; $N_A = 6.02 \times 10^{23}$ mol^{-1}

Substituting the values in the expression,

$$d = \frac{z \times M}{a^3 \times N_A}, \text{ we get}$$

$$d = \frac{4 \times 63.55\ \text{g mol}^{-1}}{(3.614 \times 10^{-8}\ \text{cm})^3 \times 6.02 \times 10^{23}\ \text{mol}^{-1}} = 8.95\ \text{g cm}^{-3}$$

OR

Here, $z = 2$, M = 56 g mol^{-1}, $d = 7.87$ g cm^{-3}

$a = 286.65$ pm = $286\ .65 \times 10^{-10}$cm = 2.8

Substituting the values in the expression,

$$N_A = \frac{z \times M}{a^3 \times d}, \text{ we get}$$

$$N_A = \frac{2 \times 56 \text{ g mol}^{-1}}{(286.65 \times 10^{-10} \text{ cm})^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= 6.042 \times 10^{23} \text{ mol}^{-1}$$

20. $A = \pi r^2 = 3.14 \times \left(\frac{1}{2}\text{cm}\right)^2 = 0.785 \text{ cm}^2$; $l = 50$ cm

$$\text{Resistivity} = \rho = \frac{R \times A}{l} = \frac{5.55 \times 10^3 \text{ ohm} \times 0.785 \text{cm}^2}{50 \text{ cm}} = 87.135 \text{ ohm cm}$$

$$\text{Conductivity} = \kappa = \frac{1}{\rho} = \frac{1}{87.135 \text{ ohm cm}} = 0.01148 \text{ s cm}^{-1}$$

$$\text{Molar Conductivity} = \Lambda_m = \frac{\kappa \times 1000}{M} = \frac{0.01148 \text{ s cm}^{-1} \times 1000 \text{ cm}^3 \text{ L}^{-1}}{0.05 \text{ mol L}^{-1}}$$

$$= 229.6 \text{ s cm}^2 \text{ mol}^{-1}$$

21

	N_2	$+$	O_2	$\longrightarrow$	$2NO$
Initial conc. in mol L^{-1}	0.8		0.2		0
Change in conc. in mol L^{-1}	$-x$		$-x$		$+2x$
Equilibrium conc. in mol L^{-1}	$0.8-x$		$0.2-x$		$2x$

$$K_C = \frac{[NO]^2}{[N_2][O_2]} \qquad \therefore \quad 1 \times 10^{-5} = \frac{(2x)^2}{(0.8-x)(0.2-x)}$$

As $x << 0.2$, therefore $0.8 - x \approx 0.8$ and $0.2 - x \approx 0.2$

$$\therefore \qquad 1 \times 10^{-5} = \frac{4x^2}{0.16} \qquad \Rightarrow \qquad 4x^2 = 16 \times 10^{-7}$$

$$x = 6.324 \times 10^{-4} \text{ mol L}^{-1},$$

$$2x = 2 \times 6.324 \times 10^{-4} = 12.648 \times 10^{-4} \text{ mol L}^{-1}$$

Thus at equilibrium

$[N_2] = 0.8$ mol L^{-1}, $[O_2] = 0.2$ mol L^{-1} and $[NO] = 1.265 \times 10^{-3}$ mol L^{-1}

22. (*i*) A colloidal system in which dispersion medium is gas and dispersed phase is either solid or liquid is called aerosol, *e.g.*, smoke, fog, etc.

(*ii*) An emulsion is a colloidal system in which both the dispersed phase and the dispersion medium are liquids, *e.g.*, milk, cod liver oil, etc.

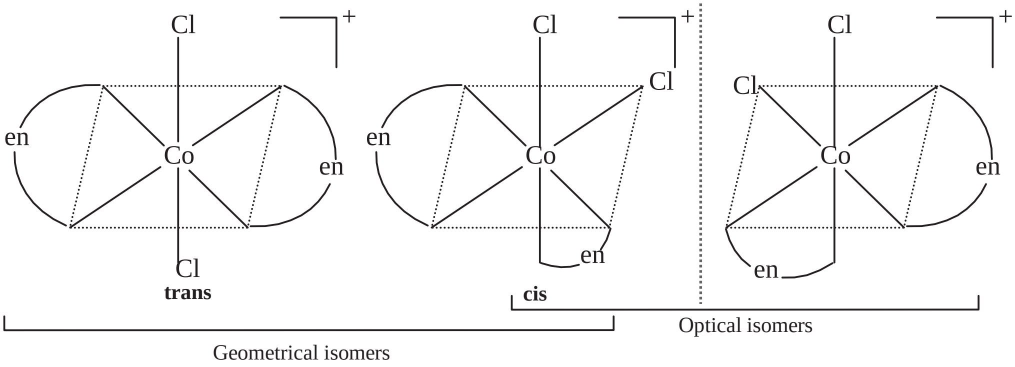
(*iii*) There are some substances such as soap which at low concentration behave as normal electrolytes, but at higher concentration exhibit colloidal behaviour due to the formation of aggregates. The aggregated particles thus formed are known as micelles or associated colloids.

23. (*i*) Lanthanoid metals show +2 and +4 oxidation states to attain extra stable f^0 and f^7 configurations.

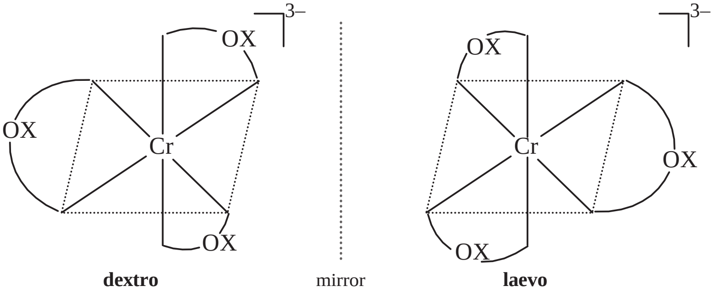
(*ii*) The main reason for positive $E°$(0.34 V) value for copper is that the sum of enthalpies for sublimation and ionisation is not balanced by hydration enthalpy.

(*iii*) This is due to lanthanoid contraction which arises due to filling of 4 *f*-orbitals which have poor shielding effect.

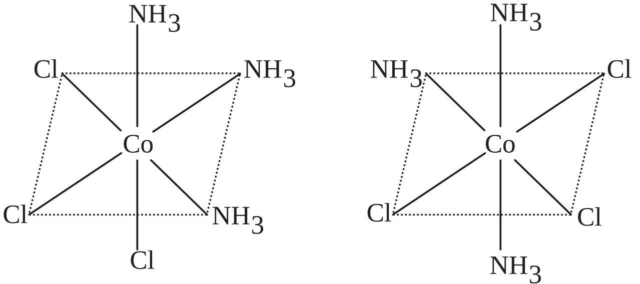
24. (***i***) **$[CO(en)_2Cl_2]^+$:** Dichloride bis (ethane-1,2-diamine) cobalt (III) ion



(***ii***) **$[Cr(C_2O_4)_3]^{3-}$:** Trioxalato chromium (III) ion



(***iii***) **$[CO(NH_3)_3Cl_3]$:** Triammine trichloride cobalt (III)



cis-or-fac-isomer

trans-or mer-isomer

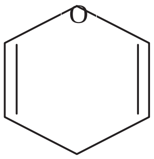
25. (*i*) Chiral molecules (or compounds) are those molecules which are non-superimposible on their mirror images and this property is known as chirality. Butan-2-ol is an example of chiral molecule.

(*ii*) Due to +I effect of alkyl groups the 2° carbonium ion $CH_3—\overset{+}{C}H—CH_2—CH_3$ derived from sec. butyl chloride is more stable than the 1° carbonium ion $CH_3—CH_2—\overset{+}{C}H_2$ derived from *n*-propyl chloride. Therefore sec. butyl chloride gets hydrolyzed more easily than *n*-propyl chloride under S_N1 conditions.

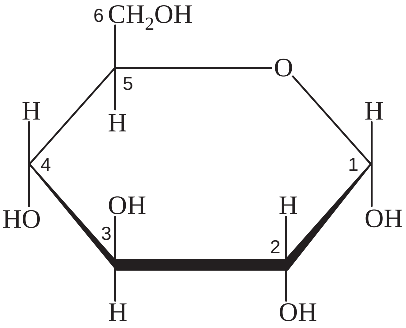
(*iii*) 

As Iodine is a better leaving group due to its larger size, it will be released at a faster rate in the presence of incoming nucleophile.

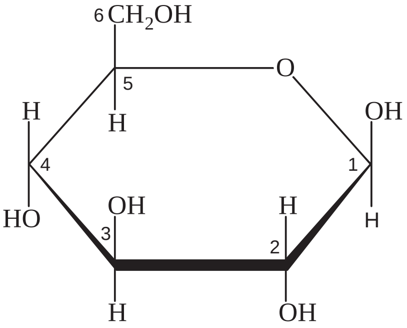
26. α-Glucose and β-Glucose differ only in the configuration of hydroxy group at C_1 and are called anomers and the C_1 carbon is called anomeric carbon. The six membered cyclic structure of glucose is called pyranose structural (α-or β-), in analogy with pyrane. The cyclic structure of glucose is more correctly represented by Haworth structure as given below.



Pyran



α-D-(+) Glucopyranose



β-D-(+) Glucopyranose

27.

Thermoplastics	Thermosetting plastics
(*i*) These polymers are linear or slightly branched chain molecules.	(*i*) These polymers are cross linked or heavily branched molecules.
(*ii*) Soften on heating and harden on cooling and can be remoulded.	(*ii*) On heating undergo extensive cross linking in moulds and become infusible.
(*iii*) Some common examples are polyethene, PVC, polystyrene, etc.	(*iii*) Some common examples are bakelite, urea-formaldehyde resins, terylene, etc.

28. (*a*) (*i*) Mole fraction of a particular component in a solution may be defined as the ratio of number of moles of that component to the sum of the moles of all the components present in the solution. For a solution of two components A and B,

$$\text{Mole fraction of A, } x_A = \frac{n_A}{n_A + n_B}$$

$$\text{Mole fraction of B, } x_B = \frac{n_B}{n_A + n_B}$$

(*ii*) A solution which obeys Raoult's law over the entire range of concentration and temperature, and during the formation of which no change in enthalpy and volume takes place is called an ideal solution. Thus for an ideal solution,

(*i*) Raoult's law is obeyed, *i.e.*, $P_A = P_A^{\circ} x_A$ and $P_B = P_B^{\circ} x_B$

(*ii*) $\Delta H_{mix} = 0$

(*iii*) $\Delta V_{mix} = 0$

(*b*) $W_B = 15.0g$; $W_A = 450g$; $\Delta K_f = 1.86$ K kg mol L^{-1}

$\Delta T_f = 0°C - (-0.34°C) = 0.34°C$ or 0.34 K

Substituting the values in the expression,

$$M_B = \frac{K_f \times W_B \times 1000}{W_A \times \Delta T_f}$$

$$M_B = \frac{1.86\ \text{K kg mol}^{-1} \times 15.0\ \text{g} \times 1000\ \text{g kg}^{-1}}{450\ \text{g} \times 0.34\ \text{K}} = 182.35\ \text{g mol}^{-1}$$

OR

(*a*) (*i*) Henry's law states that the solubility of a gas in a liquid is directly proportional to the pressure of the gas.

(*ii*) The boiling point elevation constant may be defined as the elevation in boiling point when one mole of a non-volatile solute is dissolved in one thousand grams of solvent.

(*b*) W_A = 500g; M_B = 92g mol^{-1}; K_b = 0.512 K kg mol^{-1}

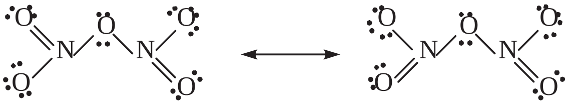
ΔT_b = 100.42°C – 100 °C = 0.42°C or 0.42K

Substituting the values in the expression;

$$W_B = \frac{M_B \times \Delta T_b \times W_A}{K_b \times 1000}$$

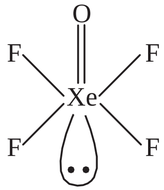
$$W_B = \frac{92\ \text{g mol}^{-1} \times 0.42\ \text{K} \times 500\ \text{g}}{0.512\ \text{K kg mol}^{-1} \times 1000} = 37.73\ \text{g}$$

29. (*a*) (*i*)



(N_2O_5)

(*ii*)



$XeOF_4$

(*b*) (*i*) It is because S–S single bond is stronger than O–O single bond.

(*ii*) This is because the bond dissociation enthalpy of I–Cl bond is lower than that of I–I bond.

(*iii*) It is due to

- low enthalpy of dissociation of F–F bond
- high hydration enthalpy of F^-.

OR

(*a*) (*i*) $3Cu + 8HNO_3$ (dilute) $\longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(*ii*) $XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$

(*b*) (*i*) It is because P–P single bond is stronger than N–N single bond.

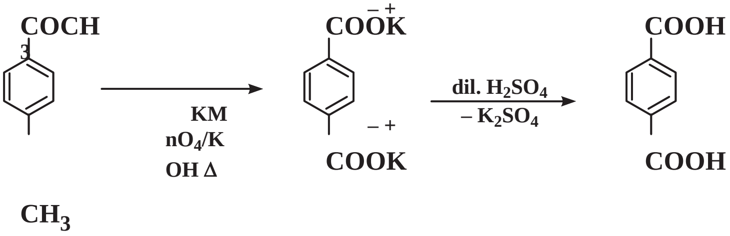
(*ii*) Because of its small size, oxygen is capable of forming pπ–pπ bond and exist as diatomic O_2 molecule. The intermolecular forces in oxygen are weak van der Waals force, due to which it is a gas at room temperature. On the other hand, sulphur, due to its larger size prefers to form S–S single bond and exist as octaatomic S_8 molecule having puckered ring structure. Because of larger size the force of attraction holding the S_8 molecules together are much stronger. Hence sulphur is a solid at room temperature.

(*iii*) All halogens are coloured. This is due to absorption of radiation in visible region which results in the excitation of outer electrons to higher energy level while the remaining light is transmitted. The colour of the halogen is the colour of transmitted light.

30. (*a*) (*i*) $CH_3CH_2CH_2CH_2.OH \xrightarrow{CrO_3 - H_2SO_4} CH_3CH_2CH_2COOH$

Butan-ol Butanoic acid

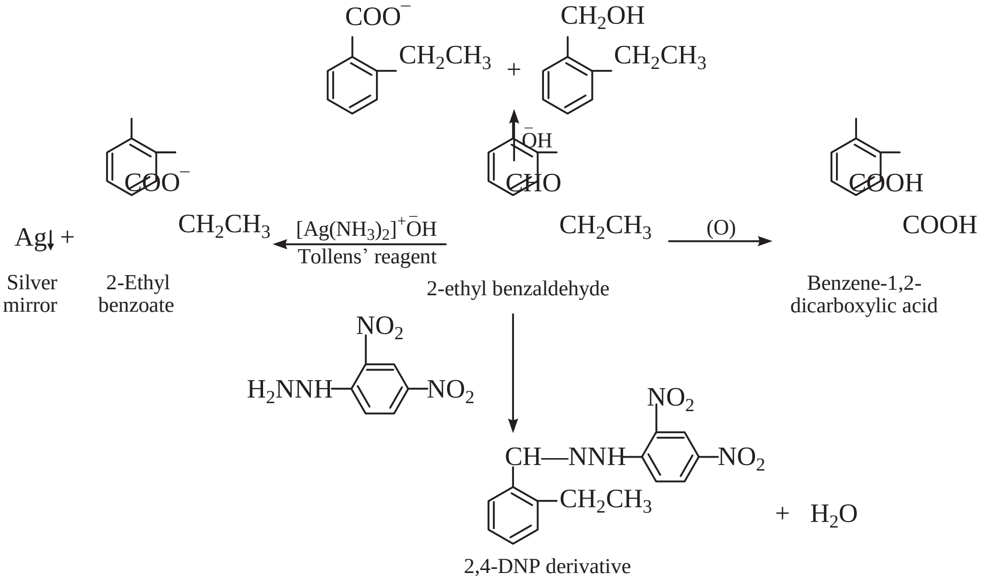
(*ii*)



4-Methyl acetophenon e

Benzene-1,4-dicarboxylic acid

(*b*) The compound is 2-ethyl benzaldehyde and the reactions involved in the question are given below:



OR

(*a*) (*i*) Propanone on treatment with I_2/NaOH (NaOI) undergoes iodoform reaction to give yellow ppt of iodoform but propanol does not.

$CH_3COCH_3 + 3NaOI \longrightarrow CH_3COO\overset{+}{N}a + CHI_3\downarrow + 2NaOH$

Propanone Iodoform

(*ii*) Benzaldehyde being an aldehyde reduces Tollens' reagent to give silver mirror test but acetophenone being a ketone does not give this test.

$$\underset{\text{Benzaldehyde}}{C_6H_5CHO} + \underset{\text{Tollen's reagent}}{2[Ag\ (NH_3)_2]^+} + 3\overset{-}{O}H \xrightarrow{\text{Heat}} C_6H_5CO\overset{-}{O} + 2H_2O + \underset{\text{Silver mirror}}{2Ag\downarrow} + 4NH_3$$

(*b*) (*i*) Methyl tert-butyl ketone < Acetone < Acetaldehyde

(*ii*) 4-Methoxy benzoic acid < Benzoic acid < 3,4-Dinitrobenzoic acid

(*iii*) $(CH_3)_2CHCOOH < CH_3CH(Br)CH_2COOH < CH_3CH_2CH(Br)COOH$

CBSE (All India) SET–II

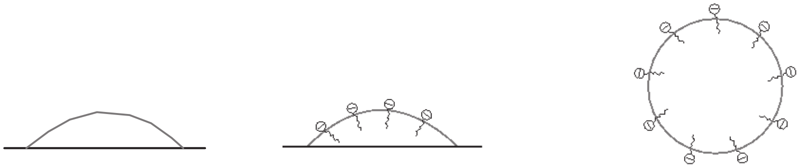
1. Interstitial defect

2. The catalytic reaction that depends upon the pore structure of the catalyst and the size of the reactant and product molecule is known as shape-selective catalysis.

3. Collectors enhance non-wettability of the mineral particles.

6. 3-Phenyl prop-2-enol

17. The cleansing action of soap such as sodium stearate is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part of the stearate ions is in the oil droplet and hydrophilic part projects out of the grease droplet like the bristles. Since the polar groups can interact with water, the oil droplet surrounded by stearate ions is now pulled in water and removed from the dirty surface. Thus soap helps in emulsification and washing away of oils and fats.



(*a*) Grease in cloth

(*b*) Stearate ions arranging around the grease droplet

(*c*) Grease droplet surrounded by stearate ions (micelle formed)

Hard water contains calcium and magnesium salts. In hard water, soap gets precipitated as calcium and magnesium soap which being insoluble stick to the clothes as gummy mass. Therefore soaps do not work in hard water.

20. **At anode:** $Al \longrightarrow Al^{3+} + 3e^-]_{\times 2}$

At Cathode: $Ni^{2+} + 2e^- \longrightarrow Ni]_{\times 3}$

Cell reaction: $2Al + 3Ni^{2+} \longrightarrow 2Al^{3+} + 3Ni$

$$E^o_{Cell} = E^o_{Cathode} - E^o_{anode} = E^o_{Ni^{2+}/Ni} - E^o_{Al^{3+}/Al}$$

$$= -0.25V - (-1.66\ V) = 1.41\ V$$

$$[Al^{3+}] = 1\times10^{-3}M;\ [Ni^{2+}] = 0.5\ M;\ n = 6$$

Substituting the values in the Nernst equation,

$$E_{cell} = E^o_{cell} - \frac{0.059}{n}\log\frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

$$E_{cell} = 1.41\ V - \frac{0.059}{6}\log\frac{(10^{-3})^2}{(0.5)^3}$$

$$= 1.41\ V - \frac{0.059}{6}\log 8\times10^{-6}$$

$$= 1.41\text{ V} - \frac{0.059}{6}(-0.54)$$

$$E_{cell} = 1.41\text{ V} + 0.0053\text{ V}$$

$$= 1.4153\text{ V}$$

23. (*i*) Interstitial compounds are well known for many of the transition elements because the transition elements are capable of entrapping small sized atoms such as H,C and N in the interstitial sites in their crystal lattices. These trapped atoms get bonded to the atoms of transition elements, for example, TiC, Fe_3H and Mn_4N, etc.

(*ii*) The decrease in metallic radius coupled with increase in atomic mass results in a general increase in density from titanium to copper in the first series of transition elements.

(*iii*) This is due to very small energy gaps between 5*f*, 6*d* and 7*s* subshells in actinoids.

27. **(*i*) Elastomers:** These are the polymers having the weakest intermolecular forces of attraction between the polymer chains. The weak forces permit the polymer to be stretched. A few 'cross links' are introduced between the chains, which help the polymer to retract to its original position after the force is released as in vulcanised rubber. Elastomers thus possess an elastic character, *e.g.*, buna-S, buna-N, neoprene, etc.

(*ii*) Condenstaion Polymers: The condensation polymers are formed by the repeated condensation reaction between different bifunctional or trifunctional monomer units usually with elimination of small molecules such as water, alcohol hydrogen chloride, etc. Nylon 6, 6, Nylon 6, terylene are some examples.

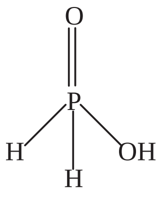
(*iii*) Addition polymers: Addition polymers are formed by repeated addition of same or different monomer molecules. The monomers used are unsaturated compounds, *e.g.*, alkenes, alkadienes and their derivatives. Polythene is an example of addition polymer.

$$n\ CH_2{=}CH_2 \xrightarrow[\text{traces of } O_2]{350\text{–}570\text{ K},\ 1000\text{–}2000\text{ atm}} \left(CH_2 - CH_2\right)_n$$

Ethene Polyethene

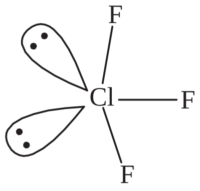
30.

(*a*) (*i*)



H_3PO_2

(*ii*) No. of electron pairs around central atom Cl = 5
No. of bond pairs = 3
No of lone pairs = 2
The shape would be slightly bent T.



ClF_3

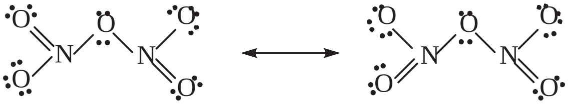
(*b*) (*i*) Nitrogen is much less reactive than phosphorus because of the high bond enthalpy of N≡N bond.

(*ii*) This is because in H_2O hydrogen bond formed is three dimensional whereas in H–F it is linear.

(*iii*) This is because S–S single bond is stronger than O–O single bond.

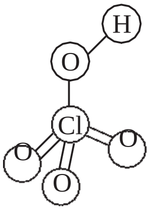
OR

(*a*) (*i*)



(N_2O_5)

(*ii*)



Perchloric acid
($HClO_4$)

(*b*) (*i*) Due to smaller size of O as compared to S, the bond dissociation enthalpy of O–H bond is higher than that of S–H bond. As a result, in aqueous solution, S–H bond can break more easily form H^+ ion than O–H bond. Hence H_2S is more acidic than H_2O.

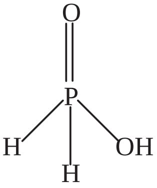
(*ii*) This is because fluorine is the most electronegative element and it does not have *d* orbitals.

(*iii*) This is because the valence shell orbital of He is completely filled ($1s^2$) and it has high ionisation enthalpy and more positive electron gain enthalpy.

CBSE (All India) SET–III

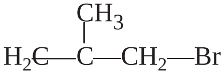
1. Silicon or germanium doped with group 15 elements like P or As are called n type of semiconductors.

4. H_3PO_2 is monobasic as it contains only one ionisable H-atom which is present as OH group.



H_3PO_2

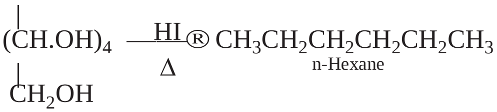
5.



$$H_2C{=}\overset{\overset{\displaystyle CH_3}{|}}{C}—CH_2—Br$$

3-Bromo-2-methyl propone

7. On prolonged heating with HI, glucose gives n-hexane.



$$\begin{array}{l} CHO \\ | \\ (CH.OH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow[\Delta]{HI} \underset{\text{n-Hexane}}{CH_3CH_2CH_2CH_2CH_2CH_3}$$

8. Human beings suffer from depression when they have low levels of noradrenaline. Noradrenaline is a neurotransmiter that plays a role in mood changes. Low levels of noradrenaline lower the signal-sending activity and make human beings suffer from depression. Tranquilizers such as improniazid and phenelyzine are useful in treating this depression.

11. (*i*) In the extraction of silver, the metal is leached with dilute solution of NaCN. Dilute NaCN solution forms a soluble complex with Ag while the impurities remain unaffected which are then filtered off.

$$4Ag + 8NaCN + O_2 + 2H_2O \longrightarrow \underset{\text{Soluble complex}}{4Na[Ag(CN)_2]} + 4NaOH$$

(*ii*) SiO_2 acts as a flux in the extraction of copper. Sulphide ore of copper contains iron as impurity which is removed as iron silicate (slag).

$$FeO + \underset{\text{Flux}}{SiO_2} \longrightarrow \underset{\text{Slag}}{FeSiO_3}$$

18. Difference between antiseptics and disinfectants:

Antiseptics

- Antiseptics are chemical substances which prevent the growth of microorganisms and may even kill them but are not harmful to living tissues.
- Antiseptics are generally applied to living tissues such as wounds, cuts, ulcers and diseased skin surfaces.
- Dettol, furacine, soframicine are antiseptics.

Disinfectants

- Disinfectants are chemical substances which kill microorganisms or stop their growth but are harmful to human tissues.
- Disinfectants are applied to inanimate objects such as floor, drainage system, instrument, etc.
- Chlorine in the concentration of 0.2 to 0.4 ppm in aqueous solution and SO_2 in very low concentration are disinfectants.

22. Three distinct features of chemisorptions which are not found in physisorptions:

(*i*) Enthalpy of adsorption: Enthalpy of adsorption is high (80-240 kJ mol^{-1}) as it involves chemical bond formation.

(*ii*) High specificity: Chemisorption is highly specific and it will only occur if there is some possibility of chemical bonding between adsorbent and adsorbate. For example, hydrogen is adsorbed by transition metals by virtue of hydride formation.

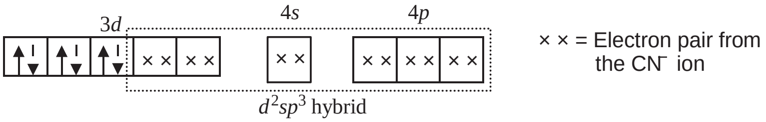
(*iii*) Irreversibility: Chemisorption is usually irreversible in nature as it involves compound formation. It is very slow at low temperatures on account of high activation energy.

23. (*i*) Cr^{2+} is reducing agent as its configuration changes from d^4 to d^3, the later having a half-filled trg level. On the other hand, the change from Mn^{2+} to Mn^{3+} results in the extra stable half-filled, d^5 configuration. Therefore Mn^{3+} is an oxidising agent.

(*ii*) This is due to small energy gap between 5*f*, 6*d* and 7*s* subshells in actinoids.

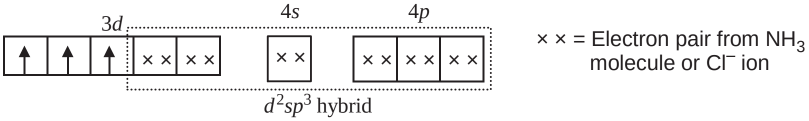
(*iii*) This is because with increase in atomic number in a series , the increased nuclear charge is partly cancelled by the increased shielding effect of electrons in the *d*-orbitals of penultimate shell.

24. (*i*) $[Fe(CN)_6]^{4-}$ = Hexacyanoferrate(II) ion; $Fe^{2+}(3d^6)$



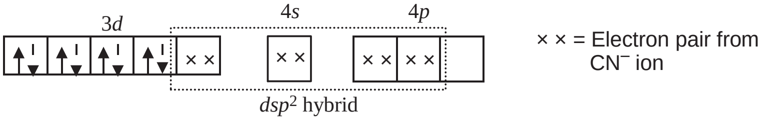
d^2sp^3-hybridisation in $[Fe(CN)_6]^{4-}$ leads to octahedral structure.

(*ii*) $[Cr(NH_3)_4Cl_2]^+$ = Tetraamminedichloridochromium (III) ion, $Cr^{3+}(3d^3)$



d^2sp^3 hybridisation in $[Cr(NH_3)_4Cl_2]^+$ leads to octahedral structure.

(*iii*) $[Ni(CN)_4]^{2-}$ = Tetracyanonickelate(II)ion; Ni^{2+}(II) $(3d^8)$



dsp^2 hybridisation in $[Ni(CN)_4]^{2-}$ leads to square planar structure.

26. (*i*) A peptide linkage is an amide linkage —(CONH)— formed between —COOH group of one α-amino acid and $—NH_2$ group of the other α-amino acid by the loss of a water molecule.

(*ii*) Primary structure of proteins: The sequence in which various amino acids are arranged in a protein is called its primary structure. Any change in the sequence of amino acids creates different protein which alters biological functions.

(*iii*) Denaturation of Proteins: When a protein in its native form is subjected to a change in temperature or a change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix gets uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation 2° and 3° structures are destroyed but 1° structures remain intact, *e.g.*, coagulation of egg white on boiling, curdling of milk, etc.

CBSE EXAMINATION PAPERS

FOREIGN–2012

Time allowed : 3 hours] **[Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*
(*ii*) *Question nos.* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*
(*iii*) *Question nos.* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*
(*iv*) *Question nos.* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*
(*v*) *Question nos.* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*
(*vi*) *Use log tables if necessary, use of calculators is not allowed.*

CBSE (Foreign) SET–I

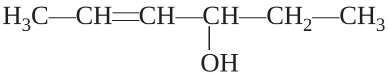
1. What is meant by the term ‘forbidden zone’ in reference to band theory of solids?

2. Why is the adsorption phenomenon always exothermic?

3. Write the reaction involved in the extraction of silver after the silver ore has been leached with NaCN.

4. Although the H-bonding in hydrogen fluoride is much stronger than that in water, yet water has a much higher boiling point than hydrogen fluoride. Why?

5. Write the IUPAC name of the following compound:



$$H_3C—CH═CH—\underset{\displaystyle OH}{\underset{|}{CH}}—CH_2—CH_3$$

6. Draw the molecular structure of the compound, 4-methylpent-3-en-2-one.

7. Write the full form of DNA and RNA.

8. What is meant by ‘narrow spectrum antibiotics’?

9. (*a*) Define any two of the following terms:
   (*i*) van’t Hoff factor
   (*ii*) Mole fraction
   (*iii*) Ebullioscopic constant
(*b*) State Raoult’s law.

OR

The density of water of a lake is 1.25 g $(mL)^{-1}$ and one kg of this water contains 92 g of Na^+ ions. what is the molarity of Na^+ ions in the water of the lake? (Atomic mass of Na = 23.00 u)

10. Define the following terms:
(*i*) Order of a reaction
(*ii*) Activation energy of a reaction

11. Name one chief ore each of copper and aluminium. Name the method used for concentration of these two ores.

12. Explain the following:

(*i*) The chemical reactivity of nitrogen is much less than that of phosphorus.
(*ii*) SF_6 is kinetically inert.

13. Draw the molecular structures of the following species:

(*i*) H_3PO_3
(*ii*) BrF_3

14. What are ambident nucleophiles? Explain giving an example.

15. Explain as to why

(*i*) Alkyl halides, though polar, are immiscible with water.
(*ii*) Grignard's reagents should be prepared under anhydrous conditions.

16. Describe the following giving the chemical equation in each case:

(*i*) Carbylamine reaction
(*ii*) Hofmann's bromamide reaction

17. Complete the following reaction equations:

(*i*) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$
(*ii*) $C_6H_5NH_2 + Br_2(aq) \longrightarrow$

18. State a reason for each of the following statements:

(*i*) Soaps do not work in hard water.
(*ii*) The use of the sweetner aspartame is limited to cold foods and drinks.

19. Iron has a body centred cubic (*bcc*) unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Avogadro's number. (Atomic mass of Fe = 55.845 u)

OR

Silver crystallises in face centred cubic (*fcc*) unit cell. If the radius of silver atom is 145 pm, what is the length of each side of the unit cell?

20. At 25°C the saturated vapour pressure of water is 3.165 kPa (23.75 mm Hg). Find the saturated vapour pressure of a 5% aqueous solution of urea (carbamide) at the same temperature.
(Molar mass of urea = 60.05 g mol^{-1})

21. Consider the reaction:

$$2A + B \longrightarrow C + D$$

Following results were obtained in experiments designed to study the rate of reaction:

Experiment No.	**Initial concentration (mol L^{-1})**		**Initial rate of formation**
	[A]	**[B]**	
1	0.10	0.10	1.5×10^{-3}
2	0.20	0.20	3.0×10^{-3}
3	0.20	0.40	6.0×10^{-3}

(*a*) Write the rate law for the reaction.

(*b*) Calculate the value of rate constant for the reaction.

(*c*) Which of the following possible reaction mechanism is consistent with the rate law found in (*a*)?

I. $A + B \longrightarrow C + E$ (slow)
$A + E \longrightarrow D$ (fast)

II. $B + C \longrightarrow E$ (slow)
$A + E \longrightarrow F$ (fast)
$A + F \longrightarrow D$ (fast)

22. Define the following terms giving one suitable example for each:

(*i*) Electrophoresis
(*ii*) Micelles
(*iii*) Peptization

23. Complete the following chemical equations:

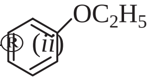
(*i*) $NH_4Cl(aq) + NaNO_2(aq) \longrightarrow$
(*ii*) $P_4 + NaOH + H_2O \longrightarrow$
(*iii*) $Xe(g) + F_2(g) \xrightarrow[1\,\text{Bar}]{673\,\text{K}}$ (Xenon in excess)

24. Explain the following:

(*i*) The π-complexes are known for transition elements only.
(*ii*) Nickel(II) does not form low spin octahedral complexes.
(*iii*) $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are of different colours in dilute solutions.

25. State the products of the following reactions:

(*i*) $CH_3—CH_2—CH_2—O—CH_3 + HBr \longrightarrow$

(*ii*) 

$+ HBr \longrightarrow$

(*iii*) $(CH_3)_3C—OC_2H_5 \xrightarrow{HI}$

26. What is glycogen? How is it different from starch? How is starch structurally different from cellulose?

27. Write the structure of the monomer of each of the following polymers:

(*i*) Nylon-6
(*ii*) Teflon
(*iii*) Neoprene

28. (*a*) What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery sending out an electric current.

(*b*) A voltaic cell is set up at 25°C with the half-cells

Ag^+ (0.001 M) | Ag and Cu^{2+} (0.10M) | Cu

What should be its cell potential? (E^o_{cell} = 0.46 V, log 10^5 = 5)

OR

(*a*) Define the term molar conductivity and explain how molar conductivity changes with solution concentration for weak and strong electrolytes.

(*b*) A strip of nickel metal is placed in a 1-molar solution of $Ni(NO_3)_2$ and a strip of silver metal is placed in a 1-molar solution of $AgNO_3$. An electrochemical cell is created when the two solutions are connected by a salt bridge and the two strips are connected by wires to a voltmeter.

(*i*) Write the balanced equation for the overall reaction occurring in the cell and calculate the cell potential

(*ii*) Calculate the cell potential, E, at 25°C for the cell if the initial concentration of $Ni(NO_3)_2$ is 0.100 molar and the initial concentration of $AgNO_3$ is 1.00 molar.

$[E^o_{Ni^{2+}/Ni} = -0.25$ V; $E^o_{Ag^{2+}/Ag} = 0.80$ V, $\log 10^{-1} = -1]$?

29. (*a*) Complete the balance the following chemical equations:

(*i*) $Cr_2O_7^{2-} + I^- + H^+ \longrightarrow$

(*ii*) $MnO_4^- + SO_3^{2-} + H^+$

$\longrightarrow$ (*b*) Explain the following
observations:

(*i*) Transition elements and their compounds are known to act as catalysts.

(*ii*) The higher oxidation states are usually exhibited by the members in the middle of a series of transition elements.

(*iii*) The metal-metal bonding is more frequently found with the second and third series of transition elements.

OR

(*a*) Calculate the number of unpaired electrons in the following gaseous state ions:

Mn^{2+}, Cr^{3+}, V^{3+} and Fe^{2+}

Which one of these is the most stable in aqueous solutions?

(At. nos. V = 23, Cr = 24, Mn = 25, Fe = 26)

(*b*) Explain the following observations:

(*i*) The transition metal ions are usually coloured in aqueous solutions.

(*ii*) Cu(I) is not stable in an aqueous solution.

(*iii*) The highest oxidation state of a transition metal is exhibited in its oxide or fluoride.

30. (*a*) Describe the mechanism of the addition of Grignard reagent to the carbonyl group of a compound to form an adduct which on hydrolysis yields an alcohol.

(*b*) Draw the structures of the following compounds:

(*i*) 3-Methylbutanal

(*ii*) Hexane-1,6-diotic acid

(*iii*) p-Nitropropiophenone

OR

(*a*) Illustrate the following reactions giving a suitable chemical equation for each:

(*i*) Cannizzaro reaction

(*ii*) Hell-Volhard-Zelinsky reaction

(*b*) How would you bring about the following conversions? Write the complete equation in each case.
  (*i*) Ethanol to 3-hydroxybutanal
  (*ii*) Benzoic acid to m-nitrobenzyl alcohol
  (*iii*) Benzaldehyde to benzophenone

CBSE (Foreign) SET–II

Questions Uncommon to Set–I

1. How would you distinguish between a metallic solid and an ionic solid other than by metallic lustre?

2. What is meant by 'shape selective catalysis'?

4. Which is more acidic and why, H_2O or H_2S?

5. Of the two alcohols; (*a*) $CH_2{=}CH{-}CH_2OH$ and (*b*) $CH_2{=}CH{-}CH_2{-}CH_2OH$, which one will react more easily with conc. HCl in the presence of $ZnCl_2$?

8. Of the two bases named below, which one is present in RNA and which one is present in DNA?
Thymine, Uracil

13. Draw the molecular structures of the following species:
  (*i*) $H_2S_2O_8$
  (*ii*) XeF_2

18. What are biodegradable and non-biodegradable detergents? Give one example of each.

22. Differentiate among a homogeneous solution, a suspension and a colloidal solution, giving a suitable example of each.

23. Complete the following chemical equations:
  (*i*) $HgCl_2 + PH_3 \longrightarrow$
  (*ii*) $NaOH + Cl_2$
  $\longrightarrow$ (hot & conc.)
  (*iii*) $XeF_4 + O_2F_2 \xrightarrow{143\text{ K}}$

24. Name the following complexes and draw the structures of one possible isomer of each:
  (*i*) $[Cr(C_2O_4)_3]^{3-}$
  (*ii*) $[Pt(NH_3)_2Cl_2]$
  (*iii*) $[Co(en)_2Cl_2]^{+}$

26. Explain the meaning of the following terms:
  (*i*) Invert sugar
  (*ii*) Polypeptides
  (*iii*) Enzymes

CBSE (Foreign) SET–III

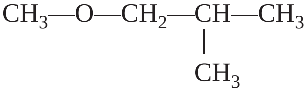
Questions Uncommon to Set–I and II

1. Define paramagnetism with an example.

3. What is the role of a depressant in Froth Floatation process for the concentration of a sulphide ore?

4. Which is a stronger acid in aqueous solution, HF or HCl, and why?

5. Write the IUPAC name of the following compound:



$CH_3—O—CH_2—CH(CH_3)—CH_3$

6. Draw the molecular structure of 4-Hydroxy-4-methylpentan-2-one.

12. State a reason for each of the following statements:

(*i*) Fluorine never exhibits any positive oxidation state.

(*ii*) Helium does not form any real chemical compound.

14. Explain why

(*i*) the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.

(*ii*) haloalkanes are only slightly soluble in water but dissolve easily in organic solvents.

20. Calculate the freezing point depression expected for 0.0711 m aqueous solution of sodium sulphate. If the solution actually freezes at – 0.320 °C, what is the actual value of van't Hoff factor at this temperature? (K_f for water = 1.86 K kg mol^{-1})

22. Present a classification of colloids where dispersion medium is water. State the characteristics and one example of each of these classes.

23. Complete the following chemical equations:

(*i*) $Sn + 2PCl_5 \xrightarrow{heating}$

(*ii*) $Fe^{3+} + SO_2 + H_2O$

$\longrightarrow$ (*iii*) $XeF_2(s) + H_2O(l)$

$\longrightarrow$

26. Write three such behaviours of glucose which cannot be explained by an open chain structure of glucose molecule. What alternative structure has been proposed for the glucose molecule?

Solutions

SET–I

1. The energy gap between valance band and conduction is known as forbidden zone.

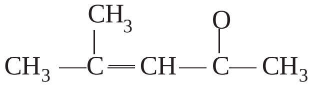
2. As the adsorption progresses, the residual forces at the surface decreases resulting in the decrease of surface energy which appears as heat.

3. $2[Ag(CN)_2](aq) + Zn(s) \longrightarrow [Zn(CN)_4]^{2-}(aq) + 2Ag(s)]$

4. This is because hydrogen bonding is multidimensional in water whereas in HF it is linear.

5. Hex-4-en-3-ol

6.



$CH_3-\overset{\overset{CH_3}{|}}{C}=CH-\overset{\overset{O}{|}}{C}-CH_3$

7. DNA: Deoxyribonucleic acid
RNA: Ribonucleic acid

8. Antibiotics which are mainly effective against gram-positive or Gram-negative bacteria are known as narrow spectrum antibiotics, *e.g.*, ampicillin G.

9. (*a*) Van't Hoff factor:

(*i*) May be defined as the ratio of normal molecular mass to observed molecular mass or the ratio of observed colligative property to calculated colligative property.

(*ii*) Mole fraction may be defined as the ratio of number of moles of one component to the sum of moles all the components present in a solution.

(*iii*) Ebuthoscopic constant may be defined as the elevation in boiling point when one mole of a non-volatile solute is added to 1000 grams of solvent.

(*b*) It states that for a solution of volatile liquids the partial vapour pressure of each component in the solution is directly proportional to its mole faction.

OR

$$\text{Number of moles of solute, Na}^+ \text{ ions} = \frac{92\text{g}}{23\text{g mol}^{-1}} = 4 \text{ mol}$$

$$\text{Volume of solution} = \frac{\text{Mass of solution}}{\text{Density of solution}} = \frac{1000\text{ g}}{1.25\text{ g mL}^{-1}} = 800\text{ mL} = \frac{800\text{ mL}}{1000\text{ mL L}^{-1}} = 0.8\text{ L}$$

$$\text{Molarity} = \frac{\text{Number of moles Na}^+\text{ ions}}{\text{Volume of solution in liter}} = \frac{4\text{ mol}}{0.8\text{ L}}$$

$$= 5 \text{ mol L}^{-1} \text{ or } 5 \text{ m.}$$

10. (*i*) The sum of the powers of the concentration of the reactants in the rate law expression is called the order of the reaction. For a general reaction

$aA + bB \longrightarrow$ products

Let rate = $K[A]^m[B]^n$

Order of the reaction = $m + n$

(*ii*) The minimum extra energy absorbed by the reactant molecular so that their energy becomes equal threshold energy is called activation energy.

Activation energy = Threshold energy – Energy possessed by reactant molecular

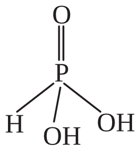
11.

Metal	**Chief ore**	**Method of concentration**
Copper	Copper pyrite ($CuFeS_2$)	Froth floatation
Aluminium	Bauxite [$AlO_x(OH)_{3-2x}$] where $0 < x < 1$	Leaching

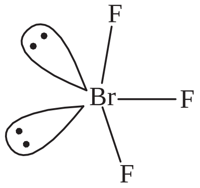
12. (*i*) As $N\equiv N$ triple bond (941.4 $kJmol^{-1}$) is much stronger than p–p single bond (213 $kJmol^{-1}$), therefore nitrogen is much less reactive than phosphorus.

(*ii*) This is because in SF_6, sulphur is sterically protected by six fluorine atoms.

13. (*i*) H_3PO_3



(*ii*) BrF_3—Slightly bent T



14. Nucleophiles which can attack through the different nucleophilic centres present in it are called ambident nucleophiles. For example, cyanide group is resonance hybrid of the following two contributing structures:

It can attack through carbon to form cyanide and through N to form isocyanide.

15. (*i*) This is due to inability of alkyl halides to form intermolecular hydrogen bonds with water molecules.

(*ii*) This is because Grignard reagent forms alkanes by reacting with moisture.

$$RMgX + H_2O \longrightarrow RH + Mg(OH)X$$

16. (*i*) Carbylamine reaction: Aliphatic and aromatic primary amines when heated with chloroform and ethanolic potassium hydroxide form carbylamines or isocyanides which are foul smelling substances. Secondary and tertiary amines do not show this reaction.

$$R—NH_2 + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} RNC + 3KCl + 3H_2O$$

$$\underset{\text{Aniline}}{C_6H_5NH_2} + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} \underset{\substack{\text{Phenyl}\\\text{isocyanide}}}{C_6H_5NC} + 3KCl + 3H_2O$$

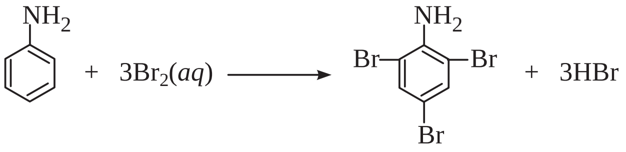
(*ii*) Hoffmann's bromamide reaction: When a primary acid amide is heated with bromine in an aqueous or ethanolic solution of NaOH, a primary amine is obtained. The amine so obtained contains one carbon less than that present in the amide.

$$\underset{\text{Acid amide}}{RCONH_2} + Br_2 + 4NaOH \longrightarrow R{-}NH_2 + Na_2\,CO_3 + 2NaBr + 2H_2O$$

$$\underset{\text{Benzamide}}{C_6H_5CONH_2} + Br_2 + 4NaOH \longrightarrow \underset{\text{Aniline}}{C_6H_5NH_2} + Na_2CO_3 + 2NaBr + 2H_2O$$

17. (*i*) $\underset{\substack{\text{Benzene}\\ \text{diazonium chloride}}}{C_6H_5N_2Cl} + H_3PO_2 + H_2O \longrightarrow \underset{\text{Benzene}}{C_6H_6} + N_2 + H_3PO_3 + HCl$

(*ii*)



Aniline 2,4,6-Tribromoaniline

18. (*i*) In hard water soaps get precipitated as calcium and magnesium soap which being insoluble in water stick to the clothes as gummy mass.

(*ii*) This is because aspartame is unstable at cooking temperature.

19. Here, $z = 2$, M = 56 g mol^{-1}, $d = 7.87$ g cm^{-3}

$a = 286.65$ pm $= 286\ .65 \times 10^{-10}$ cm = 2.8

Substituting the values in the expression,

$$N_A = \frac{z \times M}{a^3 \times d}, \text{ we get}$$

$$N_A = \frac{2 \times 56 \text{ g mol}^{-1}}{(286.65 \times 10^{-10} \text{ cm})^3 \times 7.87 \text{ g cm}^{-3}}$$

$$= 6.042 \times 10^{23} \text{ mol}^{-1}$$

OR

For *bcc* unit cell, $a = 2\sqrt{2}r$

$\therefore$ $a = 2\sqrt{2} \times 145$ pm

$= 2 \times 1.414 \times 145$ pm

$a = 410.06$ pm.

20. $W_B = 5\text{ g}, W_A = 95\text{ g}, M_B = 60.05\text{ g mol}^{-1}$,

MA = 18 g mol^{-1} P°A = 3.165 kPa

Substituting the values in the expression;

$$\frac{P_A^o - P}{P_A^o} = \frac{W_B \times M_A}{M_B \times W_A}, \text{ we get}$$

$$\frac{3.165 \text{ k Pa} - P}{3.165 \text{ k Pa}} = \frac{5 \text{ g } \times 18 \text{ g mol}^{-1}}{60.05 \text{ g mol}^{-1} \times 95\text{g}} = 0.015$$

$$P = 3.165 \text{ k Pa} - 0.015 \times 3.165 \text{ k Pa}$$

$$P = 3.118 \text{ k Pa}$$

21. (*a*) Let Rate = $k[A]^m\ [B]^n$

$$\therefore \quad 1.5 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1} = K(0.1)^m(0.1)^n \qquad \ldots (i)$$

$$3.0 \times 10^{-3} \text{ mol } L^{-1} \text{ min}^{-1} = K(0.2)^m(0.2)^n \qquad \ldots (ii)$$

$$6.0 \times 10^{-3} \text{ mol } L^{-1} \text{ min}^{-1} = K(0.2)^m(0.4)^n \qquad \ldots (iii)$$

Dividing equation (*iii*) by (*ii*), we get

$$\frac{6.0\times10^{-3}}{3.0\times10^{-3}} = \frac{k(0.2)^m(0.4)^n}{k(0.2)^m(0.2)^n}$$

$$2 = 2^n \Rightarrow n = 1$$

Dividing equation (*ii*) by (*i*), we get

$$\frac{3.0\times10^{-3}}{1.5\times10^{-3}} = \frac{k(0.2)^m(0.2)^n}{k(0.1)^m(0.1)^n}$$

$$2 = 2^m 2^n = 2^m.2$$

$$2^m = 1 \quad \text{or} \quad 2^m = 2^0 \quad \Rightarrow \ m = 0$$

$$\therefore \qquad \text{Rate} = K[A]^\circ[B]^1 \text{ or Rate} = \text{K[B]}$$

(*b*) $K = \dfrac{\text{Rate}}{[B]}$

$$K = \frac{1{\times}5\times10^{-3}\text{ mol } L^{-1} \text{ min}^{-1}}{0.1 \text{ mol } L^{-1}} = 1.5 \times 10^{-2} \text{ min}^{-1}$$

(*c*) The reaction mechanism (II) is consistent with the rate law found in (*a*).

22. (*i*) The movement of colloidal particles towards oppositely charged electrodes in an electric field is called electrophoresis.

(*ii*) There are some substances such as soap which at low concentration behave as normal electrolytes, but at higher concentration exhibit colloidal behaviour due to the formation of aggregates. The aggregated particles thus formed are known as micelles or associated colloids.

(*iii*) The process of converting a procipitate into colloidal solution by shaking it with dispersion medium in the presence of small amount of electrolyte is called peptization.

23. (*i*) $NH_4Cl(aq) + NaNO_2(aq) \longrightarrow N_2(g) + 2H_2O(l) + NaCl(aq)$

(*ii*) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

(*iii*) $Xe(g) + F_2(g) \xrightarrow[\text{1bar}]{\text{673K}} XeF_2(s)$

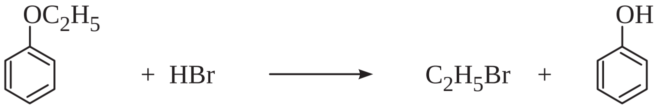
(Xenon in excess)

24. (*i*) This is because the transition metals have empty *d*-orbitals into which the electron pairs can be denoted by ligands containing and electrons, *e.g.*, C_6H_6, C_2H_4 etc.

(*ii*) As only one inner *d*-orbital is available in nickel for bonding in the presence of strong ligand, *e.g.*, $C\overline{O}$, $C\overline{N}$.

(*iii*) In both the complexes, Fe is in +2 oxide state with d^6 configuration. As the ligands CN and H_2O possess different crystal field splitting energy (ΔO), they absorb different components of visible light for *d-d* transition. Hence, the transmitted colours are different in dilute solutions.

25. (*i*) $CH_3—CH_2—CH_2—O—CH_2—CH_3—H—Br \longrightarrow CH_3—CH_2—Br—CH_3—CH_2—CH_2—OH$

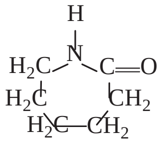
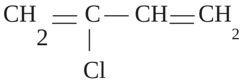
(*ii*) 

(*iii*) $(CH_3)_3C—OC_2H_5 + HI \longrightarrow (CH_3)_3C—I + C_2H_5—OH$

26. Glycogen is a polymer of $\alpha-D-$glucose. The carbohydrates are stored in animal body as glycogen. Starch is also a polymer of $\alpha-D-$glucose and consist of two components amylose and amylopectin. Amylose is linear chain polymer of $\alpha-D-$glucose. Both glycogen and amylopectin are branched chain polymer of $\alpha-D-$glucose but glycogen is more highly branched than amylopectin. Strarch is the main storage polysaccharide of plants.

Starch is a polymer of $\alpha-D-$glucose whereas cellulose is a polymer β–D–glucose.

27.

S.No.	Polymer	Monomer	Structure of Monomer
(*i*)	Nylon-6	Caprolactum	 **Caprolactum**
(*ii*)	Teflon	Tetrafluoro ethene	$CF_2=CF_2$
(*iii*)	Neoprene	Chloroprene	 $CH_2=C(Cl)—CH=CH_2$

28. (*a*) Lead storage battery is a secondary battery. The reactions occurring in lead storage battery when current is drawn from it are:

Anode: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$

Overall reaction: $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$

(*b*) **At Anode:** $Cu \longrightarrow Cu^{2+} + 2e^-$

At Cathode: $Ag^+ + e^- \longrightarrow Ag] \times 2$

Cell reaction: $Cu + 2Ag^+ \longrightarrow Cu^{2+} + 2Ag$

$$E^o_{cell} = 0.46\text{ V};\ [Ag^+] = 1 \times 10^{-3}\text{ M},\ [Cu^{2+}] = 0.1\text{M} : n = 2$$

Substituting the values in the equation:

$$E_{cell} = E^o_{cell} - \frac{0.059}{n}\log\frac{[Cu^{2+}]}{[Ag^+]^2}, \text{ we get}$$

$$E_{cell} = 0.46\text{ V} - \frac{0.059}{2}\log\frac{(0.1)}{(10^{-3})^2}$$

$$= 0.46\text{ V} - (0.0295\log 10^5) = 0.46\text{V} - 0.0295 \times 5$$

$$= 0.3125\text{ V}$$

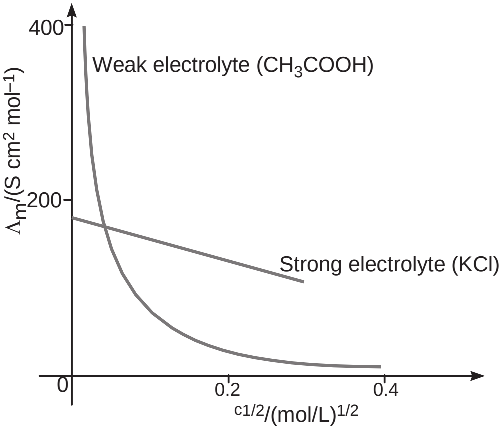
OR

(*a*) Molar conductivity of a solution at a given concentration is the conductance of the volume V of the solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length.

$$\Lambda_m = \kappa \times V = \frac{\kappa \times 1000}{c}$$

where κ is the conductivity and *V* is the volume of solution containing one mole of the electrolyte and *c* is the molar concentration.

Molar conductivity increases with decrease in concentration or increase in dilution as the number of ions as well as the mobility of ions increases with increase in dilution.



For strong electrolytes, the number of ions does not increase appreciably on dilution and only mobility of ions increases due to decrease in interionic attractions. Therefore, Λ_m increases a little as shown in figure by a straight line. For weak electrolytes, number of ions as well as mobility of ions increases on dilution which results in a very large increase in molar conductivity, especially at infinite dilution (*i.e.*, concentration, $c \rightarrow 0$) as shown by curve in figure.

(*b*) (*i*) **At Anode:** $Ni \longrightarrow Ni^{2+} + 2e^-$

At Cathode: $Ag^+ + \boldsymbol{e^-} \longrightarrow Ag] \times 2$

Cell reaction: $Ni + 2Ag^+ \longrightarrow Ni^{2+} + 2Ag$

$$E^o_{cell} = E°_{cathode} - E°_{anode}$$

$$= E^o_{Ag^+/Ag} - E^o_{Ni^{2+}/Ni} = 0.80\text{ V} - (-0.25\text{ V})$$

$$E^o_{cell} = 1.05\text{ V}$$

(*ii*) $$E_{cell} = E^o_{cell} - \frac{0.059}{n}\log\frac{[Ni^{2+}]}{[Ag^+]^2}$$

Here, $n = 2$, $E^o_{cell} = 1.05$ V, $[Ni^{2+}] = 0.1$ M, $[Ag^+] = 1.0$ M

$$\therefore \qquad E^{o}_{cell} = 1.05\text{V} - \frac{0.059}{2}\log\frac{(0.01)}{(1)^2}$$

$$E_{cell} = 1.05\text{V} - 0.0295 \log 10^{-1} = 1.05 + 0.0295 \text{ V}$$

$$E_{cell} = 1.0795 \text{ V}$$

29. (*a*) (*i*)

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$

$$2I^- \longrightarrow I_2 + 2e^-] \times 3$$

$$\underline{Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O}$$

(*ii*)

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O]\times 2$$

$$SO_3^{2-} + H_2O \longrightarrow SO_4^{2-} + 2H^+ + 2e^-] \times 5$$

$$\underline{2MnO_4^- + 5SO_3^{2-} + 6H^+ \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O}$$

(*b*) (*i*) The catalytic activity of transition metals and their compounds is attributed to the following reasons:

Due to their tendency to show variable oxidation states transition metals form instable intermediate compounds and provide a new path for the reaction with lower activation energy.

In Some cases, the transition metals provide a suitable large surface area with free valencies on which reactants are adsorbed.

(*ii*) This is due to presence of maximum number of unpaired electrons in a transition metal which is present in the middle of a series.

(*iii*) In the same group of *d*-block elements, the 4*d* and 5*d* transition elements are larger in size than than those of 3*d* elements. Hence, the valence electrons are less tightly held and form metal–metal bond more frequently.

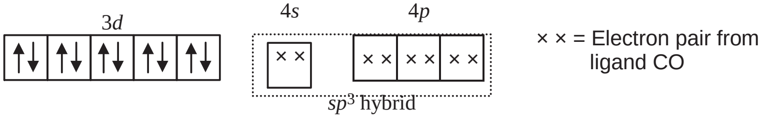
OR

(*a*)

Ion	**Electronic Configuration**	**Number of Unpaired electrons**
Mn^{2+} [Ar]	$3d^5 4s^0$	5
Cr^{3+} [Ar]	$3d^3 4s^0$	3
V^{3+} [Ar]	$3d^2 4s^0$	2
Fe^{2+} [Ar]	$3d^6 4s^0$	4

Mn^{2+} ion is most stable in aqueous solution.

(*b*) (*i*) $Ni(CO)_4$: Tetracrabonyl nickel(o); Ni = $3d^8\ 4s^2$



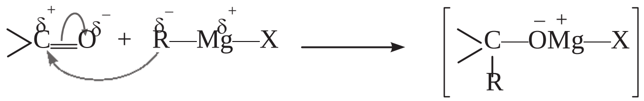
Structure = Tetrahedral; Magnetic behaviour : Diamagnetic (*ii*) Cu^{2+} (*aq*) is much more stable than Cu(*aq*). This is because high negative enthalpy of hydration of Cu^{2+}(*aq*) easily compensates the high second ionisation enthalpy of copper. Due to his Cu^{+}(*aq*) undergo disproportionation as follows:

$$2Cu^{+}(aq) \longrightarrow Cu^{2+}(aq) + Cu(s)$$

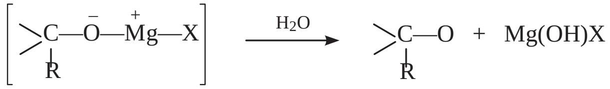
(iii) This is due to high electronegativity oxygen and fluorine.

30. **(*a*) Mechanism:**

(*i*) Nucleophilic addition of Grignard reagent to carbonyl group to form an adduct.

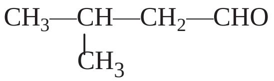


(*ii*) Hydrolysis of the adduct to alcohol.



(*b*) Name of compound — Structure

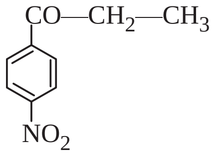
(*i*) S–Methyl butanal



$$CH_3—\underset{CH_3}{\underset{|}{C}H}—CH_2—CHO$$

(*ii*) Hexane–1, 6–dioic acid — $HOOC—CH_2—CH_2—CH_2—CH_2—COOH$

(*iii*) P–Nitropropiophenone



OR

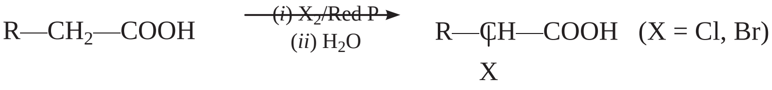
(*a*) **(*i*) Cannizzaro reaction:** Aldehydes which do not have an–α hydrogen atom, undergo disproportionation reaction on treatment with concentrated alkali. In this reaction, one molecule of the aldehyde is reduced to alcohol while another is oxidised to salt of carboxylic acid.

$$2HCHO \xrightarrow{conc.KOH} CH_3OH + HCO\overset{-}{O}K^{+}$$

Methyl alcohol

Potassium formate

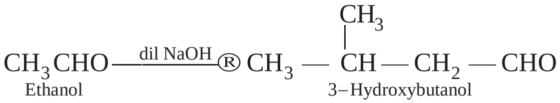
(*ii*) Hell-Volhard-Zelinsky reaction: Carbosylic acids having an α-hydrogen are halogenated at the α-position on treatment with chlorine or bromine in the presence of small amount of red phosphorus to give α-halocarboxylic acids.



$$R—CH_2—COOH \xrightarrow[(ii)\ H_2O]{(i)\ X_2/Red\ P} R—\underset{X}{\underset{|}{C}H}—COOH \quad (X = Cl, Br)$$

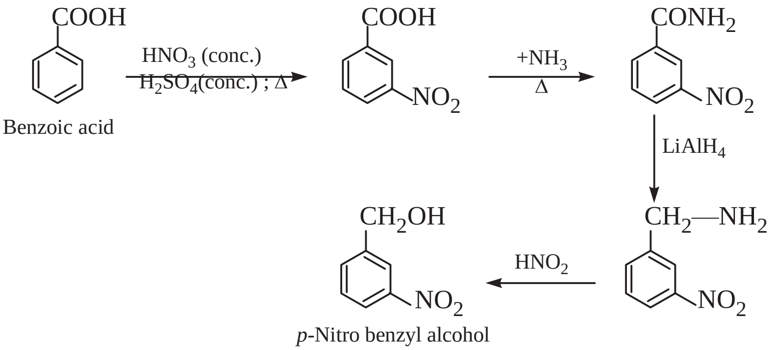
α-Halocarboxylic acid

(*b*) (*i*)

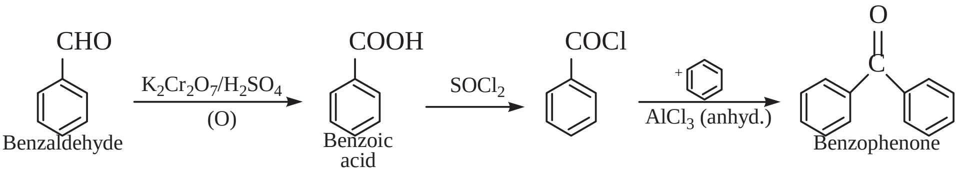


$$\underset{\text{Ethanol}}{CH_3CHO} \xrightarrow{\text{dil NaOH}} ® \underset{\text{3–Hydroxybutanol}}{CH_3 - \overset{\overset{CH_3}{|}}{CH} - CH_2 - CHO}$$

(*ii*)



(*iii*)



SET–II

1. Metallic solid conducts electricity in solid state but ionic solid conducts electricity only in solution or in molten state.

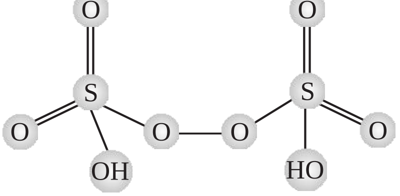
2. The catalytic reaction which depends upon the pore structure of the catalyst and the size of the reaction and product molecules is called shape selective catalysis.

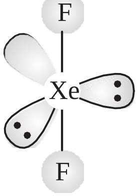
4. H_2S, due to low bond dissociation enthalpy of H–S bond.

5. $CH_2 = CH - CH_2OH$

8. (*i*) Thymine is present in DNA.
(*ii*) Uracil is present in RNA.

13. (*i*) $H_2S_2O_8$ (Peroxodisulphuric acid) (*ii*) XeF_2





22.

Property	Homogeneous solution	Colloidal solution	Suspension
1. Particle Size	Less than 1nm	Between 1 nm to 1000 nm	more than 1000 nm
2. Separation by • ordinary filtration • ultra filtration	 Not possible Not possible	 Not possible Possible	 Possible Possible
3. Settling of particles	Do not settle	Settle only on configuration	Settle under gravity
4. Appearance	Transparent	Translucent	opaque
5. Example	Glucose dissolved in water	Smoke, milk, Gold sol	Sand in water

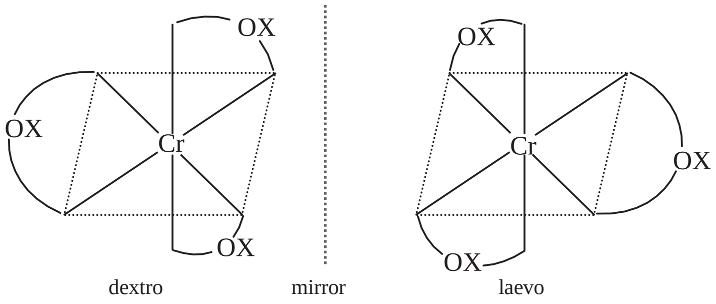
23. $3HgCl_2 + 2PH_3 \longrightarrow Hg_3P_2 + 6HCl$

$6NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(Hot and conc.)

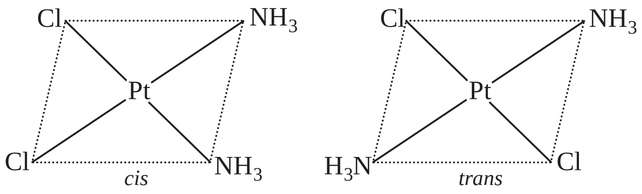
$XeF_4 + O_2F_2 \xrightarrow{143K} XeF_6 + O_2$

24. (*i*) $[Cr(C_2O_4)_3]^{3-}$: Trioxialato chromate (III) ion



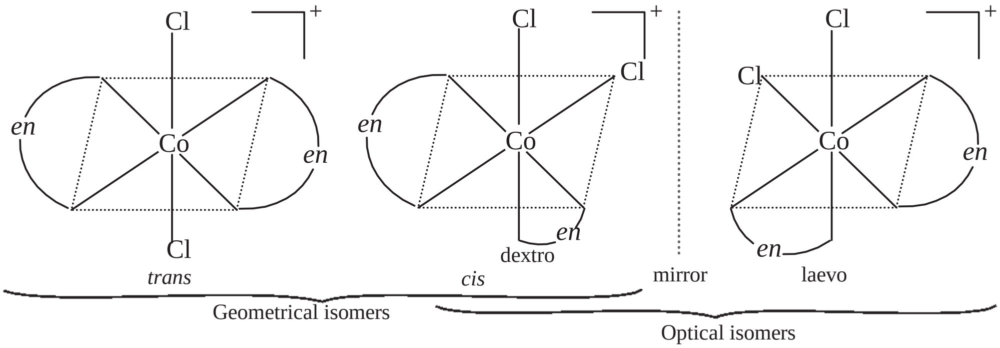
Optical isomers of $[Cr(Ox)_3]^{3-}$

(*ii*) $[Pt(NH_3)_2Cl_2]$; Diamine dichlorido platinum (II)



Geometrical isomers of $[Pt(NH_3)_2Cl_2]$

(*iii*) $[CO(en)_2Cl_2]^+$: Diechloridobis (ethane-1, 2-diamine) cobalt(III) ion



26. (*i*) Sucrose is dextrorotatory, on hydrolysis in the presence of hydrochloric acid or enzyme invertase, it gives a mixture of D-(+)-glucose and D-(–)-fructose which is laeorotatory called invert sugar.

(*ii*) If more than find-amino acids are joined together by peptide bend (CONH) the polyamide thus formed is called polypeptide.

(*iii*) Enzymes are biocatalyst. Almost all the enzymes are globular proteins. Enzymes are specific in nature and efficiency in their action. They are required in small quantity and highly active optimum temperature range (298–310 K) and pH values 5–7.

SET–III

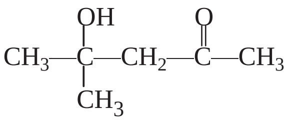
1. The substances which are weakly attracted by external magnetic field are called paramagnetic substances and the property. Thus exhibited is called paramagnetism. Paramagnetism is shown by those substances whose atoms, ions or molecules contain unpaired electron contain unpaired electrons, *e.g.*, O^2, Cu^{2+} Fe^{3+}, Cr^{3+}, etc.

3. Depressant is used to prevent the formation of froth from one of the two sulphide ores.

4. Since the bond dissociation enthalpy of the H–Cl bond is lower than H–F bond therefore H–Cl is stronger acid than H– F in aqueous solution.

5. 1-methoxy-2-methyl propane.

6.



$$CH_3\text{—}\overset{\overset{\displaystyle OH}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}\text{—}CH_2\text{—}\overset{\overset{\displaystyle O}{\|}}{C}\text{—}CH_3$$

12. (*i*) This is because fluorine is most electronegative element and does not have d-orbitals in its valence shell.

(*ii*) Due to vary high ionisation enthalpy helium does not form any real chemical compound.

14. (*i*) Dipole moment is a product of charge and distance. Since chlorobenzene has lower magnitude of negative charge on Cl atom and shorter C—Cl bond than cyclohexyl chloride due to resonance therefore chlorobenzene has lower dipole moment than cyclohexyl chloride.

(*ii*) This is because the new intermolecular attractions between haloalkenes and organic solvent molecules have almost the same strength ones being broken in the separate haloalkan and solvent molecules.

20. $\Delta T_f = T_f^0 - T_f = 0°\text{C} - (-0.320°\text{C}) = 0.320°\text{C} = 0$ or 0.320 K

$m = 0.0711\ \text{mol kg}^{-1}$, $K_f = 1.86$ K Kg mol^{-1}, $\Delta T_f = 0.320K$

Substituting these values in the expression, $\Delta T_f = iK_f m$, we get

$$0.320 \text{ K} = i \times 1.86 \text{ K kg mol}^{-1} \times 0.0711 \text{ mol kg}^{-1}$$

$$i = \frac{0.320}{0.132} = 2.42$$

22. When the dispersion medium is water colloids are classified as hydrophilic colloids and hydrophobic colloids. Hydrophilic colloids are solvent (water) attracting, reversible and quite stable, *e.g.*, gum, starch, gelatin etc. Hydrophobic colloids are solvent (water repelling, irreversible and less stable, *e.g.*, metal sulphides sol, metal hydroxide sol, etc.

23. (*i*) $Sn + 2PCl_5 \xrightarrow{\text{heating}} SnCl_4 + 2PCl_3$

(*ii*) $2Fe_3+ + SO_2 + 2H_2O \longrightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$

(*iii*) $2XeF_2(s) + 2H_2O(e) \longrightarrow 2Xe + 4HF + O_2$

26. The following reactions cannot be explained by the open chain structure of glucose.

(*i*) Despite having the aldehyde group, glucose does not give 2, 4– DNP test, Schiffs test and it does not form the hydrogensulphite addition product with $NaHSO_3$.

(*ii*) The penta acetate of glucose does not react with hydroxyl amine indicating the absence of free —CHO group.

(*iii*) D–Glucose on treatment of methyl alcohol in the presence of dry HCl gas gives two isomeric nonomethyl derivatives known as α-D-glucoside and methyl β– D–glucoside. These glucosides do not reduce fehling solution and also do not react with hydrogen cyanide indicating the absence of free —CHO group.

A ring structure called pyranose structure (α- or β-) is proposed for the glucose molecule.

CBSE Examination Papers
Delhi–2013

SET–I

Time allowed : 3 hours **Maximum marks: 70**

General Instructions:

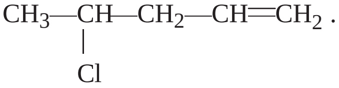
(*i*) *All questions are compulsory.*
(*ii*) *Question numbers* ***1*** *to* ***8*** *are very short answer questions and carry* ***1*** *mark each.*
(*iii*) *Question numbers* ***9*** *to* ***18*** *are short answer questions and carry* ***2*** *marks each.*
(*iv*) *Question numbers* ***19*** *to* ***27*** *are also short answer questions and carry* ***3*** *marks each.*
(*v*) *Question numbers* ***28*** *to* ***30*** *are long answer questions and carry* ***5*** *marks each.*
(*vi*) *Use log tables, if necessary. Use of calculators is not allowed.*

1. How many atoms constitute one unit cell of a face-centered cubic crystal?

2. Name the method used for the refining of nickel metal.

3. What is the covalency of nitrogen in N_2O_5?

4. Write the IUPAC name of



$CH_3—\underset{\displaystyle Cl}{\underset{|}{C}H}—CH_2—CH{=}CH_2$.

5. What happens when $CH_3—Br$ is treated with KCN?

6. Write the structure of 3–methyl butanal.

7. Arrange the following in increasing order of their basic strength in aqueous solution:
$CH_3.NH_2$, $(CH_3)_3N$, $(CH_3)_2NH$

8. What are three types of RNA molecules which perform different functions?

9. 18 g of glucose, $C_6H_{12}O_6$ (Molar Mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil?
(K_b for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K)

10. The conductivity of 0.20 M solution of KCl at 298 K is 0.025 S cm^{-1}. Calculate its molar conductivity.

11. Write the dispersed phase and dispersion medium of the following colloidal systems:
(*i*) Smoke (*ii*) Milk

OR

What are lyophilic and lyophobic colloids? Which of these sols can be easily coagulated on the addition of small amounts of electrolytes?

12. Write the differences between physisorption and chemisorption with respect to the following:

(*i*) Specificity (*ii*) Temperature dependence

(*iii*) Reversibility and (*iv*) Enthalpy change

13. (*a*) Which solution is used for the leaching of silver metal in the presence of air in the metallurgy of silver?

(*b*) Out of C and CO, which is a better reducing agent at the lower temperature range in the blast furnace to extract iron from the oxide ore?

14. What happens when

(*i*) PCl_5 is heated? (*ii*) H_3PO_3 is heated?

Write the reactions involved.

15. (*a*) Which metal in the first transition series (3*d* series) exhibits +1 oxidation state most frequently and why?

(*b*) Which of the following cations are coloured in aqueous solutions and why?

Sc^{3+}, V^{3+}, Ti^{4+}, Mn^{2+}

(At. nos. Sc = 21, V = 23, Ti = 22, Mn = 25)

16. Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same.

17. Explain the mechanism of the following reaction:

$$2CH_3—CH_2—OH \xrightarrow[413\text{ K}]{H^+} CH_3CH_2—\overset{\bullet\bullet}{\underset{\bullet\bullet}{O}}—CH_2—CH_3 + H_2O$$

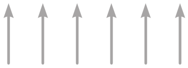
18. How will you convert:

(*i*) Propene to Propan–2–ol?

(*ii*) Phenol to 2, 4, 6 – trinitrophenol?

19. (*a*) What type of semiconductor is obtained when silicon is doped with boron?

(*b*) What type of magnetism is shown in the following alignment of magnetic moments?



(*c*) What type of point defect is produced when AgCl is doped with $CdCl_2$?

20. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2 L of water at 25°C, assuming that it is completely dissociated.
($R = 0.082$ L atm K^{-1} mol^{-1}, Molar mass of K_2SO_4 = 174 g mol^{-1}).

21. Calculate the emf of the following cell at 298 K:

Fe (s) | Fe^{2+} (0.001 M) || H^+ (1M) | H_2 (g) (1 bar), Pt (s)

(Given E^o_{cell} = + 0.44 V)

22. How would you account for the following?

(*i*) Transition metals exhibit variable oxidation states.

(*ii*) Zr (Z = 40) and Hf (Z = 72) have almost identical radii.

(*iii*) Transition metals and their compounds act as catalyst.

OR

Complete the following chemical equations:

(*i*) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow$

(*ii*) $2CrO_4^{2-} + 2H^+ \longrightarrow$

(*iii*) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow$

23. Write the IUPAC names of the following coordination compounds:

(*i*) $[Cr(NH_3)_3Cl_3]$ (*ii*) $K_3[Fe\ (CN)_6]$

(*iii*) $[CoBr_2(en)_2]^+$, (en = ethylenediamine)

24. Give the structures of A, B and C in the following reactions:

(*i*) $C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow[\Delta]{NH_3} C$

(*ii*) $C_6H_5NO_2 \xrightarrow{Sn + HCl} A \xrightarrow[273\ K]{NaNO_2 + HCl} B \xrightarrow[\Delta]{H_2O/H^+} C$

25. Write the names and structures of the monomers of the following polymers:

(*i*) Buna–S (*ii*) Neoprene

(*iii*) Nylon–6, 6

26. After watching a programme on TV about the adverse effects of junk food and soft drinks on the health of school children, Sonali, a student of Class XII, discussed the issue with the school principal. Principal immediately instructed the canteen contractor to replace the fast food with the fibre and vitamins rich food like sprouts, salad, fruits, etc. This decision was welcomed by the parents and the students.

After reading the above passage, answer the following questions:

(*a*) What values are expressed by Sonali and the Principal of the school?

(*b*) Give two examples of water-soluble vitamins.

27. (*a*) Which one of the following is a food preservative?

Equanil, Morphine, Sodium benzoate

(*b*) Why is bithional added to soap?

(*c*) Which class of drugs is used in sleeping pills?

28. (*a*) A reaction is second order in A and first order in B.

(*i*) Write the differential rate equation.

(*ii*) How is the rate affected on increasing the concentration of A three times?

(*iii*) How is the rate affected when the concentrations of both A and B are doubled?

(*b*) A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ for this reaction. (Given log 1.428 = 0.1548)

OR

(*a*) For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

(*b*) Rate constant 'k' of a reaction varies with temperature 'T' according to the equation:

$$\log k = \log A - \frac{E_a}{2.303\,R}\left(\frac{1}{T}\right)$$

Where E_a is the activation energy. When a graph is plotted for log k vs. $\frac{1}{T}$, a straight line with a slope of – 4250 K is obtained. Calculate 'E_a' for the reaction. (R = 8.314 JK^{-1} mol^{-1})

29. (*a*) Give reasons for the following:

(*i*) Bond enthalpy of F_2 is lower than that of Cl_2.

(*ii*) PH_3 has lower boiling point than NH_3.

(*b*) Draw the structures of the following molecules:

(*i*) BrF_3 (*ii*) $(HPO_3)_3$

(*iii*) XeF_4

OR

(*a*) Account for the following:

(*i*) Helium is used in diving apparatus.

(*ii*) Fluorine does not exhibit positive oxidation state.

(*iii*) Oxygen shows catenation behaviour less than sulphur.

(*b*) Draw the structures of the following molecules:

(*i*) XeF_2 (*ii*) $H_2S_2O_8$

30. (*a*) Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Give two reasons.

(*b*) How will you bring about the following conversions?

(*i*) Propanone to propane

(*ii*) Benzoyl chloride to benzaldehyde

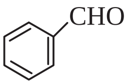
(*iii*) Ethanal to but-2-enal

OR

(*a*) Complete the following reactions:

(*i*) $2H-\underset{\underset{\displaystyle O}{\|}}{C}-H \xrightarrow{\text{conc. KOH}}$

(*ii*) $CH_3COOH \xrightarrow{Br_2/P}$

(*iii*)  $\xrightarrow[273\text{–}283\ K]{HNO_3/H_2SO_4}$

(*b*) Give simple chemical tests to distinguish between the following pairs of compounds:

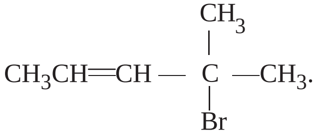
(*i*) Ethanal and Propanal

(*ii*) Benzoic acid and Phenol

SET–II

(Questions Uncommon to Set–I)

1. What type of stoichiometric defect is shown by AgCl?

2. Write the IUPAC name of 
$CH_3CH{=}CH-\underset{Br}{\overset{CH_3}{C}}-CH_3$.

4. What type of bonding helps in stabilising the α-helix structure of proteins?

6. What inspired N. Bartlett for carrying out reaction between Xe and PtF_6?

7. What happens when ethyl chloride is treated with aqueous KOH?

8. Write the structure of 4–chloropentan–2–one.

9. How will you convert the following?

(*i*) Propan–2–ol to propanone.
(*ii*) Phenol to 2, 4, 6–tribromophenol

11. What is the difference between oil/water (O/W) type and water/oil (W/O) type emulsions? Give an example of each type.

17. (*a*) Which of the following ores can be concentrated by froth floatation method and why? Fe_2O_3, ZnS, Al_2O_3.

(*b*) What is the role of silica in the metallurgy of copper?

18. (*a*) Why does *p*-dichlorobenzene have a higher m.p. than its *o*- and *m*- isomers?

(*b*) Why is (±) – Butan-2-ol is optically inactive?

23. Write the names and structures of the monomers of the following polymers:

(*i*) Polystyrene
(*ii*) Dacron
(*ii*) Teflon

27. Write the types of isomerism exhibited by the following complexes:

(*i*) $[Co(NH_3)_5Cl]SO_4$
(*ii*) $[Co(en)_3]^{3+}$
(*ii*) $[Co(NH_3)_6]\ [Cr(CN)_6]$

SET–III

(Questions Uncommon to Set-I and II)

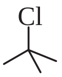
1. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic?

3. What is the composition of 'Copper matte'?

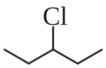
5. What is a glycosidic linkage?

6. Write the IUPAC name of $(CH_3)_2CH.CH\,(Cl)CH_3$.

7. Which compound in the following pair undergoes faster S_N1 reaction?



and



8. Write the structure of *p*-Methylbenzaldehyde molecule.

9. What is the difference between multimolecular and macromolecular colloids? Give one example of each.

14. (*a*) Give an example of zone refining of metals.

(*b*) What is the role of cryolite in the metallurgy of aluminium?

17. Account for the following:

(*i*) The C—Cl bond length in chlorobenzene is shorter than that in CH_3—Cl.

(*ii*) Chloroform is stored in closed dark brown bottles.

18. How will you convert:

(*i*) Propene to Propan-1-ol?

(*ii*) Ethanal to Propan-2-o1?

23. Give the structures of products A, B and C in the following reactions:

(*i*) $CH_3CH_2Br \xrightarrow{\text{KCN}} A \xrightarrow{\text{LiAlH}_4} B \xrightarrow[0°C]{\text{HNO}_2} C$

(*ii*) $CH_3COOH \xrightarrow[\Delta]{\text{NH}_3} A \xrightarrow{\text{NaOH} + \text{Br}_2} B \xrightarrow{\text{CHCl}_3 + \text{alc. KOH}} C$

27. Write the names and structures of the monomers of the following polymers:

(*i*) Bakelite (*ii*) Nylon-6

(*iii*) Polythene

z z z

Solutions

SET–I

1. (8 corner atoms) $\times \frac{1}{8}$ + (6 face centre atoms) $\times \frac{1}{2} = 1 + 3 = 4$

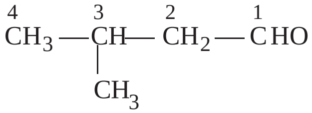
2. Mond Process.

3. 4

4. 4-Chloropent-1-ene.

5. $CH_3Br + KCN$ ——® $CH_3C \equiv N$
Ethanenitrile

6.



$$\overset{4}{C}H_3-\underset{\substack{|\\CH_3}}{\overset{3}{C}H}-\overset{2}{C}H_2-\overset{1}{C}HO$$

7. $(CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$

8. There are three types of RNAs:

(*i*) Ribosomal RNA (*r*RNA)
(*ii*) Messenger RNA (*m*RNA)
(*iii*) Transfer RNA (*t*RNA)

9. Moles of glucose = 18 g / 180 g mol^{-1} = 0.1 mol

Mass of solvent = 1 kg

Hence, molality of glucose solution = 0.1 mol kg^{-1}

For water, change in boiling point will be

$$\Delta T_b = K_b \times m$$
$$= 0.52 \text{ K kg mol}^{-1} \times 0.1 \text{ mol kg}^{-1} = 0.052 \text{ K.}$$

Since water boils at 373.15 K at 1.013 bar pressure, the boiling point of solution will be 373.15 + 0.052 = 373.202 K.

10. $$\Lambda_m = \frac{k \times 1000}{c} = \frac{0.025 \text{ S cm}^{-1} \times 1000 \text{ cm}^3 \text{ L}^{-1}}{0.20 \text{ mol L}^{-1}} = 125 \text{ S cm}^2 \text{ mol}^{-1}$$

11.

Type of Colloid	**Dispersed Phase**	**Dispersion Medium**
(*i*) Smoke	Solid	Gas
(*ii*) Milk	Liquid	Liquid

OR

Lyophilic sols are solvents attracting sols whereas lyophobic sols are solvent repelling sols. Lyophobic sols can be easily coagulated.

12.

	Physisorption	**Chemisorption**
(*i*) Specificity	It is not specific in nature.	It is highly specific in nature.
(*ii*) Temperature dependence	Low temperature is favourable for adsorption. It decreases with increase of temperature.	High temperature is favourable for adsorption. It increases with the increase of temperature.
(*iii*) Reversibility	It is reversible in nature.	It is irreversible.
(*iv*) Enthalpy change	Enthalpy of adsorption is low (20–40 kJ mol^{-1}) in this case.	Enthalpy of adsorption is high (80-240 kJ mol^{-1}) in this case.

13. (*a*) Dilute solution of NaCN.

(*b*) CO.

14. (*i*) When PCl_5 is heated, the less stable axial bonds break to form PCl_3.

$$PCl_5 \xrightarrow{\text{Heat}} PCl_3 + Cl_2.$$

(*ii*) Orthophosphorous acid on heating disproportionates to give orthophosphoric acid and phosphine.

$$\underset{\text{Orthophosphorous acid}}{4H_3PO_3} \xrightarrow{\text{Heat}} \underset{\text{Phosphine}}{PH_3} + \underset{\text{Orthophosphoric acid}}{3H_3PO_4}$$

15. (*a*) Cu has the electronic configuration $3d^{10}\ 4s^1$. It can easily lose $4s^1$ electron to give the stable $3d^{10}$ configuration. Hence, it shows +1 oxidation state.

(*b*) Mn^{2+} and V^{3+} are coloured in aqueous solutions because they have unpaired electrons.

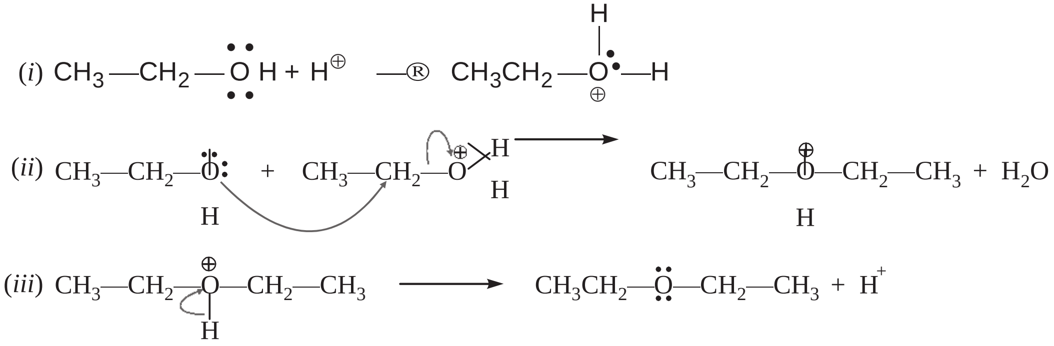
16. (*i*) Due to resonance C—Cl bond acquires a partial double bond character which is difficult to cleave.

(*ii*) Due to sp^2 hybridisation of C of C—Cl bond.

(*iii*) Due to unstable phenyl cation.

(*iv*) Due to repulsion between nucleophile and electron-rich arenes.

17.



(*i*) $CH_3-CH_2-\ddot{\underset{..}{O}}H + H^{\oplus} \rightarrow CH_3CH_2-\underset{\oplus}{\overset{H}{\overset{|}{O}}}-H$

(*ii*) $CH_3-CH_2-\underset{H}{\ddot{O}}: + CH_3-CH_2-\overset{\oplus}{O}\langle^{H}_{H} \longrightarrow CH_3-CH_2-\underset{H}{\overset{\oplus}{O}}-CH_2-CH_3 + H_2O$

(*iii*) $CH_3-CH_2-\underset{H}{\overset{\oplus}{O}}-CH_2-CH_3 \longrightarrow CH_3CH_2-\ddot{\underset{..}{O}}-CH_2-CH_3 + H^+$

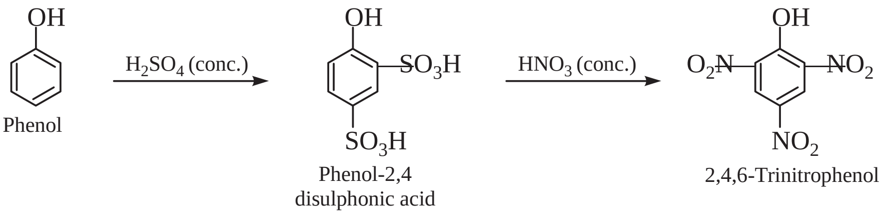
18. (*i*) Propan-2-ol can be prepared from propene by hydration as shown below:

$$CH_3-CH=CH_2 \xrightarrow{H_2O/H^+} CH_3-CH-CH_3$$

Propene

OH

(*ii*)



19. (*a*) *p*-type semiconductor.

(*b*) Ferromagnetism.

(*c*) Impurity defect/cation vacancy defect.

20. K_2SO_4 dissolved = 0.025 g

Volume of solution = 2 L, T = 25°C = 298 K

Molar mass of $K_2SO_4 = 174 \text{ g mol}^{-1}$

Since K_2SO_4 dissociates completely as $K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$

$$i = \frac{\text{Total number of moles of particle after dissociation}}{\text{Number of moles of particles before dissociation}} = \frac{3}{1} = 3$$

Applying van't Hoff equation,

$$\pi = \frac{i \times W_B \times R \times T}{M_B \times V}$$

$$= \frac{3 \times 0.025 \text{ g} \times 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1} \times 298 \text{ K}}{174 \text{ g mol}^{-1} \times 2 \text{ L}} = \mathbf{5.27 \times 10^{-3} \text{ atm}}$$

21. Cell reaction: $Fe(s) + 2H^+(aq) \longrightarrow Fe^{2+}(aq) + H_2(g)$

Nernst equation: $E_{cell} = E^{o}_{cell} - \frac{0.0591}{2} \log \frac{[Fe^{2+}]}{[H^+]^2}$

$\therefore$ $E_{cell} = 0.44 - \frac{0.0591}{2} \log \frac{10^{-3}}{(1)^2}$

$$= 0.44 - \frac{0.0591}{2} \times (-3) = 0.44 + 0.0886 = \mathbf{0.52856V}$$

22. (*i*) Transition elements show variable oxidation states because electrons in *ns* and $(n-1)$ *d*-orbitals are available for bond formation as they have nearly same energy.

(*ii*) This is due to filling of 4*f* orbitals which have poor shielding effect (lanthanoid contraction).

(*iii*) This is because of their ability to adopt multiple oxidation states and to form complexes.

OR

(*i*) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

(*ii*) $2Cr_2O_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

(*iii*) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

23. (*i*) Triamminetrichloridochromium(III)

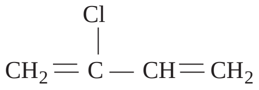
(*ii*) Potassium hexacyanoferrate(III)

(*iii*) Dibromidobis-(ethane-1,2-diammine)cobalt(III) ion

24. (*i*) A = C_6H_5CN, B = C_6H_5COOH, C = $C_6H_5CONH_2$

(*ii*) A = $C_6H_5NH_2$, B = $C_6H_5N_2^+Cl^-$, C = C_6H_5OH

25.

S. No.	Polymers	Monomer names	Monomer structures
(*i*)	Buna-S	1, 3-Butadiene, Styrene	$CH_2{=}CH{-}CH{=}CH_2$ $C_6H_5CH{=}CH_2$
(*ii*)	Neoprene	Chloroprene	 $CH_2{=}\overset{\overset{\Large Cl}{\vert}}{C}{-}CH{=}CH_2$
(*iii*)	Nylon-6, 6	Hexamethylene diamine, Adipic acid	$NH_2{-}(CH_2)_6{-}NH_2$ $COOH{-}(CH_2)_4{-}COOH$

26. (*a*) Values shown by Sonali: concern for the society, socially active and helpful to others.

Values shown by principal: caring, commanding and serious about the welfare of students.

(*b*) Vitamin B complex, Vitamin C.

27. (*a*) Sodium benzoate.

(*b*) Bithional acts as an antiseptic agent and reduces the odour produced by bacterial decomposition of organic matter on the skin.

(*c*) Tranquilizers.

28. (*a*) (*i*) Rate $= -\dfrac{d[R]}{dt} = k[A]^2[B]$

(*ii*) When concentration of A is tripled

$$\text{Rate} = k\,[3A]^2[B] = 9k\,[A]^2[B]$$

i.e., Rate of reaction will become 9 times.

(*ii*) When concentration of both A and B is doubled

$$\text{Rate} = k\,[2A]^2[2B] = 8k\,[A]^2[B]$$

i.e., Rate of reaction will become 8 times.

(*b*) For a first order reaction

$$k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

when t = 40 minutes, $\dfrac{[R]_0}{[R]} = \dfrac{100}{100-30} = \dfrac{10}{7}$

$$k = \frac{2.303}{40}\log\frac{10}{7} = \frac{2.303}{40}\log 1.428$$

$$k = \frac{2.303}{40}\times 0.1548$$

$$k = 8.91 \times 10^{-3} \ \text{min}^{-1}$$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{8.91 \times 10^{-3}}$$

$$t_{1/2} = \mathbf{77.78\ min.}$$

OR

(*a*) As $t = \frac{2.303}{k} \log \frac{[R]_0}{[R]}$

$$\therefore \quad \frac{t_{99\%}}{t_{90\%}} = \frac{\frac{2.303}{k} \log \frac{100}{1}}{\frac{2.303}{k} \log \frac{100}{10}} = \frac{\log 100}{\log 10} = 2$$

Hence $t_{99\%} = 2t_{90\%}$

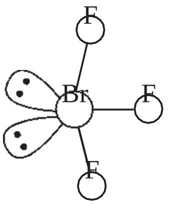
(*b*) $\text{Slope} = -\frac{E_a}{2.303 \times R} = -4250\,\text{K}$

$$E_a = -4250 \times 2.303 \times 8.314$$
$$= 81375 \text{ J mol}^{-1}$$
$$= 81.375 \text{ kJ mol}^{-1}$$

29. (*a*) (*i*) Bond dissociation enthalpy decreases as the bond distance increases from F_2 to I_2 because of the corresponding increase in the size of the atom as we move from F to I. The F—F bond dissociation enthalpy is, however, smaller than that of Cl—Cl and even smaller than that of Br—Br. This is because F atom is very small and hence the three lone pairs of electrons on each F atom repel the bond pair holding the F-atoms in F_2 molecule. Hence, the bond dissociation enthalpy increases in the order: $I_2 < F_2 < Br_2 < Cl_2$.

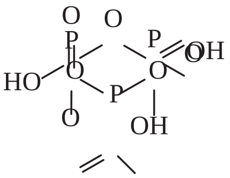
(*ii*) Unlike NH_3, PH_3 molecules are not associated through hydrogen bonding in liquid state. That is why the boiling point of PH_3 is lower than NH_3.

(*b*) (*i*) BrF_3

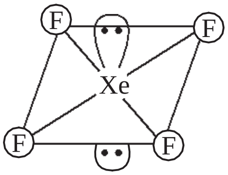


Slightly bent "T"

(*ii*) $(HPO_3)_3$



(*iii*) XeF_4



Square planar

OR

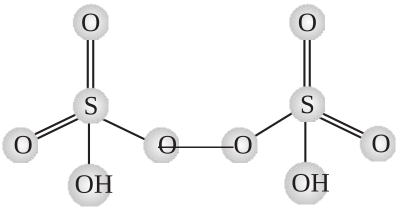
(*a*) (*i*) Helium is used as a diluent for oxygen in modern diving apparatus because of its very low solubility in blood.

(*ii*) This is because fluorine is the most electronegative element.

(*iii*) Because O—O single bond is weaker than S—S single bond.

(*b*) (*i*) Refer to Q. 12(*ii*) of CBSE (All India) Paper 2013.

(*ii*) $H_2S_2O_8$

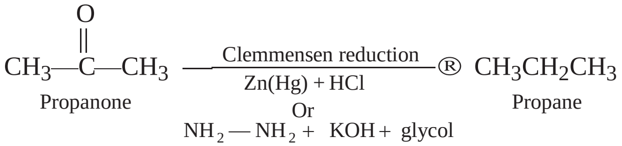


Peroxodisulphuric acid
($H_2S_2O_8$)

30. (*a*) (*i*) Resonating structures of carboxylate ion are more stable than phenoxide ion.

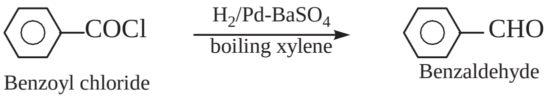
(*ii*) Negative charge is dispersing on two electronegative oxygens in carboxylate ion whereas it is on one oxygen atom in phenoxide ion.

(*b*) (*i*) Propanone to Propane

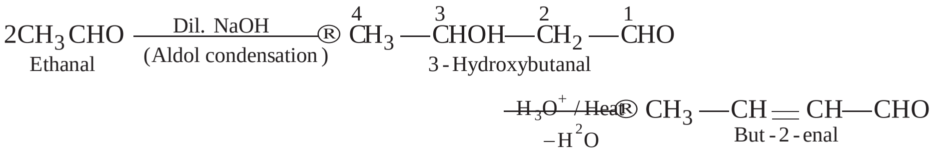


$$\underset{\text{Propanone}}{CH_3—\overset{\overset{\displaystyle O}{\|}}{C}—CH_3} \xrightarrow[\substack{Zn(Hg) + HCl \\ \text{Or} \\ NH_2—NH_2 + \ KOH + \ \text{glycol}}]{\text{Clemmensen reduction}} \underset{\text{Propane}}{CH_3CH_2CH_3}$$

(*ii*) Benzoyl chloride to benzaldehyde



(*iii*) Ethanal to but-2-enal

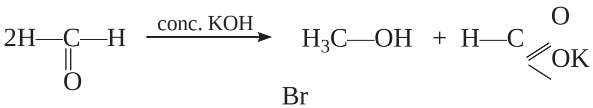


$$\underset{\text{Ethanal}}{2CH_3CHO} \xrightarrow[\text{(Aldol condensation)}]{\text{Dil. NaOH}} \underset{\text{3-Hydroxybutanal}}{\overset{4}{C}H_3—\overset{3}{C}HOH—\overset{2}{C}H_2—\overset{1}{C}HO}$$

$$\xrightarrow[-H^2O]{H_3O^+ / Heat} \underset{\text{But-2-enal}}{CH_3—CH=CH—CHO}$$

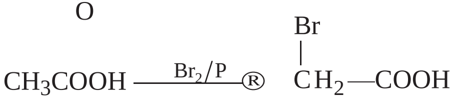
OR

(*a*) (*i*)

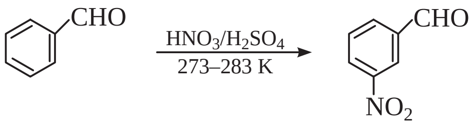


$$2H—\underset{\underset{\displaystyle O}{\|}}{C}—H \xrightarrow{\text{conc. KOH}} H_3C—OH + H—C\overset{\displaystyle O}{\lessgtr}_{OK}$$

(*ii*)



$$CH_3COOH \xrightarrow{Br_2/P} \overset{\overset{\displaystyle Br}{|}}{C}H_2—COOH$$

(*iii*) 

(*b*) (*i*) **Ethanal (CH_3CHO) and propanal (CH_3CH_2CHO):** Ethanal responds to iodoform test and gives a yellow precipitate on addition of NaOH and I_2, while propanal does not.

(*ii*) **Phenol and benzoic acid:** Benzoic acid reacts with $NaHCO_3$ giving CO_2 gas with effervescence, whereas phenol does not Phenol decolourises Br_2 water giving white precipitate, whereas benzoic acid does not.

SET–II

(Questions Uncommon to Set–I)

1. Frenkel defect.

2. 4-Bromo-4-methylpent-2-ene.

4. The α-helix structure of proteins is stabilised by intramolecular H-bonding between C═O of one amino acid residue and the N—H of the fourth amino acid residue in the chain.

6. Neil Bartlett observed that PtF_6 reacts with O_2 to yield an ionic solid, $O_2^+[PtF_6]^-$

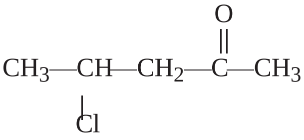
$$O_2(g) + PtF_6(g) \longrightarrow O_2^+[PtF_6]^-$$

Here, O_2 gets oxidised to O_2^+ by PtF_6.

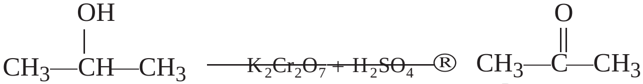
Since the first ionisation enthalpy of Xe (1170 kJ mol^{-1}) is fairly close to that of O_2 molecule (1175 kJ mol^{-1}), Bartlett thought that PtF_6 should also oxidise Xe to Xe^+. This inspired Bartlett to carry out the reaction between Xe and PtF_6. When Xe and PtF_6 were mixed, a rapid reaction occurred and a red solid with the formula, $Xe^+[PtF_6]^-$ was obtained.

$$Xe + PtF_6 \xrightarrow{278\ K} Xe^+[PtF_6]^-$$

7. $$\underset{\text{Ethyl chloride}}{CH_3CH_2Cl} + KOH(aq) \xrightarrow[\Delta]{\text{Hydrolysis}} \underset{\text{Ethyl alcohol}}{CH_3CH_2—OH} + KCl + H_2O$$

8. 

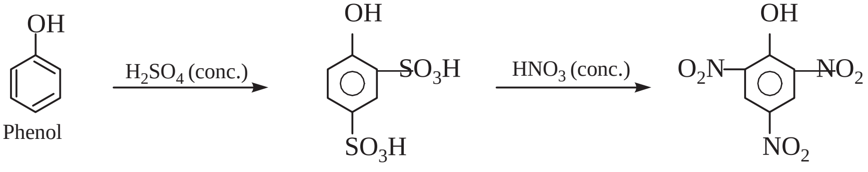
$$CH_3—\underset{\underset{Cl}{|}}{CH}—CH_2—\overset{\overset{O}{\|}}{C}—CH_3$$

9. (*i*) 

$$\underset{\text{Propan-2-ol}}{CH_3—\overset{\overset{OH}{|}}{CH}—CH_3} \xrightarrow{K_2Cr_2O_7 + H_2SO_4} \underset{\text{Propanone}}{CH_3—\overset{\overset{O}{\|}}{C}—CH_3}$$

Propan-2-ol

Propanone

(*ii*) 

Phenol

Phenol-2,4 disulphonic acid

2,4,6-trinitrophenol (Picric acid)

11. **(*i*) Oil in water (o/w) type emulsions:** In such emulsions oil is the dispersed phase and water is the dispersion medium, *e.g.*, milk, vanishing cream.

(*ii*) Water in oil (w/o) type emulsion: In such emulsions, water is the dispersed phase and oil is the dispersion medium, *e.g.*, butter, cod liver oil.

17. (*a*) ZnS. This is because the sulphide ore particles are preferentially wetted by oil and gangue particles are preferentially wetted by water.

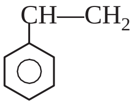
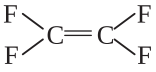
(*b*) Silica acts as a flux to remove iron oxide (FeO) as slag in the metallurgy of copper.

$$FeO + \underset{\text{Flux}}{SiO_2} \longrightarrow \underset{\text{Slag}}{FeSiO_3}$$

18. (*a*) It is due to symmetry of *p*-dichlorobenzene which fits in crystal lattice better than the *o*- and *m*-isomers.

(*b*) (±)-Butan-2-ol exist in two eventiomeric forms which rotate the plane of polarised light in opposite directions in equal amounts. Therefore, cancelling each other and becoming optically inactive.

23.

Polymer	Monomers and their structures
(*i*) Polystyrene	 Styrene (Vinyl benzene)
(*ii*) Dacron	$OHCH_2—CH_2OH$ Ethyl glycol  Terephthalic acid
(*ii*) Teflon	 Tetrafluoroethene

27. (*i*) $[Co(NH_3)_5Cl]SO_4$ — Ionisation isomerism
(*ii*) $[Co(en)_3]^{3+}$ — Optical isomerism
(*ii*) $[Co(NH_3)_6]\ [Cr(CN)_6]$ — Coordination isomerism

SET–III

(Questions Uncommon to Set-I and II)

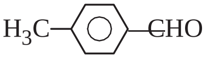
1. Ferromagnetic.

3. Cu_2S and FeS.

5. The linkage between two monosaccharide units through oxygen atom is called glycosidic linkage.

6. 2-Chloro-3-methylbutane.

7. 

8. 

9. **Multimolecular colloids:** In this type of colloids, colloidal particles are aggregates of large atoms or molecules each having size in the colloidal range, *e.g.*, sulphur sol, gold sol. Multimolecular colloids are generally lyophobic in nature.

Macromolecular colloids: These are the solution containing macromolecules in the colloidal range, *e.g.*, starch, proteins, polyethene, etc. Macromolecular colloids are generally lyophilic in nature.

14. (*a*) Zone refining is used for production of semiconductors and other metals of very high purity like germanium, silicon, boron, gallium and indium.

(*b*) Cryolite lowers the melting point of the mixture./Acts as an electrolyte./Acts as solvent for alumina. (*Any one*)

17. (*i*) Refer to Q.23(*iii*) of CBSE Examination Paper (All India) 2013.

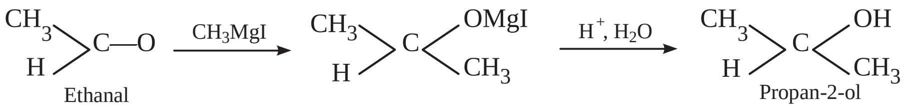
(*ii*) Because chloroform is slowly oxidised by air in the presence of light to an extremely poisonous gas phosgene.

$$\underset{\text{Chloroform}}{2CHCl_3} + O_2 \xrightarrow{\text{Light}} \underset{\text{Phosgene}}{2COCl_2} + 2HCl$$

18. (***i***) **Propene to Propan-1-ol**

$$\underset{\text{Propene}}{CH_3CH{=}CH_2} + HBr \xrightarrow{\text{Peroxide}} CH_3CH_2CH_2Br \xrightarrow[\Delta]{\text{KOH }(aq)} \underset{\text{Propan-1-ol}}{CH_3CH_2CH_2OH}$$

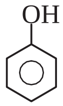
(***ii***) **Ethanal to Propan-2-o1**



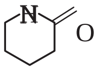
23. (*i*) A = CH_3CH_2CN, B = $CH_3CH_2CH_2NH_2$, C = $CH_3CH_2CH_2OH$

(*ii*) A = CH_3CONH_2, B = CH_3NH_2, C = CH_3NC

27.

(*i*) Bakelite:  , HCHO

Phenol Formaldehyde

(*ii*) Nylon-6: 

Caprolactum

(*iii*) Polythene: $CH_2{=}CH_2$

Ethene

* * *

CBSE Examination Papers
All India–2013

SET–I

Time allowed : 3 hours **Maximum marks: 70**

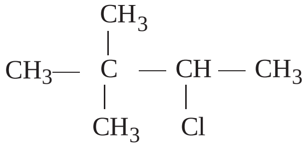
General Instructions: *Same as CBSE Examination Paper, Delhi–2013.*

1. Of physisorption or chemisorption, which has a higher enthalpy of adsorption?

2. Name the method used for refining of copper metal.

3. Name two poisonous gases which can be prepared from chlorine gas.

4. Write the IUPAC name of the following compound:

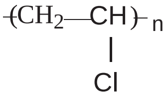


$$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3$$

5. Rearrange the following compounds in the increasing order of their boiling points:
$CH_3—CHO$, $CH_3—CH_2—OH$, $CH_3—CH_2—CH_3$

6. Write the structure of n-methylethanamine.

7. What are the products of hydrolysis of sucrose?

8. Is  $\left(CH_2—\underset{\displaystyle Cl}{\underset{|}{CH}}\right)_n$ a homopolymer or a copolymer?

9. Account for the following:

(*i*) Schottky defects lower the density of related solids.

(*ii*) Conductivity of silicon increases on doping it with phosphorus.

10. Aluminium crystallises in an fcc structure. Atomic radius of the metal is 125 pm. What is the length of the side of the unit cell of the metal?

11. The standard electrode potential ($E°$) for Daniell cell is + 1.1 V. Calculate the $\Delta G°$ for the reaction

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$$

(1 F = 96500 C mol^{-1}).

12. (*a*) For a reaction $A + B \rightarrow P$, the rate law is given by,

$$r = k[A]^{1/2}[B]^2.$$

What is the order of this reaction?

(*b*) A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14}\ \text{s}^{-1}$. Find the half life of the reaction.

13. (*a*) Name the method used for removing gangue from sulphide ores.

(*b*) How is wrought iron different from steel?

14. Draw the structures of the following molecules:

(*i*) $XeOF_4$ (*ii*) H_3PO_3

15. How are interhalogen compounds formed? What general compositions can be assigned to them?

16. Explain the mechanism of the following reaction:

$$CH_3—CH_2—OH \xrightarrow[443\ K]{H^+} CH_2{=}CH_2 + H_2O.$$

17. Write the equations involved in the following reactions:

(*i*) Reimer-Tiemann reaction

(*ii*) Williamson's ether synthesis

18. Define thermoplastic and thermosetting polymers. Give one example of each.

OR

What is a biodegradable polymer? Give an example of a biodegradable aliphatic polyester.

19. The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature.
$[R = 8.314\ \text{JK}^{-1}\ \text{mol}^{-1}, \log 4 = 0.6021]$

20. What are the characteristics of the following colloids? Give one example of each:

(*i*) Multimolecular colloids

(*ii*) Lyophobic sols

(*iii*) Emulsions

21. Give reasons for the following:

(*i*) Where R is an alkyl group, $R_3P{=}O$ exists but $R_3N{=}O$ does not.

(*ii*) $PbCl_4$ is more covalent than $PbCl_2$

(*iii*) At room temperature, N_2 is much less reactive.

22. For the complex $[NiCl_4]^{2-}$, write

(*i*) the IUPAC name.

(*ii*) the hybridisation type.

(*iii*) the shape of the complex.

(Atomic no. of Ni = 28)

OR

What is meant by crystal field splitting energy? On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t_{2g} and e_g in an octahedral field when

(*i*) $\Delta_0 > P$ (*ii*) $\Delta_0 < P$

23. Give reasons for the following:

(*i*) Ethyl iodide undergoes S_N2 reaction faster than ethyl bromide.

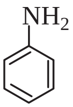
(*ii*) (±) 2–Butanol is optically inactive.

(*iii*) C–X bond length in halobenzene is smaller than C–X bond length in CH_3–X.

24. Complete the following reactions:

(*i*) $CH_3CH_2NH_2 + CHCl_3 +$ alc. KOH

——® (*ii*)$_2$ $C_6H_5N^+Cl^- \xrightarrow[\text{Room temperature}]{H_2O}$ ®

(*iii*)  + HCl(*aq*) $\longrightarrow$

25. (*i*) What class of drug is Ranitidine?

(*ii*) If water contains dissolved Ca^{2+} ions, out of soaps and synthetic detergents, which will you use for cleaning clothes?

(*iii*) Which of the following is an antiseptic?

0.2% phenol, 1% phenol.

26. Calculate the emf of the following cell at 25°C:

$$Ag(s)/Ag^+\ (10^{-3}\ M)\,||\,Cu^{2+}\ (10^{-1}\ M)\,|\,Cu\ (s)$$

Given $E^o_{cell} = +\ 0.46$ V and $\log 10^n = n$.

27. Shanti, a domestic helper of Mrs. Anuradha, fainted while mopping the floor. Mrs. Anuradha immediately took her to the nearby hospital where she was diagnosed to be severely 'anaemic'. The doctor prescribed an iron rich diet and multivitamins supplement to her. Mrs. Anuradha supported her financially to get the medicines. After a month, Shanti was diagnosed to be normal.

After reading the above passage, answer the following questions:

(*i*) What values are displayed by Mrs. Anuradha?

(*ii*) Name the vitamin whose deficiency causes 'pernicious anaemia'.

(*iii*) Give an example of a water soluble vitamin.

28. (*a*) State Raoult's law for a solution containing volatile components.

How does Raoult's law become a special case of Henry's law?

(*b*) 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. Find the molar mass of the solute. (K_f for benzene = 5.12 kg mol^{-1})

OR

(*a*) Define the following terms:

(*i*) Ideal solution

(*ii*) Azeotrope

(*iii*) Osmotic pressure

(*b*) A solution of glucose ($C_6H_{12}O_6$) in water is labelled as 10% by weight. What would be the molality of the solution?

(Molar mass of glucose = 180 g mol^{-1})

29. (*a*) Give reasons for the following:

- (*i*) Mn^{3+} is a good oxidising agent
- (*ii*) $E^{o}_{M^{2+}/M}$ values are not regular for first row transition metals (3d series).
- (*iii*) Although 'F' is more electronegative than 'O', the highest Mn fluoride is MnF_4, whereas the highest oxide is Mn_2O_7.

(*b*) Complete the following equations:

- (*i*) $2CrO_4^{2-} + 2H^+ \longrightarrow$
- (*ii*) $KMnO_4 \xrightarrow{\text{heat}}$

OR

(*a*) Why do transition elements show variable oxidation states?

- (*i*) Name the element showing maximum number of oxidation states among the first series of transition metals from Sc (Z = 21) to Zn (Z = 30).
- (*ii*) Name the element which shows only +3 oxidation state.

(*b*) What is lanthanoid contraction? Name an important alloy which contains some of the lanthanoid metals.

30. (*a*) How will you convert the following:

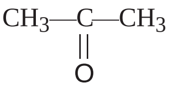
- (*i*) Propanone to Propan-2-ol
- (*ii*) Ethanal to 2-hydroxy propanoic acid
- (*iii*) Toluene to benzoic acid

(*b*) Give simple chemical test to distinguish between:

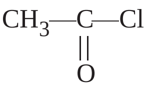
- (*i*) Pentan-2-one and Pentan-3-one
- (*ii*) Ethanal and Propanal

OR

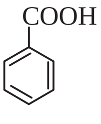
(*a*) Write the products of the following reactions:

(*i*) 

$CH_3{-}\underset{\displaystyle O}{\underset{\|}{C}}{-}CH_3 \xrightarrow[\text{conc. HCl}]{\text{Zn – Hg}} ?$

(*ii*) 

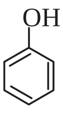
$CH_3{-}\underset{\displaystyle O}{\underset{\|}{C}}{-}Cl + H_2 \xrightarrow{\text{Pd – BaSO}_4} ?$

(*iii*) 

$\xrightarrow{Br_2/FeBr_3} ?$

(*b*) Which acid of each pair shown here would you expect to be stronger?

- (*i*) $F{-}CH_2{-}COOH$ or $Cl{-}CH_2{-}COOH$

(*ii*) 

or CH_3COOH

SET–II

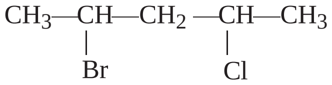
(Questions Uncommon to Set–I)

1. Write the structure of 2-aminotoluene.

2. Which aerosol depletes ozone layer?

4. Ethanol is soluble in water. Why?

5. Write the IUPAC name of the following compound:



$$CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3$$

7. Write the name of linkage joining two amino acids.

8. Give one example of a condensation polymer.

9. (*a*) Why does presence of excess of lithium makes LiCl crystals pink?

(*b*) A solid with cubic crystal is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound?

14. Draw the structures of the following molecules:

(*i*) XeF_6 (*ii*) $H_2S_2O_7$

18. Outline the principles of refining of metals by the following methods:

(*i*) Zone refining (*ii*) Vapour phase refining

19. Define the following terms giving an example of each:

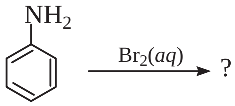
(*i*) Associated colloids (*ii*) Lyophilic sol

(*iii*) Adsorption

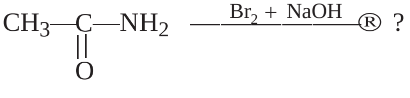
22. Write the main products of the following reactions:

(*i*) $C_6H_5N_2^+ Cl^- \xrightarrow{H_3PO_2\ +\ H_2O} ?$

(*ii*)



(*iii*)



$$CH_3-\underset{\displaystyle O}{\underset{\|}{C}}-NH_2 \xrightarrow{Br_2\ +\ NaOH} ?$$

27. Give reasons for the following:

(*i*) Oxygen is a gas but sulphur is a solid.

(*ii*) O_3 acts as a powerful oxidising agent.

(*iii*) BiH_3 is the strongest reducing agent amongst all the hydrides of Group 15 elements.

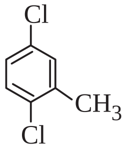
SET–III

(Questions Uncommon to Set–I and II)

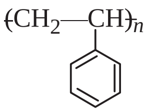
1. What is especially observed when a beam of light is passed through a colloidal solution?

2. What is the basicity of H_3PO_3 and why?

3. Write the IUPAC name of the following compound:



5. What are the products of hydrolysis of lactose?

6. Is  $\left(CH_2-CH\right)_n$ a homopolymer or a copolymer?

8. Write the structure of prop-2-en-1-amine.

12. Draw the structures of the following molecules:

(*i*) N_2O_5 (*ii*) XeF_2

13. (*a*) What change occurs when AgCl is doped with $CdCl_2$?

(*b*) What type of semiconductor is produced when silicon is doped with boron?

18. Name the principal ore of aluminium. Explain the significance of leaching in the extraction of aluminium.

19. Define the following terms with an example in each case:

(*i*) Macromolecular sol (*ii*) Peptisation

(*iii*) Emulsion

21. Give reasons for the following:

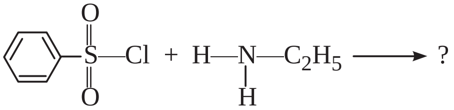
(*i*) Though nitrogen exhibits +5 oxidation state, it does not form pentahalide.

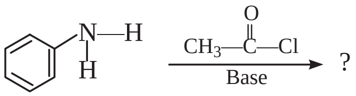
(*ii*) Electron gain enthalpy with negative sign of fluorine is less than that of chlorine.

(*iii*) The two oxygen-oxygen bond lengths in ozone molecule are identical.

27. Write the main products of the following reactions:

(*i*) $CH_3CH_2NH_2 \xrightarrow[0°C]{HNO_2}$ ® ?

(*ii*) 

(*iii*) 

z z z

Solutions

SET–I

1. Chemisorption.

2. Electrolytic refining.

3. The poisonous gases which can be prepared from chlorine gas are phosgene gas ($COCl_2$)/mustard gas ($ClCH_2CH_2SCH_2CH_2Cl$)/chloropicrin or tear gas (CCl_3NO_2)/sulphur monochloride (S_2Cl_2) .

4. 2-Chloro-3,3-dimethylbutane or 3-Chloro-2,2-dimethylbutane.

5. $CH_3CH_2CH_3 < CH_3CHO < CH_3CH_2OH$.

6. CH_3—NH—CH_2CH_3.

7. Sucrose on hydrolysis gives one molecule each of glucose and fructose.

8. Homopolymer.

9. (*i*) In Schottky defect as the number of ions are missing from their normal lattice sites, the mass decreases whereas the volume remains the same. Due to this the density decreases.

(*ii*) This is due to availability of additional unpaired electrons on doping with phosphorous.

10. For an *fcc* unit cell, $r = \dfrac{a}{2\sqrt{2}}$

$$a = 2\sqrt{2}r = 2 \times 1.414 \times 125 = \mathbf{353.5\ pm}.$$

11.

$$\Delta_r G^o = -nFE^o_{(cell)}$$

In the given equation, $n = 2$, $F = 96500\ \text{C mol}^{-1}$ and $E^o_{cell} = 1.1$ V

Therefore, $\Delta_r G^o = -2 \times 1.1\ \text{V} \times 96500\ \text{C mol}^{-1}$

$$= -212300\ \text{J mol}^{-1} = \mathbf{-212.3\ kJ\ mol^{-1}}$$

12. (*a*) Order of reaction $= \dfrac{1}{2} + 2 = \dfrac{5}{2}$

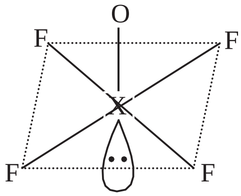
(*b*) Radioactive decay follows first order kinetics.

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{5.5 \times 10^{-14}}\ \text{s} = 1.26 \times 10^{13}\ \text{s}.$$

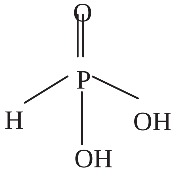
13. (*a*) Froth floatation.

(*b*) Wrought iron is the purest form of iron whereas steel is an alloy of iron.

14. (*i*) $XeOF_4$



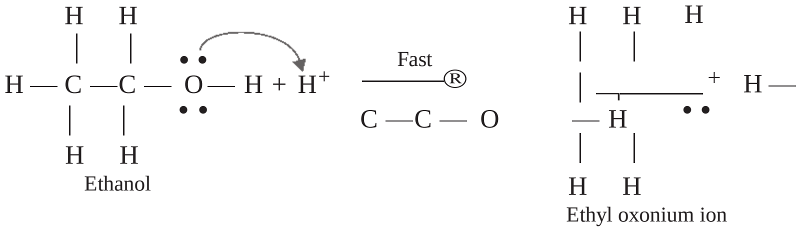
(*ii*) H_3PO_3



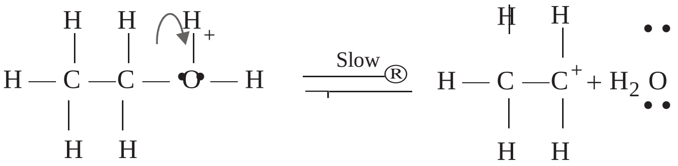
15. Interhalogen compounds are prepared by direct combustion or by the action of halogen on lower interhalogen compounds. They can be assigned general composition as XX', XX'_3, XX'_5 and XX'_7 where X is halogen of larger size and X′ of smaller size and X is more electropositive than X′.

16. The mechanism of dehydration of ethanol involves the following steps:

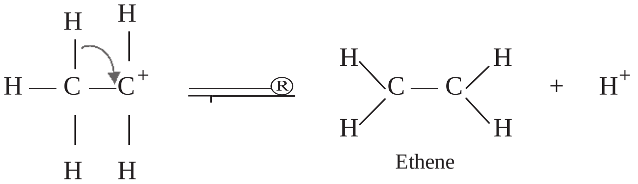
Step 1: Formation of protonated alcohol:



Step 2: Formation of carbocation: It is the slowest step and hence, the rate determining step of the reaction.

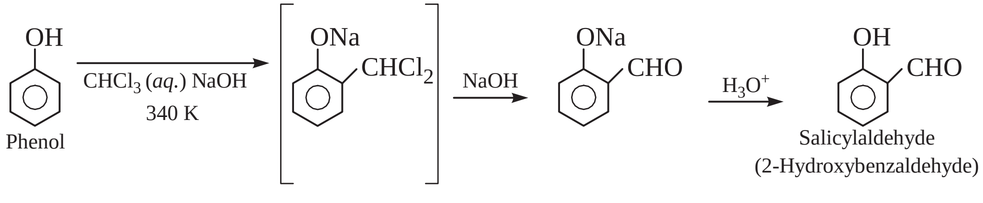


Step 3: Formation of ethane by elimination of a proton



The acid used in step 1 is released in step 3. To drive the equilibrium to the right, ethene is removed as it is formed.

17. **(*i*) Reimer-Tiemann reaction:**



(*ii*) Williamson synthesis:

$$\underset{\text{Alkyl halide}}{R—X} + \underset{\text{Sodium alkoxide}}{\overset{+}{Na}—O—R'} \longrightarrow \underset{\text{Ether}}{R—O—R'} + NaX$$

18. **Thermoplastic polymers:** These polymers are capable of repeatedly softening on heating and hardening on cooling. Example, polythene, polystyrene, etc.

Thermosetting polymers: These polymers on heating undergo extensive cross linking in moulds and again become infusible. These cannot be reused. Example, bakelite, urea-formaldehyde resins, etc.

OR

Polymers which disintegrate by themselves over a period of time due to environmental degradation by microorganisms are called biodegradable polymers. Example, PHBV (Poly-β-hydroxybutyrate-co-β-hydroxyvalerate).

19. If rate at 293 K is R, rate at 313 K will be $4R$.

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 \times T_2}\right]$$

$$\log \frac{4R}{R} = \frac{E_a}{2.303 \times 8.314}\left[\frac{313 - 293}{293 \times 313}\right]$$

$$\log 4 = \frac{E_a}{19.1471}\left[\frac{20}{91709}\right]$$

$$E_a = \frac{0.6021 \times 19.1471 \times 91709}{20}$$

$$= 52863.2177 \text{ J mol}^{-1} \text{ or } 52.863 \text{ kJ mol}^{-1}$$

20. (*i*) Multimolecular colloids are aggregates of atoms or molecules each having size less than 1 nm held together by van der Waals forces. Example, sulphur sol, gold sol.

(*ii*) Lyophobic sols are those sols in which the particles of the disperse phase have little affinity for the particles of the dispersion medium. Example, sols of metal and their sulphides and hydroxides, As_2S_3 sol, $Fe(OH)_3$ sol.

(*iii*) Emulsion is a colloidal solution in which both the dispersed phase and dispersion medium are liquids. Example, milk, cod liver oil, etc.

21. (*i*) N due to the absence of *d*-orbitals, cannot form $p\pi - d\pi$ multiple bonds. Thus, N cannot expand its covalency beyond four but in $R_3N{=}O$, N has a covalency of 5. So, the compound $R_3N{=}O$ does not exist. On the other hand, P due to the presence of *d*-orbitals forms $p\pi - d\pi$ multiple bonds and hence can expand its covalency beyond 4. Therefore, P forms $R_3P{=}O$ in which the covalency of P is 5.

(*ii*) Because Pb is in +4 oxidation state in $PbCl_4$ and has high charge/size ratio than Pb^{2+}, thus polarising power of Pb^{4+} is greater than Pb^{2+}, and hence it is more covalent.

(*iii*) N_2 is less reactive at room temperature because of strong $p\pi - p\pi$ overlap resulting into the triple bond ($N{\equiv}N$), consequently high bond dissociation enthalpy.

22. (*i*) Tetrachloridonickelate(II) ion.

(*ii*) sp^3 hybridisation.

(*iii*) Tetrahedral.

OR

The difference of energy between two sets of degenerate orbitals as a result of crystal field splitting is known as crystal field splitting energy.

(*i*) $t_{2g}^4 \; e_g^0$

(*ii*) $t_{2g}^{3}\ e_g^{1}$

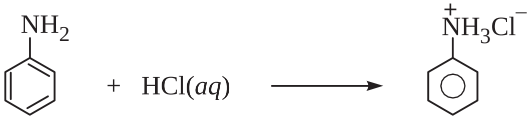
23. (*i*) Since I^- ion is a better leaving group than Br^- ion, hence, CH_3I reacts faster than CH_3Br in S_N2 reaction with OH^- ion.

(*ii*) (±) 2-Butanol is a racemic mixture, *i.e.*, there are two enantiomers in equal proportions. The rotation by one enantiomer will be cancelled by the rotation due to the other isomer, making the mixture optically inactive.

(*iii*) In CH_3–X the carbon atom is sp^2 hybridised while in halobenzene the carbon atom is sp^3 hybridised. The sp^2 hybridised carbon is more electronegative due to greater *s*-character and holds the electron pair of C–X bond more tightly than sp^3 hybridised carbon with less *s*-character. Thus, C–X bond length in CH_3–X is bigger than C–X in halobenzene.

24. (*i*) $CH_3CH_2NH_2 + CHCl_3 + 3KOH(alc.) \longrightarrow CH_3CH_2NC + 3KCl + 3H_2O$

(*ii*) $C_6H_5\overset{+}{N}_2Cl^- \xrightarrow[\text{Room temperature}]{H_2O} C_6H_5OH + N_2 + HCl$

(*iii*) 

25. (*i*) Antacid/antihistamine.

(*ii*) Synthetic detergents

(*iii*) 0.2% phenol.

26. The given cell notation in the question is incorrect.

The correct cell formula is given below:

$$Cu^{2+}(10^{-1}\ M)\ |\ Cu(s)\ ||\ Ag^+\ (10^{-3}\ M)\ |\ Ag(s)$$

According to Nernst equation

$$E_{cell} = E^o_{cell} - \frac{0.0591}{2}\log\frac{[Cu^{2+}]}{[Ag^+]^2}$$

Given: $E^o_{cell} = 0.46$ V

$$E_{cell} = 0.46 - \frac{0.0591}{2}\log\frac{[0.1]}{[10^{-3}]^2}$$

$$= 0.46 - 0.02955\log\frac{[0.1]}{[10^{-6}]}$$

$$= 0.46 - 0.02955\log 10^5$$

$$= 0.46 - 0.02955 \times 5$$

$$= 0.46 - 0.148 = \mathbf{0.314\ V}.$$

Or

$$E_{cell} = E^o_{cell} - \frac{0.059}{2}\log\frac{[Ag^+]^2}{[Cu^{2+}]}$$

$$= 0.46 - \frac{0.0591}{2}\log\frac{[10^{-3}]^2}{[0.1]}$$

$$= 0.46 - 0.02955 \log \frac{[10^{-6}]}{[0.1]}$$

$$= 0.46 + 0.0295 \times 5$$

$$= \mathbf{0.6075\ V}.$$

27. (*i*) Helpfulness, caring, generosity, kindness attitude towards poor.

(*ii*) Vitamin B_{12}.

(*iii*) Vitamin C.

28. (*a*) For a solution of volatile liquids, Raoult's law states that the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution, *i.e.*,

$$p_A \propto x_A, \quad \text{or} \qquad p_A = p_A^o\, x_A$$

According to Henry's law, the partial pressure of a gas in vapour phase (p) is directly proportional to mole fraction (x) of the gas in the solution.

$$p = K_H x$$

On comparing it with Raoult's law it can be seen that partial pressure of the volalite component or gas is directly proportional to its mole fraction in solution.

$$p \propto x$$

only the proportionality constant K_H differs from p_A^o. Thus, it becomes a special case of Henry's law in which $K_H = p_A^o$.

(*b*) Substituting the values of various terms involved in equation $M_B = \dfrac{K_f \times W_B \times 1000}{\Delta T_f \times W_A}$, we get

$$M_B = \frac{5.12\ \text{K kg mol}^{-1} \times 1.00\ \text{g} \times 1000\ \text{g kg}^{-1}}{0.40\ \text{K} \times 50\ \text{g}} = \mathbf{256\ g\ mol^{-1}}$$

OR

(*a*) ***(i)*** **Ideal solution:** The solution which follows Raoult's law at all concentrations and temperatures.

(ii) **Azeotrope:** A liquid mixture which distills at constant temperature without undergoing any change in composition.

(iii) **Osmotic pressure:** The minimum excess pressure that has to be applied on the solution side when the solution and solvent are separated by a semipermeable membrane to stop osmosis.

(*b*) 10% w/w solution of glucose means 10 grams of glucose is present in 100 g of solution, *i.e.*, 90 g of water.

$$m = \frac{1000 \times \text{wt\%}}{(100 - \text{wt\%}) \times \text{Molecular weight of solute}} = \frac{1000 \times 10}{(100 - 10) \times 180} = \mathbf{0.617\ m}$$

29. (*a*) (*i*) Mn^{3+} ($3d^4$) is a good electron acceptor as the resulting species is more stable ($3d^5$).

(*ii*) The $E°$ (M^{2+} / M) values are not regular which can be explained from the irregular variation of ionisation enthalpies ($\Delta_i H_1 + \Delta_i H_2$) and also the sublimation enthalpies which are relatively much less for manganese and vanadium.

(*iii*) Due to multiple bond formation ability of oxygen with Mn in Mn_2O_7.

(*b*) (*i*) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

(*ii*) $2KMnO_4 \xrightarrow{\text{Heat}} K_2MnO_4 + MnO_2 + O_2$

OR

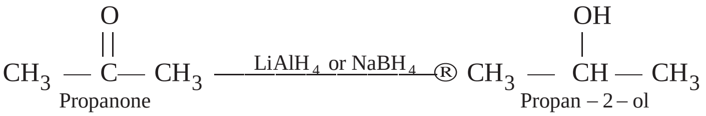
(*a*) Transition elements show variable oxidation states because electrons in *ns* and $(n-1)$ *d*-orbitals are available for bond formation as they have nearly same energy.

(*i*) Manganese (*ii*) Scandium.

(*b*) The steady decrease in the atomic and ionic radii (having the same charge) with increase in atomic number as we move across the series from lanthanum to lutetium is known as lanthanoid contraction.

Misch metal.

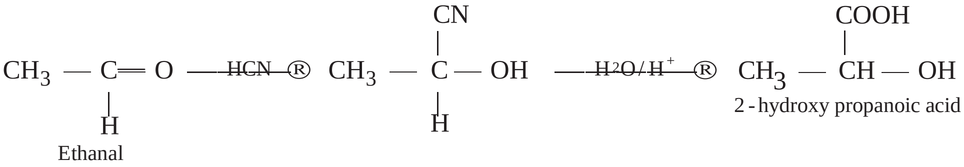
30. (*a*) (*i*)



$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{LiAlH_4 \text{ or } NaBH_4} CH_3-\overset{\overset{OH}{|}}{CH}-CH_3$$

Propanone Propan – 2 – ol

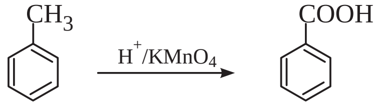
(*ii*)



$$CH_3-\underset{\underset{H}{|}}{C}=O \xrightarrow{HCN} CH_3-\overset{\overset{CN}{|}}{\underset{\underset{H}{|}}{C}}-OH \xrightarrow{H_2O/H^+} CH_3-\overset{\overset{COOH}{|}}{CH}-OH$$

Ethanal 2 - hydroxy propanoic acid

(*iii*)



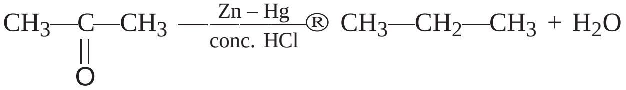
Toluene Benzoic acid

(*b*) **(*i*) Pentan-2-one and pentan-3-one:** Pentan-2-one responds to iodoform test and gives yellow coloured precipitate with I_2 and NaOH, while pentan-3-one does not.

(*ii*) Ethanal and propanal: Ethanal responds to iodoform test and gives yellow coloured precipitate with I_2 and NaOH, while propanal does not.

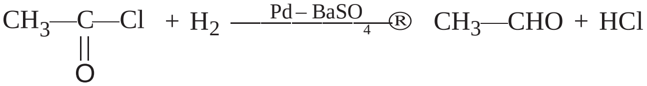
OR

(*a*) (*i*)



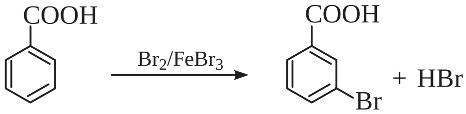
$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{conc. HCl}]{Zn-Hg} CH_3-CH_2-CH_3 + H_2O$$

(*ii*)

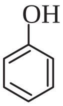


$$CH_3-\underset{\underset{O}{\|}}{C}-Cl + H_2 \xrightarrow{Pd-BaSO_4} CH_3-CHO + HCl$$

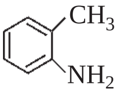
(*iii*)



(*b*) (*i*) $F-CH_2-COOH > Cl-CH_2-COOH$, because of higher –ve I effect of F.

(*ii*) $CH_3COOH >$  , because CH_3COO^- is a more stable conjugate base.

SET–II

1. 

2. CCl_2F_2/Freon.

4. Alcohols can form H-bonds with water and break the H-bonds already existing between water molecules. Hence, they are soluble in water.

5. 2-Bromo-4-chloropentane.

7. Peptide linkage.

8. Nylon-6,6/Dacron/Glyptal.

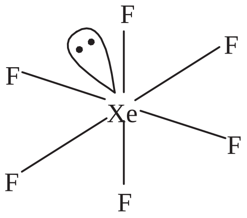
9. (*a*) Excess of lithium leads to metal excess defect. Lithium atoms lose electrons to form Li^+ ions. These electrons diffuse into the crystal and form F-centres. Therefore, LiCl crystals become pink.

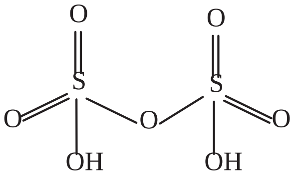
(*b*) Number of P atoms per unit cell = 1 (at the body centre) $\times 1 = 1$

Number of Q atoms per unit cell = 8 (at the corners) $\times \frac{1}{8} = 1$

Hence, the formula of the compound = PQ.

14. (*i*) XeF_6 (*ii*) $H_2S_2O_7$





18. **(*i*) Zone refining:** Zone refining is based on the principle that the impurities are more soluble in the melt than in the solid state of metal.

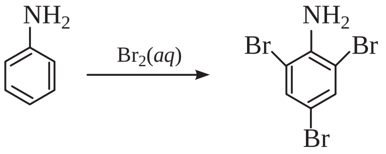
(*ii*) Vapour phase refining: In this, metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal.

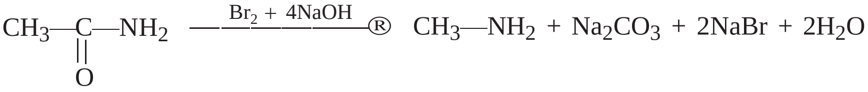
19. **(*i*) Associated colloids:** There are certain substances which at low concentrations behave as normal strong electrolytes, but at higher concentrations exhibit colloidal behaviour due to the formation of aggregates. Such colloids are known as associated colloids or micelles, *e.g.*, soaps and detergents.

(*ii*) Lyophilic sol: Lyophilic sols are those sols in which the particles of dispersed phase have great affinity for the dispersion medium, *e.g.*, sols of gum, gelatin, starch, etc.

(*iii*) Adsorption: The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is termed adsorption, *e.g.*, water vapours on silica gel, poisonous gases on charcoal.

22. (*i*) $C_6H_5N_2^+Cl^- \xrightarrow{H_3PO_2 + H_2O} C_6H_6 + N_2 + H_3PO_3 + HCl$

(*ii*) 

(*iii*) 
$CH_3—\underset{\underset{O}{\|}}{C}—NH_2 \xrightarrow{Br_2\ +\ 4NaOH} CH_3—NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

27. (*i*) Oxygen forms $p\pi - p\pi$ multiple bonds. Due to small size and high electronegativity oxygen exists as diatomic (O_2) molecules. Whereas, sulphur because of its bigger size and lower electronegativity, has a much greater tendency for catenation than oxygen and lower tendency for $p\pi - p\pi$ multiple bonds.

(*ii*) Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidising agent.

(*iii*) This is because Bi—H bond is the weakest among the hydrides of group 15.

SET–III

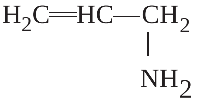
1. Tyndall effect/Illumination of the path of light.

2. As two P—OH bonds are present in the molecule, therefore, its basicity is two.

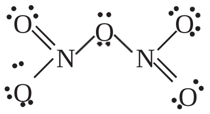
3. 2, 5-Dichlorotoluene/1,4-Dichloro-2-methylbenzene.

5. Glucose and galactose.

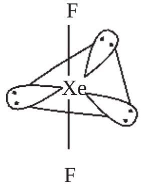
6. Homopolymer.

8. 
$H_2C{=}HC—\underset{\underset{NH_2}{|}}{CH_2}$

12. (*i*) N_2O_5



(*ii*) XeF_2



Linear

13. (*a*) A cationic vacancy is generated.

(*b*) *p*-type semiconductor.

18. Bauxite ($Al_2O_3.2H_2O$).

Leaching is significant as it helps in removing the impurities like SiO_2, Fe_2O_3, TiO_2 etc. from the bauxite ore and thus alumina is obtained.

19. **(*i*) Macromolecular sol:** Macromolecules in suitable solvents form solutions in which the size of the macromolecules may be in colloidal range, *e.g.*,starch, cellulose, nylon, etc.

(*ii*) Peptisation: The process of conversion of a freshly prepared precipitate into a colloidal solution by shaking it with dispersion medium in the presence of a suitable electrolyte is called peptisation. Example, freshly prepared precipitate of $Fe(OH)_3$ is peptised by $FeCl_3$.

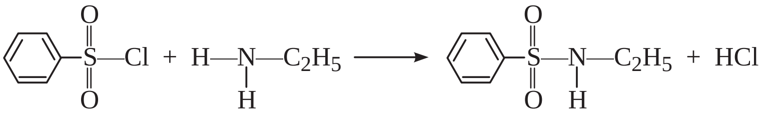
(*iii*) Emulsion: These are the colloidal systems in which both the dispersion medium and the dispersion phase are liquid, *e.g.*, milk is an emulsion of fat in water.

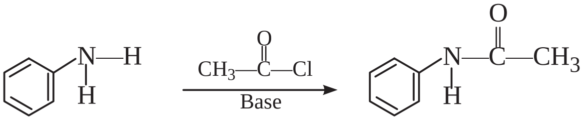
21. (*i*) Nitrogen does not have *d*-orbitals in its valence shell to expand its covalence beyond four. That is why it does not form pentahalide.

(*ii*) Lower value of bond dissociation enthalpy of F_2 is due to the strong repulsion between the non-bonding electrons of F atoms in the small sized F_2 molecule.

(*iii*) Because of resonance.

27. (*i*) $CH_3CH_2NH_2 \xrightarrow[0°C]{HNO_2} CH_3CH_2OH$

(*ii*) 

(*iii*) 

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CBSE Examination Papers Foreign–2013

SET–I

Time allowed: 3 hours **Maximum marks: 70**

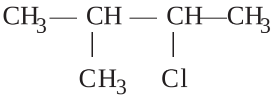
General Instructions: *Same as CBSE Examination Paper, Delhi–2013*.

1. Which group of solids is electrical conductors, as well as malleables and ductiles?

2. Measurement of which colligative property is preferred for determination of molar mass of biomolecules?

3. Name the method used for refining of germanium metal.

4. Write the IUPAC name of the following compound:



$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3$$

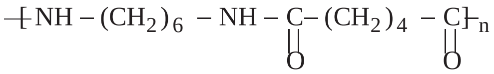
5. Arrange the following compounds in the increasing order of their acid strengths:

4-nitrophenol, phenol, 2,4,6-trinitrophenol

6. Write the structure of 3-hydroxybutanal.

7. Why is methylamine more basic than aniline?

8. Write the names of monomers of the polymer



$$\left[NH-(CH_2)_6-NH-\underset{\displaystyle O}{\underset{\|}{C}}-(CH_2)_4-\underset{\displaystyle O}{\underset{\|}{C}}\right]_n$$

9. Henry's law constant (κ_H) for the solution of methane in benzene at 298 K is 4.27×10^5 mm Hg. Calculate the solubility of methane in benzene at 298 K under 760 mm Hg.

10. (*i*) Why is an increase in temperature observed on mixing chloroform and acetone?

(*ii*) Why does sodium chloride solution freeze at a lower temperature than water?

11. The rate constant for a first order reaction is $60\ s^{-1}$. How much time will it take to reduce the initial concentration of the reactant to $\frac{1}{10}$ th of its initial value?

12. (*a*) What happens when a freshly precipitated $Fe(OH)_3$ is shaken with water containing a small quantity of $FeCl_3$?

(*b*) Why is a finely divided substance more effective as an adsorbent?

13. Write two differences between lyophobic and lyophilic sols. Give one example of each type of sol.

14. How can you separate alumina (Al_2O_3) from silica present in bauxite ore? Write the chemical equations for the reactions involved.

OR

(*a*) What are the constituents of ‘copper matte’?

(*b*) What is the role of depressant in froth floatation process?

15. Arrange the following in the order of property indicated for each set:

(*a*) HF, HCl, HBr, HI — increasing acid strength.

(*b*) NH_3, PH_3, AsH_3, SbH_3, BiH_3 — increasing reducing power.

16. Write the reactions involved when *D*-glucose is treated with the following reagents:

(*a*) HCN (*b*) Br_2-water

17. (*a*) What type of bonding helps in stabilising the α-helix structure of proteins?

(*b*) What is the structural difference between a nucleoside and a nucleotide?

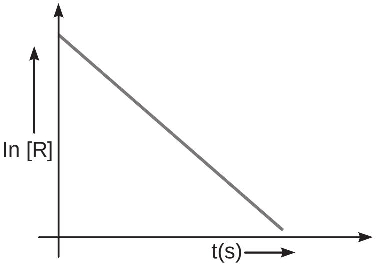
18. Arrange the following polymers in increasing order of their intermolecular forces:

(*a*) Nylon-6,6, Buna-S, Polythene

(*b*) PVC, Nylon-6, Neoprene

19. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length 4.05×10^{-8} cm. If its density is 2.7 g cm^{-3}, what is the nature of the cubic unit cell?

20. For a chemical reaction R ® P, the variation in the concentration *ln* [*R*] vs. time *t* plot is given as



For this reaction

(*i*) what is the order of the reaction?

(*ii*) what is the slope of the curve?

(*iii*) what is the unit of rate constant ‘*k*’?

21. Draw the structures of the following molecules:

(*i*) N_2O_5 (*ii*) H_3PO_2

(*iii*) XeF_6

22. Account for the following:

(*i*) White phosphorus is more reactive than red phosphorus.

(*ii*) $SnCl_4$ is more covalent than $SnCl_2$.

(*iii*) O_3 is a powerful oxidising agent.

OR

Complete the following equations:

(*i*) $PC1_3 + H_2O$ ——® (*ii*) $XeF_2 + PF_5$

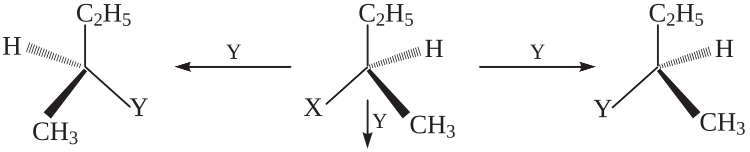
——® (*iii*) $NaN_3 \xrightarrow{heat}$ ®

23. (*a*) Write the IUPAC name of the complex $[CoBr_2(en)_2]^+$.

(*b*) What type of isomerism is shown by the complex $[Co(NH_3)_5SO_4]Br$?

(*c*) Why is CO a stronger ligand than NH_3 in complexes?

24. Consider the three types of replacement of group X by group Y as shown here.



(B) (A) + (B) (A)

This can result in giving compound (A) or (B) or both. What is the process called if

(*i*) (A) is the only compound obtained?

(*ii*) (B) is the only compound obtained?

(*iii*) (A) and (B) are formed in equal proportions?

25. (*a*) Explain the mechanism of the following reaction:

$$2CH_3CH_2OH \xrightarrow[413\ K]{H^+} CH_3CH_2—O—CH_2CH_3 + H_2O$$

(*b*) Name the reagent used in the oxidation of ethanol to ethanoic acid.

26. How will you convert the following:

(*i*) Aniline to chlorobenzene

(*ii*) Ethanoic acid to methanamine

(*iii*) Benzene diazonium chloride to phenol

27. Mr. Naresh works in a multi-national company. He is stressed due to his hectic schedule. Mr. Amit, his friend, comes to know that he has started taking sleeping pills without consulting the doctor. Mr. Amit requests Naresh to stop this practice and takes him to a Yoga centre. With regular Yoga sessions, Mr. Naresh is now a happy and relaxed man.

After reading the above passage, answer the following questions:

(*i*) Write the values shown by Mr. Amit.

(*ii*) Which class of drugs is used in sleeping pills?

(*iii*) Why is it not advisable to take sleeping pills without consultation with the doctor?

28. (*a*) State Kohlrausch's law of independent migration of ions. Mention one application of Kohlrausch's law.

(*b*) The resistance of a conductivity cell containing 10^{-3} M KCl solution at 25ºC is 1500 Ω. What is the cell constant if conductivity of 10^{-3} M KCl solution at 25°C is 1.5×10^{-4} S cm^{-1}?

OR

Calculate emf and ΔG^o for the following cell at 298 K:

$Mg(s) \mid Mg^{2+}(10^{-3}\ M) \mid\mid Cu^{2+}(10^{-4}\ M) \mid Cu(s)$

Given $E^o_{Mg^{2+}/Mg} = -2.36$ V and $E^o_{Cu^{2+}/Cu} = +0.34$ V

(1 F = 96500 C mol^{-1})

29. Assign reasons for the following:

(*i*) In the series Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomisation of Zn is the lowest.

(*ii*) Zr and Hf have almost identical radii.

(*iii*) Transition metals show variable oxidation states.

(*iv*) The $E^{\circ}_{M^{2+}/M}$ value for copper is positive (+ 0.34 V).

(*v*) Cr^{2+} is a very good reducing agent.

OR

Describe the preparation of $KMnO_4$ from pyrolusite ore (MnO_2). How does the acidified permanganate solution react with the following:

(*i*) Fe^{2+} ions

(*ii*) Oxalic acid ($C_2O_4H_2$)

Write the ionic equations for the reactions involved.

30. (*a*) Give reasons for the following:

(*i*) Ethanal is more reactive than acetone towards nucleophilic addition reaction.

(*ii*) $(CH_3)_3C—CHO$ does not undergo aldol condensation.

(*iii*) Carboxylic acids are higher boiling liquids than alcohols.

(*b*) Give a simple chemical test to distinguish between

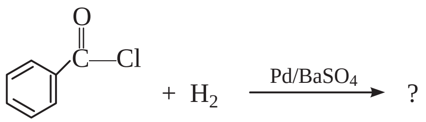
(*i*) Acetophenone and Benzophenone

(*ii*) Benzaldehyde and Ethanal

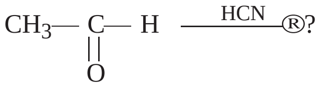
OR

Write the structures of products of the following reactions:

(*i*)

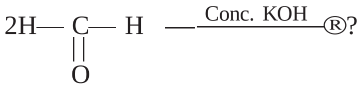


(*ii*)



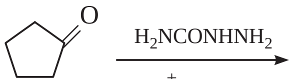
$$\mathrm{CH_3{-}\underset{\underset{O}{\|}}{C}{-}H \xrightarrow{HCN} \circledR?}$$

(*iii*)

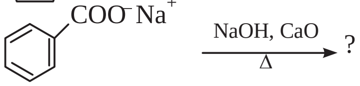


$$\mathrm{2H{-}\underset{\underset{O}{\|}}{C}{-}H \xrightarrow{Conc.\ KOH} \circledR?}$$

(*iv*)



(*v*)



SET–II

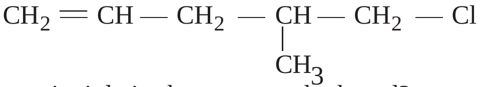
Questions Uncommon to Set-I

1. Why is glass considered a supercooled liquid?

2. Ethylamine is soluble in water whereas aniline is almost insoluble. Why?

4. Write the structure of 4-methyl pent-3-en-2-one.

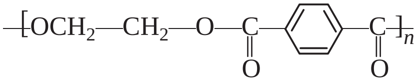
6. Write the IUPAC name of the following compound:



$$CH_2{=}CH-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-Cl$$

7. On what principle is chromatography based?

8. Write the names of monomers of the following polymer:



9. What type of deviation is shown by a mixture of ethanol and acetone? What type of azeotrope is formed by mixing ethanol and acetone?

14. Write the reactions involved when *D*-glucose is treated with the following reagents:

(*i*) HI

(*ii*) $H_2N—OH$

16. What is special about the following terms:

(*i*) Kraft Temperature

(*ii*) Sorption

22. Draw the structures of the following molecules:

(*i*) PCl_5

(*ii*) $H_4P_2O_7$

(*iii*) ClF_3

25. (*a*) Write the formulae for the following coordination compounds:

(*i*) Tetraammineaquachloridocobalt (III) chloride

(*ii*) Potassiumtetracyanonickelate (II)

(*b*) Write the hybridisation of the complex $[NiCl_4]^{2-}$. (Atomic number of Ni = 28)

27. How are the following conversions carried out:

(*i*) Aniline to fluorobenzene

(*ii*) Benzene diazonium chloride to benzene

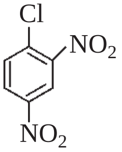
(*iii*) Methyl chloride to ethylamine

SET—III

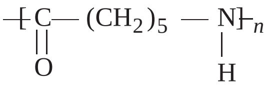
Questions Uncommon to Set-I and II

1. What is the two-dimensional coordination number of a molecule in a square close-packed layer?

2. Write the IUPAC name of the following compound:



3. Write the names of monomers of the following polymer:



$$-\!\!\left[\underset{\displaystyle O}{\underset{||}{C}}-(CH_2)_5-\underset{\displaystyle H}{\underset{|}{N}}\right]_n$$

4. Why are diazonium salts of aromatic amines more stable than those of aliphatic amines?

7. Write the structural formula of 2-phenyl ethanoic acid?

8. Name the method used for the refining of Titanium metal.

9. Out of two 0.1 molal solutions of glucose and of potassium chloride, which one will have a higher boiling point and why?

14. Write the structural difference between DNA and RNA.

16. Write the dispersed phase and dispersion medium of the following colloids:

(*i*) Cheese (*ii*) Fog

21. (*a*) What type of isomerism is shown by each of the following complexes:

(*i*) $[Pt(NH_3)_2Cl_2]$ (*ii*) $[Co(NH_3)_5(NO_2)]Cl_2$

(*b*) Give an example of the role of coordination compounds in biological systems.

23. Draw the structures of the following:

(*i*) Solid PCl_5 (*ii*) $H_2S_2O_8$

(*iii*) XeO_3

26. How are the following conversions carried out:

(*i*) Aniline to iodobenzene

(*ii*) Ethyl nitrile to ethyl amide

(*iii*) Benzene diazonium chloride to benzonitrile

z z z

Solutions

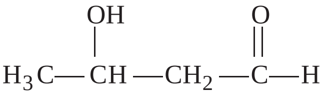
1. Metallic solids.

2. Osmotic pressure.

3. Zone refining method.

4. 2-Chloro-3-methylbutane.

5. phenol < 4-nitrophenol < 2,4,6-trinitrophenol

6. 

$$H_3C—\overset{\overset{\large OH}{|}}{CH}—CH_2—\overset{\overset{\large O}{||}}{C}—H$$

7. Methylamine is more basic than aniline due to resonance in aniline and lower stability of aniline ions.

8. Hexamethylenediamine $[H_2N—(CH_2)_6—NH_2]$ and adipic acid $[HOOC—(CH_2)_4—COOH]$.

9. Here, $\kappa_H = 4.27 \times 10^5 \text{ mm Hg}$

$p = 760 \text{ mm Hg}$

According to Henry's law, $p = \kappa_H x_{CH_4}$

$$\therefore \quad x_{CH_4} = \frac{p}{\kappa_H} = \frac{760 \text{ mm Hg}}{4.27 \times 10^5 \text{ mm Hg}} = 1.78 \times 10^{-3}$$

Mole fraction of methane in benzene; $x_{CH_4} = \mathbf{1.78 \times 10^{-3}}$**.** 2

10. (*i*) The bonds between chloroform molecules and molecules of acetone are dipole–dipole interactions but on mixing, the chloroform and acetone molecules, they start forming hydrogen bonds which are stronger bonds resulting in the release of energy. This gives rise to an increase in temperature.

(*ii*) When a non-volatile solute is dissolved in a solvent, the vapour pressure decreases. As a result, the solvent freezes at a lower temperature.

11.

$$t = \frac{2.303}{k} \log \frac{[R]_0}{[R]} \quad \text{as} \quad [R] = \frac{[R]_0}{10}$$

$$\therefore \quad t = \frac{2.303}{k} \log \frac{[R]_0}{\frac{[R]_0}{10}} = \frac{2.303}{60} \times \log 10 = \frac{2.303}{60} \times 1 = \mathbf{3.838 \times 10^{-2} s}$$

12. (*a*) It is converted into colloidal state.

$$Fe(OH)_3 + FeCl_3 \longrightarrow [Fe(OH)_3Fe]^{3+} + 3Cl^-$$

(*b*) Powdered substances have greater surface area as compared to their crystalline forms. Greater the surface area, greater is the adsorption.

13. (***i***) **Lyophobic sols:** Particles of dispersed phase have no affinity for dispersion medium, rather they hate dispersion medium. They are not easily prepared and need stabilizing agents for their preservation. They are irreversible. Examples: sols of gold, silver, $Fe(OH)_3$, As_2O_3 etc. They are also called extrinsic colloids.

(*ii*) **Lyophilic sols:** Particles of dispersed phase have great affinity for the dispersion medium. They are self-stabilized because of strong attractive forces operating between the suspended particles and the dispersion medium. They are reversible in nature. Examples: gums, gelatin, starch, albumin, etc. They are also known as intrinsic colloids.

14. **Leaching of aluminium from bauxite:** Finely powdered bauxite ore is digested with an aqueous solution of sodium hydroxide at 473–523 K and 35–36 bar pressure. Al_2O_3 is leached out as sodium aluminate (and SiO_2 too as sodium silicate) leaving impurities behind.

$$Al_2O_3(s) + 2NaOH(aq) + 3H_2O \longrightarrow 2Na[Al(OH)_4](aq)$$

The aluminate in solution is neutralised by passing CO_2 gas and hydrated Al_2O_3 is precipitated. At this stage, the solution is seeded with freshly prepared samples of hydrated Al_2O_3 which induces the precipitation.

$$2Na\,[Al(OH)_4](aq) + CO_2(g) \longrightarrow Al_2O_3 . xH_2O + 2NaHCO_3(aq)$$

The sodium silicate remains in the solution and hydrated alumina is filtered, dried and heated to get back pure Al_2O_3.

$$Al_2O_3 . xH_2O(s) \xrightarrow{1470\ K} Al_2O_3(s) + xH_2O(g)$$

OR

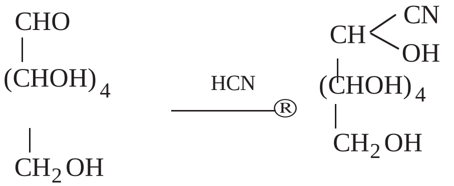
(*a*) Cu_2S and FeS.

(*b*) In froth floatation process, the role of the depressant is to prevent certain type of particles from forming the froth with the air bubbles.

15. (*a*) HF < HCl < HBr < HI.

(*b*) $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$.

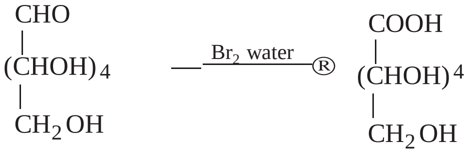
16. (*a*) **HCN**



$$\begin{array}{c}CHO\\ |\\ (CHOH)_4\\ |\\ CH_2OH\end{array} \xrightarrow{HCN} \begin{array}{c}CH\begin{smallmatrix}CN\\OH\end{smallmatrix}\\ |\\ (CHOH)_4\\ |\\ CH_2OH\end{array}$$

D-Glucose Glucose cyanohydrin

(*b*) **Br_2-water**

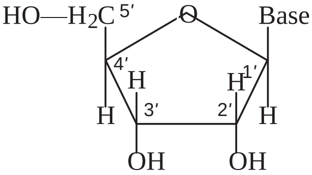


$$\begin{array}{c}CHO\\ |\\ (CHOH)_4\\ |\\ CH_2OH\end{array} \xrightarrow{Br_2\ water} \begin{array}{c}COOH\\ |\\ (CHOH)_4\\ |\\ CH_2OH\end{array}$$

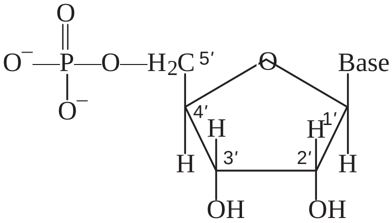
D-Glucose Gluconic acid

17. (*a*) Hydrogen bonds (intermolecular) between the C═O of one amino acid residue and N—H of the fourth amino acid residue in the chain give stability to the structure.

(*b*) A nucleoside is formed of pyrimidine or purine base connected to C-1 of sugar (ribose or deoxyribose) by a β-linkage.



A nucleotide contains all the three basic components of nucleic acids, *i.e.*, a phosphoric acid group, a pentose sugar and a nitrogenous base.



18. (*a*) Buna-S < Polythene < Nylon 6,6.

(*b*) Neoprene < PVC < Nylon-6.

19. Density, $d = \dfrac{Z \times M}{a^3 \times N_A}$ or $Z = \dfrac{d \times a^3 \times N_A}{M}$ ...(*i*)

Here, $M = 27 \text{ g mol}^{-1}$

$a = 4.05 \times 10^{-8} \text{ cm}$

$d = 2.7 \text{ g cm}^{-3}$

$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Substituting these values in expression (*i*), we get

$$Z = \frac{2.7 \text{ g cm}^{-3} \times (4.05 \times 10^{-8} \text{ cm})^3 \times 6.022 \times 10^{23} \text{ mol}^{-1}}{27 \text{ g mol}^{-1}}$$

$Z = 3.99 = \mathbf{4}$

Thus, there are 4 atoms of the element present per unit cell. Hence, the cubic unit cell must be face-centred.

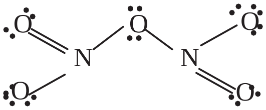
20. For this reaction

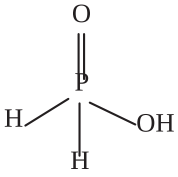
(*i*) First order

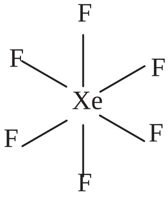
(*ii*) – *k* (rate constant)

(*iii*) time^{-1} (s^{-1})

21. (*i*) N_2O_5 (*ii*) H_3PO_2 (*iii*) XeF_6







22. (*i*) This is due to polymeric structure of red phosphorus or angular strain in P_4 molecule of white phosphorus where the angle is only 60°.

(*ii*) The oxidation states of central atom Sn in $SnCl_4$ and $SnCl_2$ are +4 and +2 respectively. +4 state of Sn has higher polarising power which, inturn, increase the covalent character of bond formed between the central atom and the other atoms.

(*iii*) Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidising agent.

$$O_3 \longrightarrow O_2 + O \text{ (nascent oxygen)}$$

OR

(*i*) $PCl_3 + 3H_2O \longrightarrow H_3PO_3 + 3HCl$

(*ii*) $XeF_2 + PF_5 \longrightarrow [XeF]^+ [PF_6]^-$

(*iii*) $2NaN_3 \xrightarrow{\text{heat}} 2Na + 3N_2$

23. (*a*) Dibromobis (ethane-1, 2-diamine) cobalt

(*b*) Ionisation isomerism.

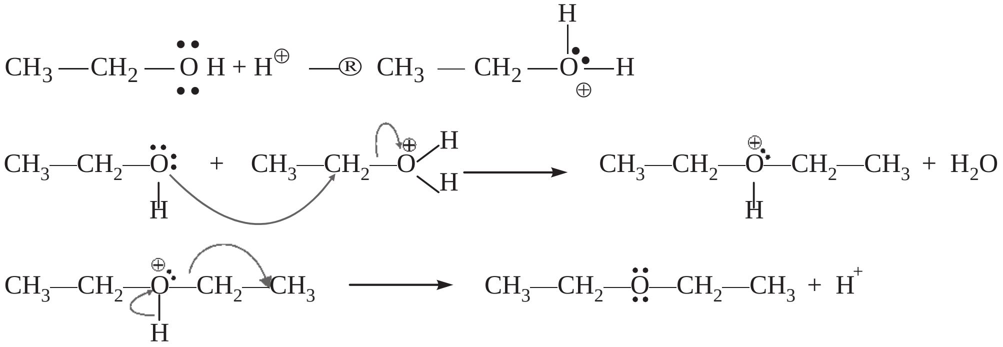
(*c*) Because in case of CO back bonding takes place in which the central metal uses its filled *d* orbital with empty anti-bonding π^* molecular orbital of CO.

24. (*i*) Retention

(*ii*) Inversion

(*iii*) Racemisation

25. (*a*)



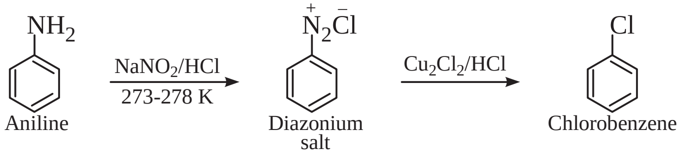
$$CH_3-CH_2-\underset{\cdot\cdot}{\ddot{O}}H + H^{\oplus} \longrightarrow CH_3-CH_2-\overset{H}{\overset{|}{\underset{\oplus}{\ddot{O}}}}-H$$

$$CH_3-CH_2-\underset{H}{\ddot{O}}: + CH_3-CH_2-\overset{\oplus}{O}\begin{smallmatrix}H\\H\end{smallmatrix} \longrightarrow CH_3-CH_2-\underset{H}{\overset{\oplus}{\ddot{O}}}-CH_2-CH_3 + H_2O$$

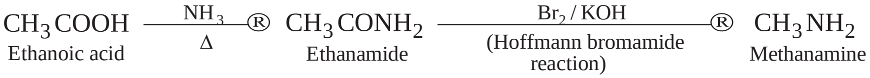
$$CH_3-CH_2-\underset{H}{\overset{\oplus}{\ddot{O}}}-CH_2-CH_3 \longrightarrow CH_3-CH_2-\underset{\cdot\cdot}{\ddot{O}}-CH_2-CH_3 + H^+$$

(*b*) Tollens' reagent.

26. (*i*) Aniline to chlorobenzene

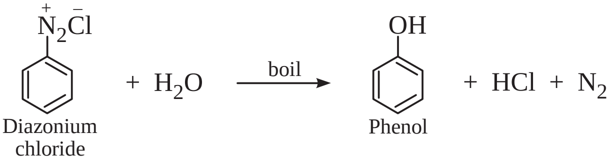


(*ii*) Ethanoic acid to methanamine



$$\underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow[\Delta]{NH_3} \underset{\text{Ethanamide}}{CH_3CONH_2} \xrightarrow[\text{(Hoffmann bromamide reaction)}]{Br_2/KOH} \underset{\text{Methanamine}}{CH_3NH_2}$$

(*iii*) Benzene diazonium chloride to phenol



27. (*i*) Caring nature, helpful.

(*ii*) Tranquilizers.

(*iii*) Most of the drugs taken in doses higher than recommended may cause harmful effects and act as poison. Therefore, a doctor should always be consulted before taking the medicine.

28. (*a*) **Kohlrausch's Law:** It states that the limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. In general, if an electrolyte on dissociation gives ν_+ cations and ν_- anions then its limiting molar conductivity is given by

$$\Lambda_m^o = \nu_+ \lambda_+^o + \nu_- \lambda_-^o$$

Here, λ_+^o and λ_-^o are the limiting molar conductivities of cations and anions, respectively.

Applications of Kohlrausch's Law:

Calculation of molar conductivities of weak electrolyte at infinite dilution: For example, molar conductivity of acetic acid (weak acid) at infinite dilution can be obtained from the knowledge of molar conductivities at infinite dilution of strong electrolytes like HCl, CH_3COONa and NaCl as illustrated below.

$$\Lambda^o_{m(CH_3COOH)} = \lambda^o_{CH_3COO^-} + \lambda^o_{H^+}$$

$$= [\lambda^o_{CH_3COO^-} + \lambda^o_{Na^+}] + [\lambda^o_{H^+} + \lambda_{Cl^-}] - [\lambda^o_{Na^+} + \lambda^o_{Cl^-}]$$

i.e., $$\Lambda^o_{m(CH_3COOH)} = \Lambda^o_{m(CH_3COONa)} + \Lambda^o_{m(HCl)} - \Lambda^o_{m(NaCl)}$$

(*b*) $$\text{Conductivity } (\kappa) = \frac{1}{\text{Resistance } (R)} \times \text{Cell constant}$$

$\kappa = 1.5 \times 10^{-4}$ S cm^{-1}, $R = 1500$ ohm

$$1.5 \times 10^{-4} = \frac{1}{1500} \times \text{Cell constant}$$

$\therefore$ $$\text{Cell constant} = 1.5 \times 10^{-4} \times 1500 = 0.225 \text{ cm}^{-1}$$

OR

Cell reaction: $Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu$; $n = 2$

Nernst equation: $E_{cell} = E^{o}_{cell} - \frac{0.0591}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$

$$\therefore \quad E_{cell} = 0.34 - (-2.36) - \frac{0.0591}{2} \log \frac{10^{-3}}{10^{-4}}$$

$$= 2.70 - 0.02655 = \mathbf{2.67\ V}$$

$$\Delta G^{\circ} = -nFE^{o}_{cell}$$

$$\Delta G^{\circ} = -2 \times 96500 \times 2.71$$

$$= \mathbf{-5.23 \times 10^{5}\ J\ mol^{-1}}$$

$$= -5.23 \times 10^{2}\ kJ\ mol^{-1}$$

29. (*i*) In the formation of metallic bonds, no electrons from 3*d*-orbitals are involved in case of zinc, while in all other metals of the 3*d* series, electrons from the *d*-orbitals are always involved in the formation of metallic bonds. That is why, the enthalpy of atomisation of zinc is the lowest in the series.

(*ii*) This is due to filling of 4*f* orbitals which have poor shielding effect (lanthanoid contraction).

(*iii*) Transition elements show variable oxidation states because electrons in *ns* and $(n - 1)$ *d*-orbitals are available for bond formation as they have nearly same energy.

(*iv*) This is because the sum of enthalpies of sublimation and ionisation is not balanced by hydration enthalpy.

(*v*) Cr^{2+} is a stronger reducing agent because after the loss of one electron Cr^{2+} becomes Cr^{3+} which has more stable t_{2g}^{3} (half-filled) configuration in a medium like water.

OR

It is prepared by fusion of pyrolusite, MnO_2, with KOH in the presence of an oxidising agent like KNO_3. This produces the dark green potassium manganate, K_2MnO_4 which disproportionates in a neutral or acidic solution to give purple permanganate.

$$2MnO_2 + 4KOH + O_2 \longrightarrow K_2MnO_4 + 2H_2O$$

$$3MnO_4^{2-} + 4H^{+} \longrightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$$

Commercially, it is prepared by alkaline oxidative fusion of MnO_2 followed by the electrolytic oxidation of manganate (VI).

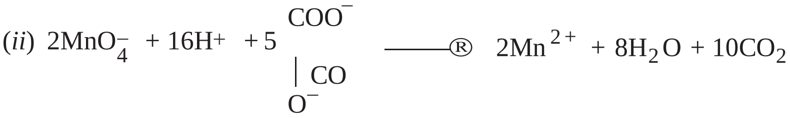
$$MnO_2 \xrightarrow[\text{oxidised with air or } KNO_3]{\text{Fused with KOH}} \underset{\text{Manganate ion}}{MnO_4^{2-}}$$

$$MnO_4^{2-} \xrightarrow[\text{in alkaline solution}]{\text{Electrolytic oxidation}} \underset{\text{Permanganate}}{MnO_4^{-}}$$

In the laboratory, $KMnO_4$ is prepared by oxidation of manganese (II) ion salt by peroxodisulphate.

$$2Mn^{2+} + \underset{\text{Peroxodisulphate}}{5S_2O_8^{2-}} + 8H_2O \longrightarrow \underset{\text{Permanganate}}{2MnO_4^{-}} + 10SO_4^{2-} + 16H^{+}$$

(*i*) $MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$



(*ii*) $2MnO_4^- + 16H^+ + 5\begin{matrix} COO^- \\ | \\ COO^- \end{matrix} \longrightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

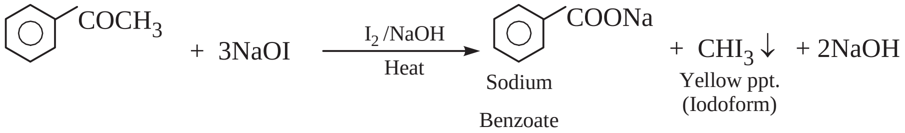
30. (*a*) (*i*) This is due to steric and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent. Electronically two alkyl groups reduce the positivity of the carbonyl carbon more effectively in ketones than in aldehydes.

(*ii*) This is because for aldol condensation to take place, at least one α-hydrogen (*i.e.*, hydrogen at carbon adjacent to carbonyl carbon) should be available, which is not present in $(CH_3)_3C—CHO$.

(*iii*) This is due to more extensive association of carboxylic acid molecules through intermolecular hydrogen bonding. The hydrogen bonds do not break completely even in the vapour phase.

(*b*) (*i*) Acetophenone and benzophenone:

Acetophenone responds to iodoform test and gives a yellow precipitate on addition of NaOH and I_2, but benzophenone does not.



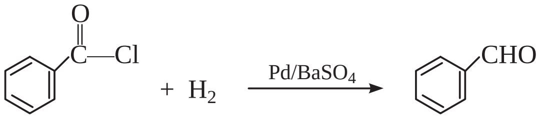
(*ii*) Benzaldehyde and Ethanal

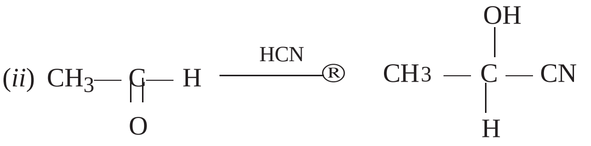
Ethanal reacts with NaOI (I_2/NaOH) to form yellow precipitate of iodoform while benzaldehyde does not give this test.

$$CH_3CHO + 3I_2 + 3NaOH \longrightarrow HCO\overset{-}{O}\overset{+}{Na} + \underset{\substack{\text{Iodoform} \\ \text{(Yellow ppt.)}}}{CHI_3\downarrow} + 3NaI + 3H_2O$$

OR

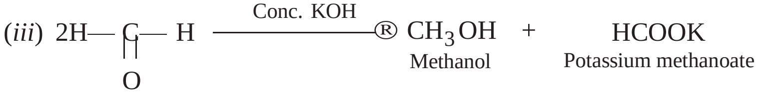
(*i*)



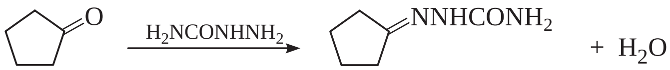


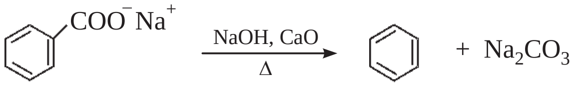
(*ii*) $CH_3—\underset{\substack{\| \\ O}}{C}—H \xrightarrow{HCN} CH_3—\underset{\substack{| \\ H}}{\overset{\substack{OH \\ |}}{C}}—CN$

Acetaldehyde cyanohydrin



(*iii*) $2H—\underset{\substack{\| \\ O}}{C}—H \xrightarrow{\text{Conc. KOH}} \underset{\text{Methanol}}{CH_3OH} + \underset{\text{Potassium methanoate}}{HCOOK}$

(*iv*) 

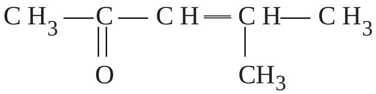
(*v*) 

SET–II

(Questions Uncommon to Set–I)

1. Glass is an amorphous solid and has a tendency to flow, though very slowly.

2. Due to hydrogen bonding ability of ethylamine.

4. 

$CH_3—\underset{\underset{O}{\|}}{C}—CH=\underset{\underset{CH_3}{|}}{C}H—CH_3$

6. 5-Chloro-4-methyl pent-1-ene.

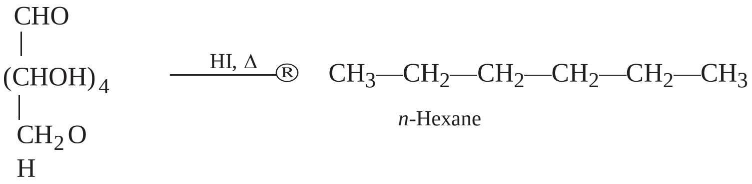
7. Is is based on the principle that different components of a mixture are differently adsorbed on an adsorbent.

8. Ethylene glycol and terephthalic acid

9. Positive deviation.

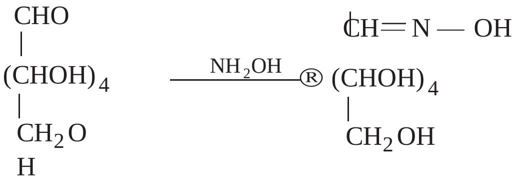
Minimum boiling azeotropes.

14.

(*a*) 

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow{HI,\ \Delta} CH_3—CH_2—CH_2—CH_2—CH_2—CH_3$$

n-Hexane

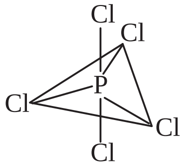
(*ii*) 

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow{NH_2OH} \begin{array}{l} CH=N—OH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}$$

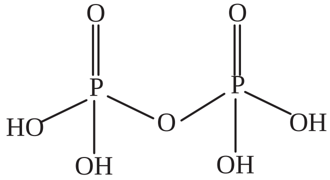
16. (*i*) Kraft temperature is the minimum temperature above which the formation of micelles takes place.

(*ii*) Sorption is the process in which adsorption and absorption take place simultaneously, *e.g.*, dyeing of cotton fibres by azo dyes.

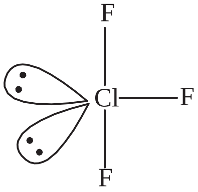
22. (*i*) PCl_5



(*ii*) $H_4P_2O_7$



(*iii*) ClF_3

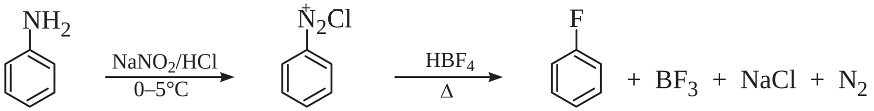


25. (*a*) (*i*) $[Co(NH_3)_4(H_2O)Cl]Cl_2$

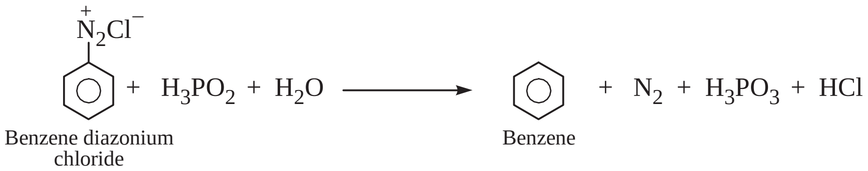
(*ii*) $K_2[Ni(CN)_4]$

(*b*) *sp*^{3} hybridisation.

27. (*i*) Aniline to fluorobenzene



(*ii*) Benzene diazonium chloride to benzene



(*iii*) Methyl chloride to ethylamine

$$CH_3\text{—}Cl \xrightarrow{\text{alc. KCN}} CH_3\text{—}CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2$$

SET–III

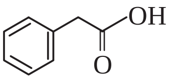
1. 4.

2. 1-chloro 2,4-dinitrobenzene.

3. Caprolactam.

4. The diazonium salts of aromatic amines are more stable than those of aliphatic amines due to dispersal of the positive charge on the benzene ring.

7.



8. Vapour phase refining.

9. 0.1 M KCl solution will have higher boiling point as KCl dissociates in the solution.

14. Structural difference between DNA and RNA:

DNA	RNA
1. The sugar present in DNA is 2-deoxy *D*-(–) ribose.	1. The sugar present in RNA is *D*-(–)-ribose.
2. DNA has double stranded α-helix structure.	2. RNA has single α-helix structure.

16.

	Dispersed phase	**Dispersion medium**
(*i*) Cheese	Liquid	Solid
(*ii*) Fog	Liquid	Gas

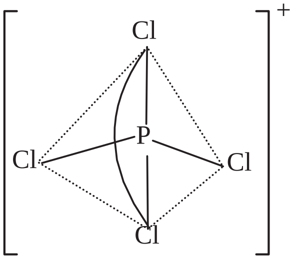
21. (*a*) (*i*) Geometrical isomerism

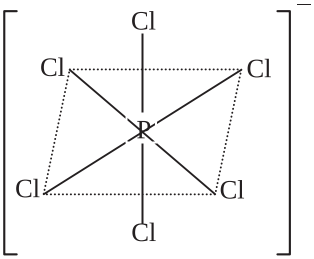
(*ii*) Linkage isomerism.

(*b*) Vitamin B_{12} (Cyanocobalamine), the antipernicious anaemia factor, is a complex of cobalt.

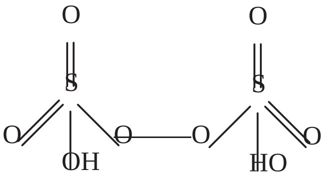
23. (*i*) Solid PCl_5

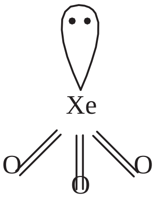
In solid state PCl_5 exist as $[PCl_4]^+$ $[PCl_6]^-$ in which the cation, $[PCl_4]^+$ is tetrahedral and the anion, $[PCl_6]^-$ is octahedral.



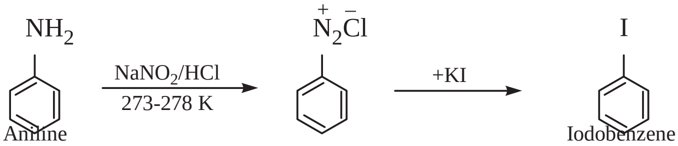


(*ii*) $H_2S_2O_8$ (*iii*) XeO_3





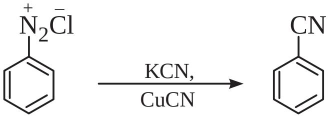
26. (*i*) Aniline to iodobenzene



(*ii*) Ethyl nitrile to ethyl amide

$$CH_3—CN \xrightarrow{H_2O/H^+} CH_3—COOH \xrightarrow[\Delta]{NH_3,} CH_3CONH_2$$

(*iii*) Benzene diazonium chloride to benzonitrile



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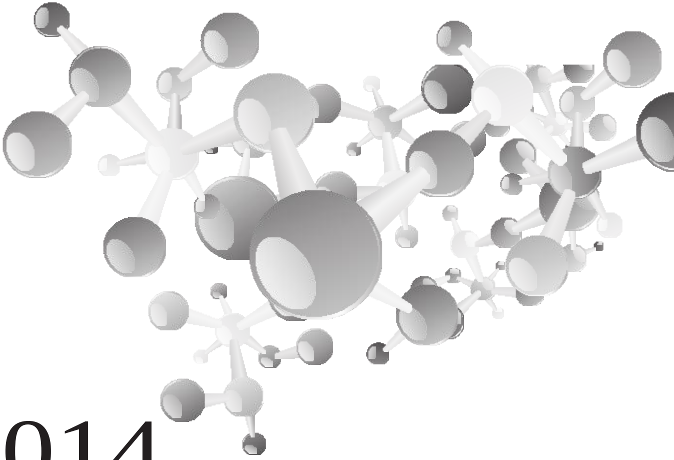


CBSE Examination Paper Delhi-2014

Time allowed : 3 hours **Maximum marks : 70**

General Instructions:

(*i*) *All questions are compulsory.*
(*ii*) *Question numbers **1** to **8** are very short answer questions and carry **1** mark each.*
(*iii*) *Question numbers **9** to **18** are short answer questions and carry **2** marks each.*
(*iv*) *Question numbers **19** to **27** are also short answer questions and carry **3** marks each.*
(*v*) *Question numbers **28** to **30** are long answer questions and carry **5** marks each.*
(*vi*) *Use log tables, if necessary. Use of calculators is not allowed.*

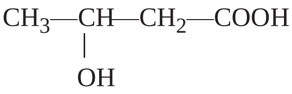
SET–I

1. Give one example each of 'oil in water' and 'water in oil' emulsion.

2. Which reducing agent is employed to get copper from the leached low grade copper ore?

3. Which of the following is more stable complex and why? $[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$

4. Write the IUPAC name of compound.



$$CH_3—\underset{\underset{OH}{|}}{CH}—CH_2—COOH$$

5. Which of the following isomers is more volatile:
o-nitrophenol or p-nitrophenol?

6. What are isotonic solutions?

7. Arrange the following compounds in increasing order of solubility in water:
$C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$

8. Which of the two components of starch is water soluble?

9. An element with density 11.2g cm^{-3} forms a f.c.c. lattice with edge length of 4×10^{-8} cm. Calculate the atomic mass of the element.
(Given: $N_A = 6.022 \times 10^{23}\ mol^{-1}$)

10. Examine the given defective crystal

A^+	B^-	A^+	B^-	A^+
B^-	0	B^-	A^+	B^-
A^+	B^-	A^+	0	A^+
B^-	A^+	B^-	A^+	B^-

Answer the following questions:

(*i*) What type of stoichiometric defect is shown by the crystal?

(*ii*) How is the density of the crystal affected by this defect?

(*iii*) What type of ionic substances show such defect?

11. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K (K_f = 5.12 K kg mol^{-1}).

12. Define an ideal solution and write one of its characteristics.

13. Write two differences between 'order of reaction' and 'molecularity of reaction'.

14. Outline the principles behind the refining of metals by the following methods:

(*i*) Zone refining method

(*ii*) Chromatographic method

15. Complete the following chemical equations:

(*i*) Ca_3P_2 + H_2O ——®

(*ii*) Cu + H_2SO_4 (conc.) ——®

OR

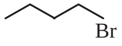
Arrange the following in the order of property indicated against each set:

(*i*) HF, HCl, HBr, HI — increasing bond dissociation enthalpy

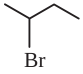
(*ii*) H_2O, H_2S, H_2Se, H_2Te — increasing acidic character

16. Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]^+$. What type of isomerism does it exhibit?

17. (*i*) Which alkyl halide from the following pair is chiral and undergoes faster S_N2 reaction?



(*a*)

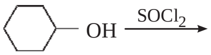


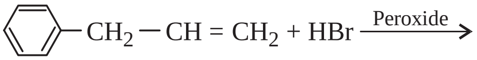
(*b*)

(*ii*) Out of S_N1 and S_N2, which reaction occurs with

(*a*) Inversion of configuration (*b*) Racemisation

18. Draw the structure of major monohalo product in each of the following reactions:

(*i*) 

(*ii*) 

19. (*a*) In reference to Freundlich adsorption isotherm write the expression for adsorption of gases on solids in the form of an equation.

(*b*) Write an important characteristic of lyophilic sols.

(*c*) Based on type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid.

20. (*a*) Draw the structures of the following molecules:

(*i*) $XeOF_4$

(*ii*) H_2SO_4

(*b*) Write the structural difference between white phosphorus and red phosphorus.

21. Account for the following:

(*i*) PCl_5 is more covalent than PCl_3.

(*ii*) Iron on reaction with HCl forms $FeCl_2$ and not $FeCl_3$.

(*iii*) The two O—O bond lengths in the ozone molecule are equal.

22. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:

$$SO_2Cl_2 \longrightarrow SO_2(g) + Cl_2(g)$$

Experiment	**Time/second^{-1}**	**Total pressure/atm**
1	0	0.4
2	100	0.7

Calculate the rate constant.

(Given: log 4 = 0.6021, log 2 = 0.3010)

23. (*i*) Give two examples of macromolecules that are chosen as drug targets.

(*ii*) What are antiseptics? Give an example.

(*iii*) Why is use of aspartame limited to cold foods and soft drinks?

24. (*i*) Deficiency of which vitamin causes night-blindness?

(*ii*) Name the base that is found in nucleotide of RNA only.

(*iii*) Glucose on reaction with HI gives n-hexane. What does it suggest about the structure of glucose?

25. ***After the ban on plastic bags, students of one school decided to make the people aware of the harmful effects of plastic bags on environment and Yamuna River. To make the awareness more impactful, they organised rally by joining hands with other schools and distributed paper bags to vegetable vendors, shopkeepers and departmental stores. All students pledged not to use polythene bags in future to save Yamuna River.***

After reading the above passage, answer the following questions:

(i) What values are shown by the students?

(ii) What are biodegradable polymers? Give one example.

(iii) Is polythene a condensation or an addition polymer?

26. (*a*) Write the mechanism of the following reaction:

$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

(*b*) Write the equations involved in Reimer-Tiemann reaction.

27. Give the structures of A, B and C in the following reactions:

(*i*) $CH_3Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273\text{ K}]{HNO_2} C$

(*ii*) $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{Br_2 + KOH} B \xrightarrow{CHCl_3 + NaOH} C$

OR

How will you convert the following:

(*i*) Nitrobenzene into aniline

(*ii*) Ethanoic acid into methanamine

(*iii*) Aniline into N-phenylethanamide

(Write the chemical equations involved.)

28. (*a*) Define the following terms:

(*i*) Limiting molar conductivity (*ii*) Fuel cell

(*b*) Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1}KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L^{-1}KCl solution. The conductivity of 0.1 mol L^{-1}KCl solution is $1.29 \times 10^{-2}\ \Omega^{-1}\ cm^{-1}$.

OR

(*a*) State Faraday's first law of electrolysis. How much charge in terms of Faraday is required for the reduction of 1 mol of Cu^{2+} to Cu?

(*b*) Calculate emf of the following cell at 298 K:

$$Mg(s)\,|\,Mg^{2+}(0.1M)\,\|\,Cu^{2+}(0.01)\,|\,Cu(s)$$

[Given $E^o_{cell} = +2.71$ V, 1 F = 96500 C mol^{-1}]

29. (*a*) How do you prepare:

(*i*) K_2MnO_4 from MnO_2? (*ii*) $Na_2Cr_2O_7$ from Na_2CrO_4?

(*b*) Account for the following:

(*i*) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.

(*ii*) The enthalpy of atomisation is lowest for Zn in 3d series of the transition elements.

(*iii*) Actinoid elements show wide range of oxidation states.

OR

(*i*) Name the element of 3d transition series which shows maximum number of oxidation states. Why does it show so?

(*ii*) Which transition metal of 3d series has positive $E^0(M^{2+}/M)$ value and why?

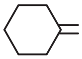
(*iii*) Out of Cr^{3+} and Mn^{3+}, which is a stronger oxidising agent and why?

(*iv*) Name a member of the lanthanoid series which is well known to exhibit +2 oxidation state.

(*v*) Complete the following equation:

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow ®$$

30. (*a*) Write the products of the following reactions:



(*i*) O + $H_2N \overset{H^+}{—} OH$

$\longrightarrow$® (*ii*) $2C_6H_5CHO$ + conc. NaOH $\longrightarrow$®

(*iii*) $CH_3COOH \xrightarrow{Cl_2/P}$ ®

(*b*) Give simple chemical tests to distinguish between the following pairs of compounds:

(*i*) Benzaldehyde and Benzoic acid
(*ii*) Propanal and Propanone

OR

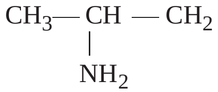
(*a*) Account for the following:
  (*i*) CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.
  (*ii*) Carboxylic acid is a stronger acid than phenol.

(*b*) Write the chemical equations to illustrate the following name reactions:
  (*i*) Wolff-Kishner reduction
  (*ii*) Aldol condensation
  (*iii*) Cannizzaro reaction

SET–II (Questions Uncommon to Set–I)

1. Give one example each of sol and gel.

3. Write the IUPAC name of the compound.



$$CH_3—\underset{\displaystyle NH_2}{\underset{|}{CH}}—CH_2$$

5. Some liquids on mixing form ‘azeotropes’. What are ‘azeotropes’?

6. Arrange the following in increasing order of basic strength.
$C_6H_5NH_2$, $C_6H_5NHCH_3$, $C_6H_5CH_2NH_2$

7. Which component of starch is a branched polymer of α-glucose and insoluble in water?

9. State Henry’s law. What is the effect of temperature on the solubility of a gas in a liquid?

10. Define the following terms:
  (*i*) Pseudo first order reaction
  (*ii*) Half life period of reaction ($t_{1/2}$)

11. Write the principle behind the following methods of refining:
  (*i*) Hydraulic washing
  (*ii*) Vapour phase refining

22. (*a*) Draw the structures of the following:
  (*i*) XeF_2
  (*ii*) BrF_3

24. Account for the following:
  (*i*) Bi(V) is a stronger oxidising agent than Sb(V).
  (*ii*) N – N single bond is weaker than P – P single bond.
  (*iii*) Noble gases have very low boiling points.

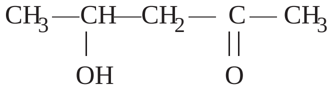
25. (*i*) Name the sweetening agent used in the preparation of sweets for a diabetic patient.
  (*ii*) What are antibiotics? Give an example.
  (*iii*) Give two examples of macromolecules that are chosen as drug targets.

27. (*i*) Deficiency of which vitamin causes rickets?
  (*ii*) Give an example for each of fibrous protein and globular protein.
  (*iii*) Write the product formed on reaction of D-glucose with Br_2 water.

SET–III (Questions Uncommon to Set-I and II)

1. Give one example each of lyophobic sol and lyophilic sol.

2. Write the IUPAC name of the compound.



$$CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-\underset{O}{\underset{||}{C}}-CH_3$$

3. What type of intermolecular attractive interaction exists in the pair of methanol and acetone?

5. Arrange the following in increasing order of basic strength:

$C_6H_5NH_2$, $C_6H_5NHCH_3$,$C_6H_5N(CH_3)_2$

6. Name the products of hydrolysis of sucrose.

9. State Raoult's law for the solution containing volatile components. What is the similarity between Raoult's law and Henry's law?

10. Explain the following terms:

(*i*) Rate constant (k)

(*ii*) Half life period of a reaction ($t_{1/2}$)

11. Write the principles of the following methods:

(*i*) Froth floatation method

(*ii*) Electrolytic refining

20. (*a*) Draw the structures of the following compounds:

(*i*) XeF_4

(*ii*) N_2O_5

22. Account for the following:

(*i*) Sulphur in vapour form exhibits paramagnetic behaviour.

(*ii*) $SnCl_4$ is more covalent than $SnCl_2$.

(*iii*) H_3PO_2 is a stronger reducing agent than H_3PO_3.

23. (*i*) What are disinfectants? Give an example.

(*ii*) Give two examples of macromolecules that are chosen as drug targets.

(*iii*) What are anionic detergents? Give an example.

24. (*i*) Deficiency of which vitamin causes scurvy?

(*ii*) What type of linkage is responsible for the formation of proteins?

(*iii*) Write the product formed when glucose is treated with HI.

z z z

Solutions

SET–I

1. Oil in water emulsion: milk, vanishing cream.
Water in oil emulsion: Butter, cold cream, cod liver oil.

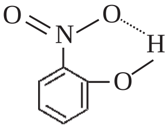
2. Scrap iron, $Cu^{2+}(aq) + Fe(s) \longrightarrow Cu(s) + Fe^{2+}(aq)$

or H_2 gas, $Cu^{2+}(aq) + H_2(g) \longrightarrow Cu(s) + 2H^{+}(aq)$

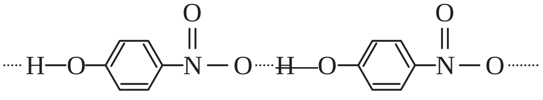
3. In both of the given complexes, Co is in +3 oxidation state. As ethane-1, 2-diamine is bidentate chelating ligand, it forms rings and hence $[Co(en)_3]^{3+}$ is more stable complex than $[Co(NH_3)_6]^{3+}$.

4. 3-hydroxybutanoic acid

5. o-nitrophenol, is more volatile as intermolecular hydrogen bonding causes association molecules in p-nitrophenol.



o-nitrophenol
Intramolecular hydrogen bonding



p-nitrophenol
Intermolecular hydrogen bonding

6. Two solutions which have the same osmotic pressure at a given temperature are called isotonic solutions.

7. The solubility increases in the order in which molecular mass decreases with increase in hydrogen atoms on nitrogen atom which undergo hydrogen bonding, *i.e.*,
$C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$

8. Amylose is water soluble whereas amylopectin is water insoluble component.

9. For *fcc* lattice number of atoms per unit cell, $z = 4$
Here, $d = 11.2 \text{ g cm}^{-3}$, $a = 4 \times 10^{-8}$ cm, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

$$\text{Atomic mass, } M = \frac{d \times a^3 \times N_A}{z}$$

$$= \frac{11.2 \text{ g cm}^{-3} \times (4 \times 10^{-8} \text{ cm})^3 \times 6.022 \times 10^{23} \text{ mol}^{-1}}{4} = 107.9 \text{ g mol}^{-1} \text{ or } 107.9\, u$$

10. (*i*) Schottky defect
(*ii*) Decreases
(*iii*) This type of defect is shown by ionic compounds which have high coordination number and small difference in size of cations and anions e.g. NaCl, KCl etc.

11. Here, $\Delta T_f = 0.48$ K, $M_B = 256 \text{ g mol}^{-1}$, $W_A = 75$ g, $K_f = 5.12 \text{ K kg mol}^{-1}$.

$$\text{Mass of solute, } W_B = \frac{\Delta T_f \times M_B \times W_A}{K_f \times 1000} = \frac{0.48 \text{ K} \times 256 \text{ g mol}^{-1} \times 75 \text{ g}}{5.12 \text{ K kg mol}^{-1} \times 1000 \text{ g kg}^{-1}} = 1.8 \text{ g}$$

12. A solution which obeys Raoult's law over the entire range of concentration is called ideal solution. The important characteristics of an ideal solution are

(*i*) The enthalpy of mixing of pure components to form the solution is zero *i.e.*, $\Delta_{mix} H = 0$

(*ii*) The volume of mixing is zero *i.e.*, $\Delta_{mix} V = 0$

13. Differences between order and molecularity of reaction.

Order	**Molecularity**
(*i*) It is the sum of the powers of the concentration of the reactants in the rate law expression.	(*i*) It is the number of reacting species taking part in an elementary reaction, which must collide simultaneously so as to result into a chemical reaction.
(*ii*) It is determined experimentally.	(*ii*) It is a theoretical concept.
(*iii*) It can be zero or a fraction.	(*iii*) It cannot be zero or a fraction.
(*iv*) Order is applicable to elementary as well as complex reactions.	(*iv*) Molecularity is applicable only for elementary reactions. For complex reactions it has no meaning.

(*Any two*)

14. (*i*) Zone refining method is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal.

(*ii*) Chromatographic method is based on the principle that different components of a mixture are adsorbed to different extent on an adsorbent. The adsorbed components are removed by using suitable solvents.

15. (*i*) $Ca_3P_2(s) + 6H_2O(l) \longrightarrow 2PH_3 + 3Ca(OH)_2$

(*ii*) $Cu + 2H_2SO_4(conc.) \longrightarrow CuSO_4 + SO_2 + 2H_2O$

OR

(*i*) Shorter the bond length, higher is the bond dissociation enthalpy of hydrogen halide. As the atomic size increases down the group the E–H (E = F, Cl, Br, I) bond length increases and hence the bond dissociation enthalpy increases in the reverse order *i.e.*,

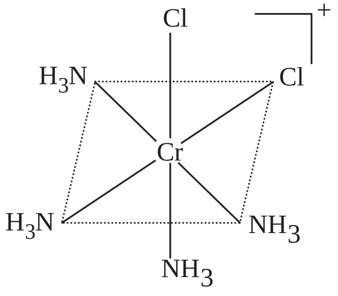
$HI < HBr < HCl < HF$

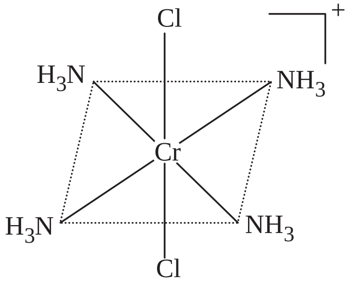
(*ii*) $H_2O < H_2S < H_2Se < H_2Te$

The increase in acidic character from H_2O to H_2Te is due to decrease in bond enthalpy for dissociation of H – E (E = O, S, Se, Te) bond down the group.

16. $[Cr(NH_3)_4Cl_2]^+$: Tetraamminedichloridochromium (III) ion.

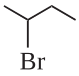
Geometrical isomerism



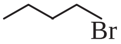


cis-Tetraamminedichlorido
chromium (III) ion

trans-Tetraamminedichlorido
chromium (III) ion

17. (*i*) 

, 2-bromobutane is a chiral molecule.

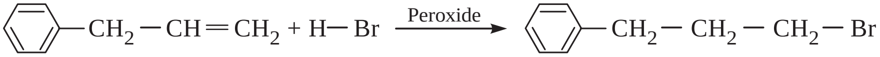


, primary halides undergo faster S_N2 reactions than secondary halides due to less steric hinderance.

(*ii*) (*a*) S_N2 reaction occurs with inversion of configuration.

(*b*) S_N1 reaction occurs with racemisation.

18. (*i*) 

(*ii*) 

19. (*a*) Freundlich adsorption isotherm equation for adsorption of gases on solids:

$$\frac{x}{m} = kp^{1/n} \, (n > 1)$$

or
$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

where x is the mass of the gas adsorbed on mass m of the adsorbent at pressure p, k and n are constants which depends on the nature of the gas and adsorbent at a particular temperature.

(*b*) Important characteristics of lyophilic sols:

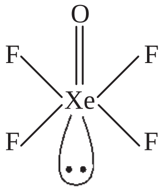
(*i*) They are reversible in nature, *i.e.*, once the dispersed phase is separated from dispersion medium the sol can be made again by simply remixing with dispersion medium.

(*ii*) They are quite stable and are not easily coagulated.

(*c*)

Type of Colloid	Example
Associated colloid	Surface active agents such as soap (CMC is 10^{-4} to 10^{-3} mol L^{-1}) and synthetic detergents.
Multimolecular colloid	Sulphur sol, gold sol

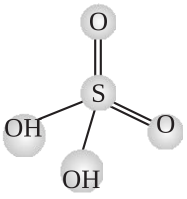
20. (*a*) (*i*)



$XeOF_4$

Square pyramidal

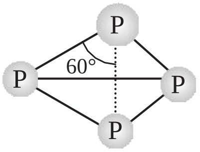
(*ii*)



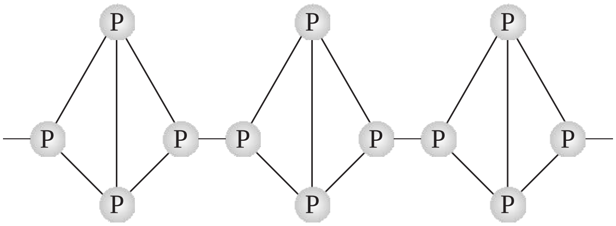
H_2SO_4

Sulphuric acid

(*b*) White phosphorus consists of discrete tetrahedral P_4 molecule with six P—P covalent bonds.



Red phosphorus has polymeric structure in which P_4 tetrahedra are linked together through P—P covalent bond to form chain.



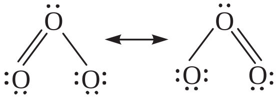
21. (*i*) The oxidation state of central atom phosphorus is +5 in PCl_5 whereas it is +3 in PCl_3. Higher the positive oxidation of central atom, more will be its polarising power which, in turn, increases the covalent character of bond formed between the central atom and the atoms surrounding it.

(*ii*) Iron reacts with HCl to form $FeCl_2$ and H_2.

$$Fe + 2HCl \longrightarrow FeCl_2 + H_2$$

H_2 thus produced prevents the oxidation of $FeCl_2$ to $FeCl_3$.

(*iii*) Ozone is a resonance hybrid of the following two main structures:



As a result of resonance, the two O—O bond lengths in O_3 are equal.

22. $k = \dfrac{2.303}{t} \log \dfrac{P_0}{2P_0 - P_t}$

Here, $P_0 = 0.4$ atm, $t = 100$ s, $P_t = 0.7$ atm

$$\therefore \quad k = \frac{2.303}{100} \log \frac{0.4}{2 \times 0.4 - 0.7}$$

$$= \frac{2.303}{100} \log \frac{0.4}{0.1} = \frac{2.303}{100} \log 4 = \frac{2.303}{100} \times 0.6021$$

$$k = 1.386 \times 10^{-2}\ s^{-1}$$

23. (*i*) Biological macromolecules such as carbohydrates, proteins, lipids and nucleic acids are chosen as drug targets.

(*ii*) Antiseptics are the chemical substances which prevent the growth of microorganism or may even kill them but are not harmful to living human tissues, *e.g.*, dettol, soframycin, boric acid, hydrogen peroxide etc.

(*iii*) Use of aspartame is limited to cold foods and soft drink because it is unstable at cooking temperature.

24. (*i*) Vitamin A

(*ii*) Uracil

(*iii*) It suggests that all the six carbon atoms in glucose are linked in a straight chain.

25. (*i*) Concern towards water pollution, concern for environmental protection, team work, socially aware.

(*ii*) The polymers which can be broken into small segments by enzyme catalysed reactions or to some extent by oxidation over a period of time are called biodegradable polymers. The required enzymes are produced by microorganism *e.g.*, poly-β-hydroxybutyrate-co-β-hydroxyvalerate (PHBV), nylon-2-nylon-6 etc.

(*iii*) Polyethene is an addition polymer.

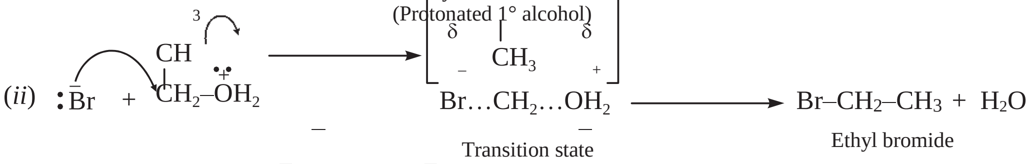
26. (*a*) S_N2 Mechanism

(*i*) $H–Br \rightleftharpoons H^+ + :\bar{Br}$

$CH_3–CH_2\ddot{O}H + H^+ \rightleftharpoons CH_3–CH_2\overset{+}{\ddot{O}}H_2$

Ethyl oxonium ion
(Protonated 1° alcohol)

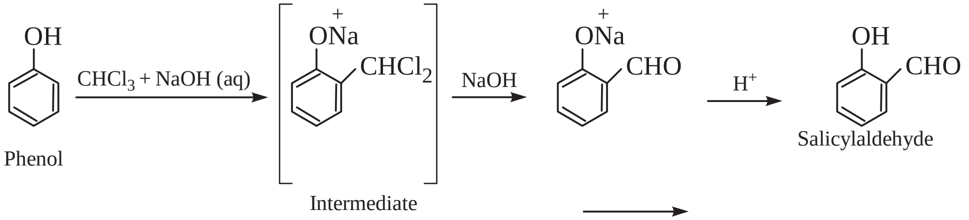
(*ii*)



Transition state

Ethyl bromide

(*b*)



27. (*i*) $CH_3Br \xrightarrow{KCN} CH_3CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2 \xrightarrow[273K]{HNO_2} CH_3CH_2OH$

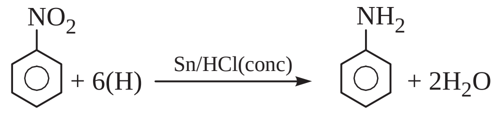
Bromomethane; Ethanenitrile (A); Ethanamine (B); Ethanol (C)

(*ii*) $CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow{Br_2+KOH} CH_3NH_2 \xrightarrow{CHCl_3+NaOH} CH_3NC$

Ethanoic acid; Ethanamide (A); Methanamine (B); Methyl isocyanide (C)

OR

(*i*)

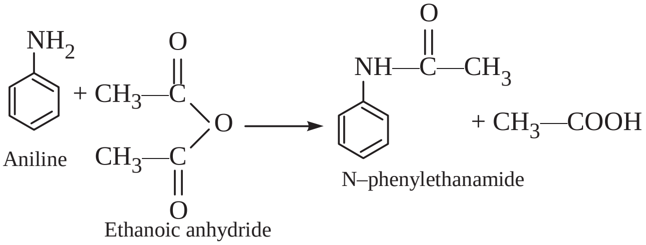


Nitrobenzene Aniline

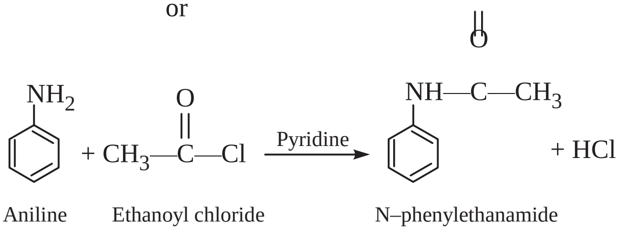
(*ii*) $CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow{Br_2/NaOH} CH_3NH_2$

Ethanoic acid Ethanamide Methanamine

(*iii*)



or



28. (*a*) (*i*) The molar conductivity when concentration approaches to zero is called limiting molar conductivity.

(*ii*) A fuel cell is a device which converts energy produced during the combustion of fuels like hydrogen, methane, methyl alcohol etc. directly into electrical energy. One such successful fuel cell is hydrogen-oxygen fuel cell.

(*b*) For 0.1 mol L^{-1} KC*l* solution

Conductivity, $\kappa = 1.29 \times 10^{-2}\ \Omega^{-1}\ cm^{-1}$, Resistance, $R = 100\ \Omega$

Cell constant = Conductivity × resistance

$$= 1.29 \times 10^{-2}\ \Omega^{-1}\ cm^{-1} \times 100\ \Omega = 1.29\ cm^{-1}$$

For 0.02 mol L^{-1} solution

Resistance = 520 Ω, Cell constant = $1.29\ cm^{-1}$,

$$\text{Conductivity, } \kappa = \frac{\text{Cell constant}}{\text{Resistance}}$$

$$= \frac{1.29\ cm^{-1}}{520\ \Omega} = 0.00248\ \Omega^{-1}\ cm^{-1}$$

$$\text{Molar conductivity, } \Lambda_m = \frac{\text{Conductivity } (\kappa) \times 1000\ cm^3 L^{-1}}{\text{Molarity}}$$

$$= \frac{0.00248\ \Omega^{-1} cm^{-1} \times 1000\ cm^3\ L^{-1}}{0.02\ mol\ L^{-1}}$$

$$= 124\ \Omega^{-1} cm^2 mol^{-1}$$

OR

(*a*) It states that the amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte (solution or melt).

$$Cu^{2+} + 2e^- \longrightarrow Cu$$

Charge required for reduction of 1 mol of Cu^{2+} = 2F.

(*b*) At anode: $Mg \longrightarrow Mg^{2+} + 2e^-$

At cathode: $Cu^{2+} + 2e^- \longrightarrow Cu$

$$\underline{Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu}$$

$$\text{Nernst equation: } E_{cell} = E^o_{cell} - \frac{0.059}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]} \text{ (at 298K)}$$

Here, $E^o_{cell} = 2.71$ V, $[Mg^{2+}] = 0.1$ M, $[Cu^{2+}] = 0.01$ M, $n = 2$

$$\therefore \quad E_{cell} = 2.71 - \frac{0.059}{2} \log \frac{0.1}{0.01} = 2.71 - 0.029 \times 1$$

$$= 2.681\ V$$

29. (*a*) (*i*) Pyrolusite is fused with KOH in the presence of atmospheric oxygen to give K_2MnO_4.

$$\underset{\text{Pyrolusite}}{2MnO_2} + 4KOH + O_2 \xrightarrow{\text{Heat}} \underset{\text{Potassium manganate}}{2K_2MnO_4} + 2H_2O$$

(*ii*) Na_2CrO_4 is extracted with water and acidified with H_2SO_4 to give $Na_2Cr_2O_7$.

$$\underset{\text{Sodium chromate}}{2Na_2CrO_4} + H_2SO_4 \longrightarrow \underset{\text{Sodium dichromate}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$$

(*b*) (*i*) The electronic configuration of Mn^{2+} is [Ar] $3d^5$ which is half-filled and hence stable. So Mn^{2+} cannot lose third electron easily. On the other hand, Fe^{2+} has electronic configuration [Ar] $3d^6$. It tends to lose one electron to acquire stable [Ar] $3d^5$ electronic configuration. Hence Mn^{2+} is more stable than Fe^{2+} towards oxidation.

(*ii*) In the formation of metallic bonds, no electrons from 3*d*-orbitals are involved in case of zinc, while in all other metals of the 3*d* series, electrons from the *d*-orbitals are always involved in the formation of metallic bonds. That is why, the enthalpy of atomisation of zinc is the lowest in the series.

(*iii*) This is due to comparable energies of 5*f*, 6*d* and 7*s* orbitals.

OR

(*i*) Manganese ($3d^5 4s^2$) shows maximum number of oxidation states as its atoms have 5 unpaired electrons in 3d orbitals. It shows all the oxidation states from +2 to +7.

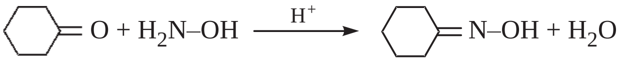
(*ii*) Copper has positive E^o (M^{2+}/M) value, as high energy ($\Delta_a H + \Delta_i H$) to transform Cu(*s*) to Cu^{2+}(*aq*) is not balanced by hydration enthalpy.

(*iii*) Mn^{3+} is stronger oxidising agent as the charge from Mn^{3+} to Mn^{2+} results in half filled, d^5 configuration which has extra stability.

(*iv*) Europium, Eu. Eu^{2+} is formed by losing the two *s* electrons and its (Xe) f^7 configuration accounts its formation.

(*v*) $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

30. (*a*) (*i*)



Cyclohexanone oxime

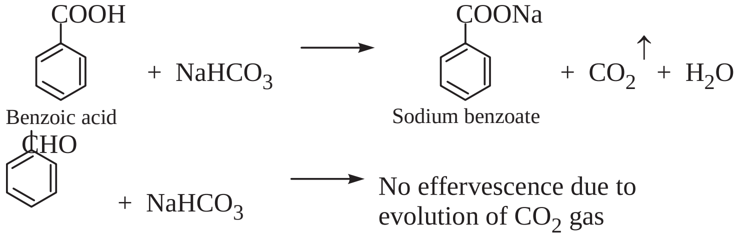
(*ii*) $2C_6H_5CHO + NaOH \longrightarrow C_6H_5-CH_2-OH + C_6H_5\overset{-}{COO}\overset{+}{Na}$

(Conc.) Benzyl alcohol Sodium benzoate

(*iii*) $CH_3COOH \xrightarrow{Cl_2/P} Cl-CH_2-COOH + HCl$

2-chloro ethanoic acid

(*b*) (*i*) Benzoic acid being an acid reacts with $NaHCO_3$ solution to give brisk effervescence due to evolution of CO_2 while benzaldehyde does not response to this test.



(*ii*) Propanal being an aldehyde reduces Tollens reagent to silver mirror but propanone being a ketone does not.

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + 2[Ag(NH_3)_2]^+ + 3OH^- \longrightarrow CH_3CH_2COO^- + \underset{\text{Silver mirror}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

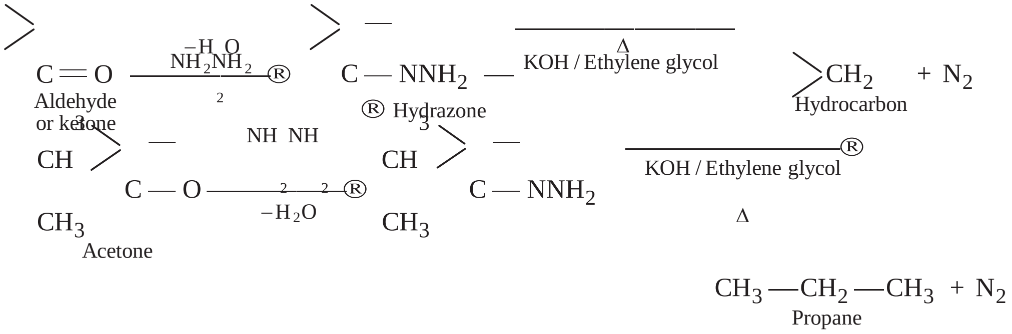
$$\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow{\text{Tollens reagent}} \text{No silver mirror}$$

OR

(*a*) (*i*) The methyl group due to its +I effect reduce the magnitude of positive charge on carbonyl carbon atom. Moreover it also hinders the approach of nucleophile CN^-. Since in acetaldehyde there is one methyl while in acetone there are two methyl groups attached to carbonyl group therefore acetaldehyde is more reactive than acetone towards nucleophilic addition with HCN.

(*ii*) Because the release of proton from carboxylic acid is much easier than from phenol as the conjugate base carboxylate ion is much more resonance stabilised than conjugate base phenoxide ion.

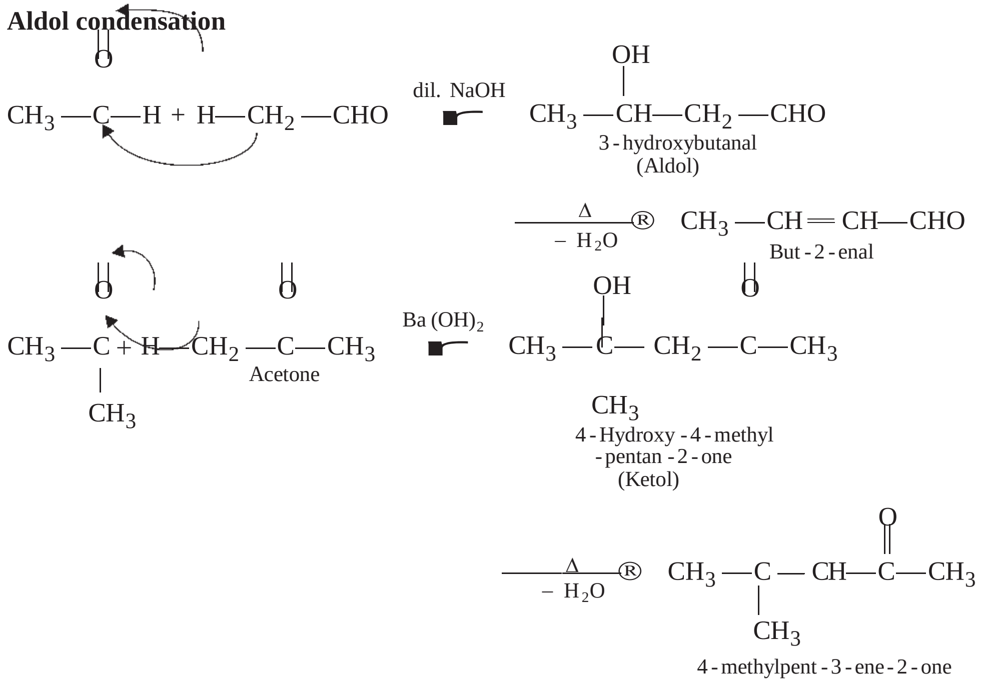
(*b*) **(*i*) Wolff–Kishner reduction**



$$\underset{\text{Aldehyde or ketone}}{>C{=}O} \xrightarrow[-H_2O]{NH_2NH_2} \underset{\text{Hydrazone}}{>C{=}NNH_2} \xrightarrow[\Delta]{\text{KOH / Ethylene glycol}} \underset{\text{Hydrocarbon}}{>CH_2} + N_2$$

$$\underset{\text{Acetone}}{(CH_3)_2C{=}O} \xrightarrow[-H_2O]{NH_2NH_2} (CH_3)_2C{=}NNH_2 \xrightarrow[\Delta]{\text{KOH / Ethylene glycol}} \underset{\text{Propane}}{CH_3{-}CH_2{-}CH_3} + N_2$$

(*ii*) Aldol condensation



$$CH_3{-}\overset{O}{\overset{\|}{C}}{-}H + H{-}CH_2{-}CHO \xrightarrow{\text{dil. NaOH}} \underset{\text{3-hydroxybutanal (Aldol)}}{CH_3{-}\overset{OH}{\overset{|}{C}H}{-}CH_2{-}CHO} \xrightarrow[-H_2O]{\Delta} \underset{\text{But-2-enal}}{CH_3{-}CH{=}CH{-}CHO}$$

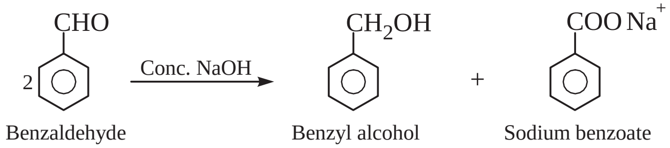
$$CH_3{-}\underset{CH_3}{\underset{|}{\overset{O}{\overset{\|}{C}}}} + H{-}\underset{\text{Acetone}}{CH_2{-}\overset{O}{\overset{\|}{C}}{-}CH_3} \xrightarrow{Ba(OH)_2} \underset{\text{4-Hydroxy-4-methyl-pentan-2-one (Ketol)}}{CH_3{-}\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}{-}CH_2{-}\overset{O}{\overset{\|}{C}}{-}CH_3} \xrightarrow[-H_2O]{\Delta} \underset{\text{4-methylpent-3-ene-2-one}}{CH_3{-}\underset{CH_3}{\underset{|}{C}}{=}CH{-}\overset{O}{\overset{\|}{C}}{-}CH_3}$$

(*iii*) Cannizzaro reaction

$2HCHO \xrightarrow{\text{Conc. KOH}}$ CH_3OH +

® Formaldehyde $HCOO^- K^+$ Methyl alcohol

Potassium formate



SET–II

1. Sol: Paints, cell fluids

Gel: Butter, cheese

3. 3-aminobutanal

5. Azeotropes are the binary mixtures of liquids having the same composition in liquid and vapour phase and boil at a constant temperature e.g. a mixture of 68% nitric acid and 32% water by mass.

6. $C_6H_5NH_2 < C_6H_5NHCH_3 < C_6H_5CH_2NH_2$

7. Amylopectin

9. It states that "the partial pressure of the gas in vapour phase (p) is directly proportional to the mole fraction of gas (x) in the solution".

Mathematically, $p = K_H x$

where K_H is the Henry's law constant.

The solubility of a gas in liquid decreases with rise in temperature as dissolution of a gas in a liquid is an exothermic process.

10. (*i*) A reaction which is not truely of first order but under certain conditions becomes a reaction of first order is called pseudo first order reaction *e.g.* acid hydrolysis of ethyl acetate.

$$CH_3COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3COOH + C_2H_5OH$$

Rate $\propto [CH_3COOC_2H_5]$ as H_2O is in excess.

(*ii*) The half life ($t_{1/2}$) of a reaction is the time in which the concentration of reactant is reduced to one half of its initial concentration $[R]_o$.

For a first order reaction $t_{1/2} = \dfrac{0.693}{k}$ *i.e.*, independent of $[R]_o$.

For a zero order reaction $t_{1/2} = \dfrac{[R]_o}{2k}$ *i.e.*, $t_{1/2} \propto [R]_o$.

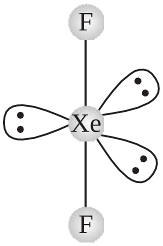
11. (*i*) Hydraulic washing: It is based on the differences in the gravities of the ore and the gangue particles.

(*ii*) Vapour phase refining: In this, metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal. So, the two requirements are:

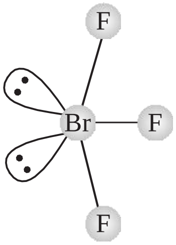
(*a*) The metal should form a volatile compound with an available reagent.

(*b*) The volatile compound should be easily decomposable, so that the recovery is easy.

22. (*a*) (*i*) There are two bond pairs and three lone pairs of electrons around central Xe atom in XeF_2. Therefore according to VSEPR Theory XeF_2 should be linear.



(*ii*) There are three bond pairs and two lone pairs of electrons around central Br atom in BrF_3. Therefore according to VSEPR theory BrF_3 should be slightly bent "T".



24. (*i*) Due to inert pair effect +3 oxidation state of Bi is more stable than its +5 oxidation state while +5 oxidation state of Sb is more stable than its +3 oxidation state. Therefore, Bi (V) can more easily accept a pair of electrons to form more stable Bi (III) than Sb (V) can accept a pair of electrons and hence Bi (V) is stronger oxidising agent than Sb (V).

(*ii*) N–N single bond is weaker than P–P single bond due to large interelectronic repulsion between the lone pairs of electrons present on the N atoms of N–N bond having small bond length.

(*iii*) Noble gases being monoatomic have no interatomic forces except weak London or dispersion forces and therefore, they are liquefied at very low temperatures. Hence, they have very low boiling points.

25. (*i*) Saccharin, sucrolose.

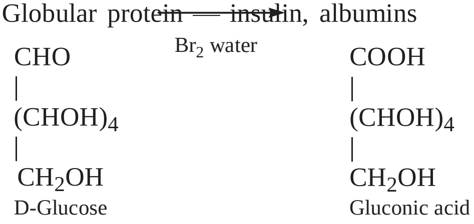
(*ii*) Antibiotics are the chemical substance produced wholly or partly by chemical synthesis, which in low concentrations, either kill or inhibit the growth of microorganisms by intervening in their metabolic processes. A few examples of antibiotics are chloramphenicol, ofloxacin, penicillin.

(*iii*) Biomolecules such as carbohydrates, proteins, lipids and nucleic acids are chosen as drug targets.

27. (*i*) Vitamin D

(*ii*) Fibrous protein — keratin, myosin
Globular protein — insulin, albumins

(*iii*)



$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{D-Glucose} \end{array} \xrightarrow{Br_2\ \text{water}} \begin{array}{l} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Gluconic acid} \end{array}$$

SET–III

1. Lyophobic sol — Gold sol, As_2S_3 sol
Lyophilic sol — Sol of starch, sol of gum

2. 4-hydroxypentan-2-one

3. Hydrogen bonds

5. $C_6H_5NH_2 < C_6H_5NHCH_3 < C_6H_5N(CH_3)_2$

6. $$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{D-(+)-Glucose}}{C_6H_{12}O_6} + \underset{\text{D-(–)-Fructose}}{C_6H_{12}O_6}$$

9. It states that for a solution of volatile liquids, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction. According to Raoults law, for a volatile component, A of the solution

$P_A \propto x_A$ or $P_A = P_A^o x_A$, where P_A^0 is the vapour pressure of pure component A.

If one of the component is so volatile that it exist as a gas then according to Henry's law
$p = K_H x$, where K_H is the Henry law constant *i.e.*, the partial vapour pressure of the volatile component (gas) is directly proportional to its mole fraction in the solution.

Thus the similarity between Raoult's law and Henry's law is that both state that the partial vapour pressure of the volatile component or gas is directly proportional to its mole fraction in the solution.

10. (*i*) Rate constant, *k* may be defined as the rate of reaction when concentration of each reactant is taken as unity.

(*ii*) Refer to Ans. 10 (*ii*) Set-II CBSE Delhi 2014.

11. (*i*) This method of concentration of ore is based on the principle that the surface of sulphide ores is preferentially wetted by oils while that of gangue is preferentially wetted by water.

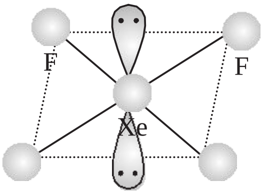
(*ii*) Electrolytic refining: In this method, impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in a electrolytic bath containing soluble salt of same metal. On passing electric current, metal ions from the electrolyte solution are deposited at the cathode in the form of pure metal while an equivalent amount of metal dissolves from the anode and goes into the electrolyte solution as metal ions, *i.e.*,

At cathode: $M^{n+}(aq) + ne^- \longrightarrow M(s)$

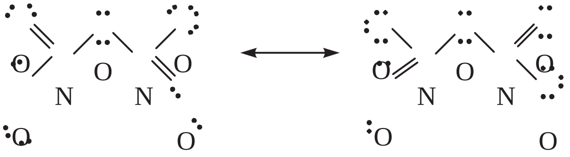
At anode: $M(s) \longrightarrow M^{n+}(aq) + ne^-$

The voltage applied for the electrolysis is such that the impurities of more electropositive metals remain in the solution as ions where impurities of less basic metals settle down under the anode as anode mud. A large number of metals such as copper, gold, silver, zinc, aluminium, etc., are refined by this method.

20. (*a*) (*i*) There are four bond pairs and two lone pairs of electrons around central Xe atom in XeF_4. Therefore according to VSEPR theory XeF_4 should be square planar.



(*ii*)



)

F F

(XeF_4) Square planar

22. (*i*) In vapour form sulphur partly exists as S_2 molecules which have two unpaired electrons in the antibonding π^* molecular orbitals like O_2 molecule and hence, exhibits paramagnetism.

(*ii*) The oxidation of central atom Sn is +4 in $SnCl_4$ while it is +2 in $SnCl_2$. Higher the positive oxidation of central atom, more will be its polarising power which, in turn increases the covalent character of bond formation between the central atom and the atoms around it.

(*iii*) Acids which contains P—H bonds have reducing character. Since H_3PO_2 contains two P—H bonds while H_3PO_3 contains only one P—H bond therefore H_3PO_2 is a stronger reducing agent than H_3PO_3.

23. (*i*) Chemical substances which kill microorganisms or stop their growth but are not safe to be applied to the living tissues are called disinfectants. For example, chlorine in concentrations of 0.2 to 0.4 ppm is used for sterilisation of water to make it fit for drinking.

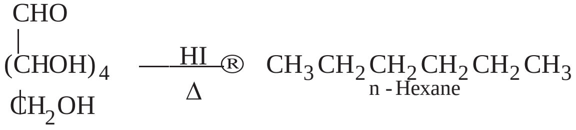
(*ii*) Biomolecules such as carbohydrates, proteins, liquids and nucleic acids are chosen as drug targets.

(*iii*) Anionic detergents: These are so named because large part of their molecules are anions and it is the anionic part of the molecule which is involved in the cleansing action. These are sodium salt of sulphonated long chain alcohols or hydrocarbons. For example, sodium lauryl sulphate, sodium dodecylbenzene sulphonate, etc. Anionic detergents are used in household work and in toothpastes.

24. (*i*) Vitamin C

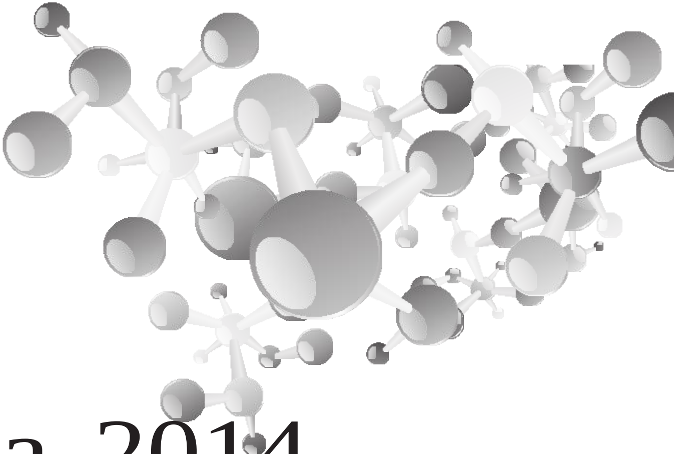
(*ii*) Peptide linkage

(*iii*) On prolonged heating with HI, glucose gives n-hexane.



$$\begin{array}{l}\text{CHO}\\ |\\ (\text{CHOH})_4\\ |\\ \text{CH}_2\text{OH}\end{array} \xrightarrow[\Delta]{\text{HI}} \underset{\text{n - Hexane}}{CH_3CH_2CH_2CH_2CH_2CH_3}$$

* * *



CBSE Examination Paper All India-2014

Time allowed : 3 hours **Maximum marks: 70**

General Instructions: *Same as CBSE Examination Paper Delhi-2014.*

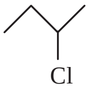
SET–I

1. What is the effect of temperature on chemisorption?

2. What is the role of zinc metal in the extraction of silver?

3. What is the basicity of H_3PO_3?

4. Identify the chiral molecule in the following pair:



5. Which of the following is a natural polymer?
Buna-S, Proteins, PVC

6. The conversion of primary aromatic amines into diazonium salts is known as __________ .

7. What are the products of hydrolysis of sucrose?

8. Write the structure of p-methylbenzaldehyde.

9. An element with density 2.8 g cm^{-3} forms a f.c.c. unit cell with edge length 4×10^{-8} cm. Calculate the molar mass of the element.
(Given: $N_A = 6.022 \times 10^{23}$ mol^{-1})

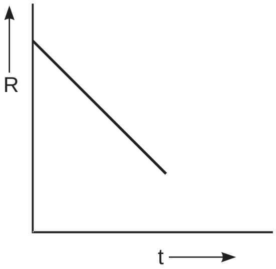
10. (*i*) What type of non-stoichiometric point defect is responsible for the pink colour of LiCl?
(*ii*) What type of stoichiometric defect is shown by NaCl?

OR

How will you distinguish between the following pairs of terms:
(*i*) Tetrahedral and octahedral voids
(*ii*) Crystal lattice and unit cell

11. State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution?

12. For a chemical reaction R ® P, the variation in the concentration (*R*) vs. time (*t*) plot is given as



(*i*) Predict the order of the reaction.

(*ii*) What is the slope of the curve?

13. Explain the principle of the method of electrolytic refining of metals. Give one example.

14. Complete the following equations:

(*i*) $P_4 + H_2O$

——® (*ii*

) $XeF_4 + O_2F_2$ ——®

15. Draw the structures of the following:

(*i*) XeF_2 (*ii*) BrF_3

16. Write the equations involved in the following reactions:

(*i*) Reimer-Tiemann reaction

(*ii*) Williamson synthesis

17. Write the mechanism of the following reaction:

CH_3CH_2OH $\xrightarrow{HBr}$® $CH_3CH_2Br + H_2O$

18. Write the name of monomers used for getting the following polymers:

(*i*) Bakelite (*ii*) Neoprene

19. (*a*) Calculate $\Delta_r G^0$ for the reaction

$Mg(s) + Cu^{2+}(aq)$ ——® $Mg^{2+}(aq) + Cu(s)$

Given: $E^o_{cell} = +2.71$ V, 1 F = 96500 C mol^{-1}

(*b*) Name the type of cell which was used in Apollo space programme for providing electrical power.

20. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:

SO_2Cl_2 (g) ——® $SO_2(g) + Cl_2(g)$

Experiment	Time/s^{-1}	Total pressure/atm
1	0	0.4
2	100	0.7

Calculate the rate constant.

(Given: log 4 = 0.6021, log 2 = 0.3010)

21. What are emulsions? What are their different types? Give one example of each type.

22. Give reasons for the following:

(*i*) $(CH_3)_3 P{=}O$ exists but $(CH_3)_3N{=}O$ does not.

(*ii*) Oxygen has less electron gain enthalpy with negative sign than sulphur.

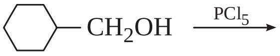
(*iii*) H_3PO_2 is a stronger reducing agent than H_3PO_3.

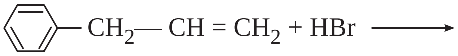
23. (*i*) Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]Cl$.

(*ii*) What type of isomerism is exhibited by the complex $[Co(en)_3]^{3+}$?
(en = ethane-1,2-diamine)

(*iii*) Why is $[NiCl_4]^{2-}$ paramagnetic but $[Ni(CO)_4]$ is diamagnetic?
(At nos.: Cr = 24, Co = 27, Ni = 28)

24. (*a*) Draw the structures of major monohalo products in each of the following reactions:

(*i*)


(*ii*)


(*b*) Which halogen compound in each of the following pairs will react faster in S_N2 reaction?

(*i*) CH_3Br or CH_3I

(*ii*) $(CH_3)_3 C$—C1 or CH_3—C1

25. Account for the following:

(*i*) Primary amines ($R\text{-}NH_2$) have higher boiling point than tertiary amines (R_3N).

(*ii*) Aniline does not undergo Friedel–Crafts reaction.

(*iii*) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

OR

Give the structures of A, B and C in the following reactions:

(*i*) $C_6H_5NO_2 \xrightarrow{Sn + HCl} A \xrightarrow[273K]{NaNO_2 + HCl} B \xrightarrow{H_2O} C$

(*ii*) $CH_3CN \xrightarrow{H_2O/H^+} A \xrightarrow[\Delta]{NH_3} B \xrightarrow{Br_2 + KOH} C$

26. Define the following terms as related to proteins:

(*i*) Peptide linkage

(*ii*) Primary structure

(*iii*) Denaturation

27. ***On the occasion of World Health Day, Dr. Satpal organised a 'health camp' for the poor farmers living in a nearby village. After check-up, he was shocked to see that most of the farmers suffered from cancer due to regular exposure to pesticides and many were diabetic. They distributed free medicines to them. Dr. Satpal immediately reported the matter to the National Human Rights Commission (NHRC). On the suggestions of NHRC, the government decided to provide medical care, financial assistance, setting up of super-speciality hospitals for treatment and prevention of the deadly disease in the affected villages all over India.***

(i) Write the values shown by

(a) Dr. Satpal ***(b) NHRC***

(ii) What type of analgesics are chiefly used for the relief of pains of terminal cancer?

(*iii*) ***Give an example of artificial sweetener that could have been recommended to diabetic patients.***

28. (*a*) Define the following terms:

(*i*) Molarity

(*ii*) Molal elevation constant (K_b)

(*b*) A solution containing 15 g urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution.

OR

(*a*) What type of deviation is shown by a mixture of ethanol and acetone? Give reason.

(*b*) A solution of glucose (molar mass = 108 g mol^{-1}) in water is labelled as 10% (by mass). What would be the molality and molarity of the solution?

(Density of solution = 1.2 g mL^{-1})

29. (*a*) Complete the following equations:

(*i*) $Cr_2O_7^{2-} + 2OH^- \longrightarrow$

(*ii*) $MnO_4^- + 4H^+ + 3e^- \longrightarrow$

(*b*) Account for the following:

(*i*) Zn is not considered as a transition element.

(*ii*) Transition metals form a large number of complexes.

(*iii*) The E° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple.

OR

(*i*) With reference to structural variability and chemical reactivity, write the differences between lanthanoids and actinoids.

(*ii*) Name a member of the lanthanoid series which is well known to exhibit +4 oxidation state.

(*iii*) Complete the following equation:

$MnO_4^- + 8H^+ + 5e^- \longrightarrow$

(*iv*) Out of Mn^{3+} and Cr^{3+}, which is more paramagnetic and why?

(Atomic nos.: Mn = 25, Cr = 24)

30. (*a*) Write the products formed when CH_3CHO reacts with the following reagents:

(*i*) HCN

(*ii*) $H_2N—OH$

(*iii*) CH_3CHO in the presence of dilute NaOH

(*b*) Give simple chemical tests to distinguish between the following pairs of compounds:

(*i*) Benzoic acid and Phenol

(*ii*) Propanal and Propanone

OR

(*a*) Account for the following:

(*i*) $Cl—CH_2COOH$ is a stronger acid than CH_3COOH.

(*ii*) Carboxylic acids do not give reactions of carbonyl group.

(*b*) Write the chemical equations to illustrate the following name reactions:

(*i*) Rosenmund reduction

(*ii*) Cannizzaro's reaction

(*c*) Out of CH_3CH_2 —CO—CH_2—CH_3 and CH_3CH_2—CH_2—CO—CH_3, which gives iodoform test?

SET–II (Questions Uncommon to SET–I)

1. Why is adsorption always exothermic?

2. Name the method that is used for refining of nickel.

3. Why does NO_2 dimerise?

4. Based on molecular forces what type of polymer is neoprene?

5. What are the products of hydrolysis of maltose?

6. Write the structure of 4-chloropentan-2-one.

9. Write the name of monomers used for getting the following polymers:

(*i*) Terylene

(*ii*) Nylon-6, 6

10. Describe the role of the following:

(*i*) SiO_2 in the extraction of copper from copper matte

(*ii*) NaCN in froth floatation process

11. Complete the following equations:

(*i*) Ag + PCl_5 ———®

(*ii*) CaF_2 + H_2SO_4

———® **12.** Draw

the structures of the following:

(*i*) XeF_4

(*ii*) $HClO_4$

13. (*i*) Write the type of magnetism observed when the magnetic moments are oppositively aligned and cancel out each other.

(*ii*) Which stoichiometric defect does not change the density of the crystal?

14. Define the following terms:

(*i*) Fuel cell

(*ii*) Limiting molar conductivity (Λ_m°)

19. Define the following terms:

(*i*) Glycosidic linkage

(*ii*) Invert sugar

(*iii*) Oligosaccharides

SET–III (Questions Uncommon to Set–I and II)

1. What are the dispersed phase and dispersion medium in milk?
2. Name the method used for refining of copper metal.

3. Why does NH_3 act as a Lewis base?

5. Which of the following is a fibre?

Nylon, Neoprene, PVC

6. Write the products of hydrolysis of lactose.

8. Write the structure of 2-hydroxybenzoic acid.

9. Complete the following equations:

(*i*) $C + \text{conc. } H_2SO_4 \longrightarrow$

(*ii*) $XeF_2 + H_2O \longrightarrow$

10. Draw the structures of the following:

(*i*) XeO_3

(*ii*) H_2SO_4

11. Write the name of monomers used for getting the following polymers:

(*i*) Teflon

(*ii*) Buna-N

13. (*i*) Write the type of magnetism observed when the magnetic moments are aligned in parallel and anti-parallel directions in unequal numbers.

(*ii*) Which stoichiometric defect decreases the density of the crystal?

14. Define the following terms:

(*i*) Molar conductivity (Λ_m)

(*ii*) Secondary batteries

17. Write the principle behind the froth floatation process. What is the role of collectors in this process?

23. Define the following terms:

(*i*) Nucleotide

(*ii*) Anomers

(*iii*) Essential amino acids

z z z

Solutions

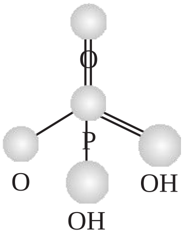
SET–I

1. Chemisorption initially increases then decreases with rise in temperature. The initial increase is due to the fact that heat supplied acts as activation energy. The decrease afterwards is due to the exothermic nature of adsorption equilibrium.

2. Zinc acts as reducing agent in the extraction of silver. It reduces Ag^+ to Ag and itself get oxidised to Zn^{2+}.

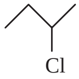
$$2Na[Ag(CN)_2] + Zn \longrightarrow Na_2[Zn(CN)_4] + 2Ag$$

↓ **3.** As H_3PO_3 contains two ionizable P–OH bonds. Therefore, it is dibasic.



H_3PO_3

4.



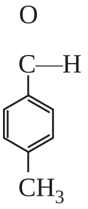
5. Proteins

6. Diazotisation.

7. Sucrose on hydrolysis gives one molecule each of glucose and fructose.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

8.



p-methylbenzaldehyde

9. For f.c.c. unit cell number of atoms per unit cell, $z = 4$

$$M = \frac{d \times N_A \times a^3}{z}$$

Here, $d = 2.8\ gcm^{-3}$, $N_A = 6.022 \times 10^{23}\ mol^{-1}$, $a = 4 \times 10^{-8}$ cm

$$\therefore \quad M = 2.8\ \text{g cm}^{-3} \times 6.022 \times 10^{23}\ \text{mol}^{-1} \times (4 \times 10^{-8}\ \text{cm})^{3}$$

$$M = 26.98\ \text{g mol}^{-1}$$

10. (*i*) Metal excess defect due to anionic vacancies.

(*ii*) Schottky defect.

OR

(*i*) A void surrounded by four spheres occupying the corners of tetrahedron is called a tetrahedral void. It is much smaller than the size of spheres in the close packing. A void surrounded by six spheres along the corners of an octahedral is called octahedral void. The size of the octahedral void is smaller than that of the spheres in the close packing but larger than the octahedral void.

(*ii*) The regular three dimensional arrangement of identical points in the space which represent how the constituent particles (atoms, ions, molecules) are arranged in a crystal is called a crystal lattice.

A unit cell is the smallest portion of a crystal lattice, which when repeated over and again in different directions produces the complete crystal lattice.

11. Kohlrausch law states that the limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of cation and anion of the electrolyte.

In general, if an electrolyte on dissociation gives ν_+ cations and ν_- anions then its limiting molar conductivity is given by

$$\Lambda^\circ_m = \nu_+ \lambda^\circ_+ + \nu_- \lambda^\circ_-$$

where, λ°_+ and λ°_- are the limiting molar conductivities of cations and anions respectively.

Conductivity of a solution decreases with dilution. This is due to the fact that the number of ions per unit volume that carry the current in a solution decreases with dilution.

12. (*i*) Order of the reaction is zero.

(*ii*) Slope $= \dfrac{d[R]}{dt} = -k$

13. Electrolytic refining: In this method, impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in an electrolytic bath containing soluble salt of same metal. On passing electric current, metal ions from the electrolyte solution are deposited at the cathode in the form of pure metal while an equivalent amount of metal dissolves from the anode and goes into the electrolyte solution as metal ions, *i.e.*,

At cathode: $\mathrm{M}^{n+}(aq) + ne^- \longrightarrow \mathrm{M}(s)$

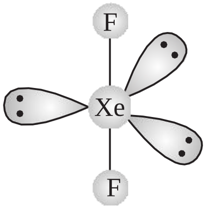
At anode: $\mathrm{M}(s) \longrightarrow \mathrm{M}^{n+}(aq) + ne^-$

The voltage applied for the electrolysis is such that the impurities of more electropositive metals remain in the solution as ions whereas impurities of less basic metals settle down under the anode as anode mud. A large number of metals such as copper, gold, silver, zinc, aluminium, etc., are refined by this method.

14. (*i*) $P_4 + H_2O \longrightarrow$ No reaction

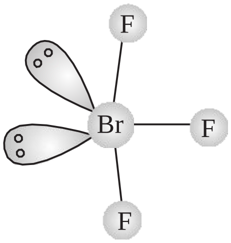
(*ii*) $XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$

15. (*i*) There are two bond pairs and three lone pairs electrons around central Xe atom in XeF_2. Therefore according to VSEPR theory XeF_2 should be linear.



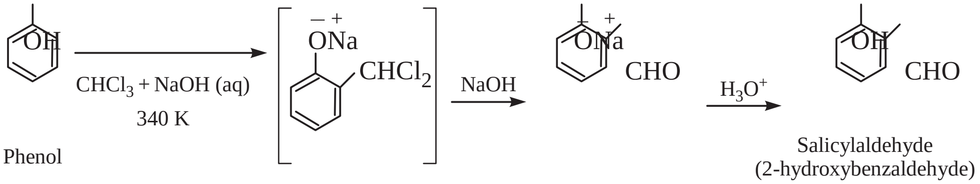
XeF_2

(*ii*) There are three bond pairs and two lone pairs of electrons around central Br atom in BrF_3. Therefore according to VSEPR theory BrF_3 should be slightly bent "T".



BrF_3

16. (*i*) **Reimer–Tiemann reaction:**



(*ii*) **Williamson synthesis:**

$$\underset{\text{Alkyl halide}}{R—X} + \underset{\text{Sodium alkoxide}}{\overset{+}{Na}—\overset{-}{O}—R'} \longrightarrow \underset{\text{Ether}}{R—O—R'} + NaX$$

$$\underset{\text{Ethyl bromide}}{CH_3—CH_2—Br} + \underset{\text{Sodium ethoxide}}{\overset{+}{Na}—\overset{-}{O}—CH_2—CH_3} \longrightarrow \underset{\substack{\text{Diethyl ether}\\\text{(Symmetrical ether)}}}{CH_3—CH_2—O—CH_2—CH_3} + NaBr$$

17. Refer to Ans 26 (*a*) Set-I, CBSE Delhi 2014.

18. (*i*) Phenol and formaldehyde

(*ii*) Chloroprene

19. (*a*) $Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)$

$$\Delta_r G^0 = -nFE^o_{cell}$$

Here, $n = 2$, $F = 96500$ C mol^{-1} and $E^o_{cell} = 2.71$ V

$$\therefore \quad \Delta_r G^0 = -2 \times 96500 \text{ C mol}^{-1} \times 2.71 \text{ V}$$
$$= -523030 \text{ J mol}^{-1}$$
$$= -523.03 \text{ kJ mol}^{-1}$$

(*b*) $H_2—O_2$ fuel cell

20. Refer to Ans. 22 Set-I, CBSE Delhi 2014.

21. Emulsions are the colloidal solutions in which both the dispersed phase and dispersion medium are liquids. Emulsion can be classified into two types. These are:

(*i*) Oil in water (O/W) type emulsion: In this type of emulsions oil acts as disperse phase and water acts as dispersion medium *e.g.*, milk, vanishing cream.

(*ii*) **Water in oil (W/O) type emulsion:** In this type of emulsions water acts as disperse phase and oil acts as dispersion medium e.g., butter, cod liver oil, cold cream.

22. (*i*) Phosphorus due to presence of *d* orbitals in its valence shell forms $p\pi - d\pi$ multiple bonds. As a result phosphorus can expand its covalency beyond four. Therefore, phosphorus form $R_3P{=}O$ in which its covalency is 5. In contrast, nitrogen due to absence of *d*-orbitals, cannot form $p\pi - d\pi$ multiple bonds and hence cannot expand its covalency beyond 4. Therefore, $(CH_3)_3N{=}O$ does not exist.

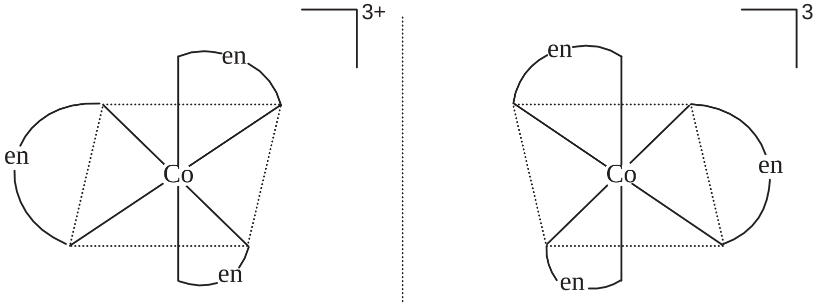
(*ii*) The size of O atom is smaller as compared to S. Thus when an electron is added to isolated gaseous O atom, the interelectronic repulsions encountered in the smaller 2*p*-orbitals of O are larger than those encountered in the larger 3*p*-orbitals of S.

As a result less energy is released in case of O than in case of S. Hence oxygen has less electron gain enthalpy with negative sign than sulphur.

(*iii*) Acids which contains P–H bonds have reducing character. Since H_3PO_2 contains two P–H bonds while H_3PO_3 contains only one P–H bond therefore H_3PO_2 is a stronger reducing agent than H_3PO_3.

23. (*i*) Tetraamminedichloridochromium (III) chloride.

(*ii*) Complex $[Co(en)_3]^{3+}$ shows optical isomerism.

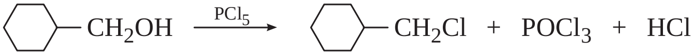


d-Tris-(ethane1,2-diamine) cobalt (III)

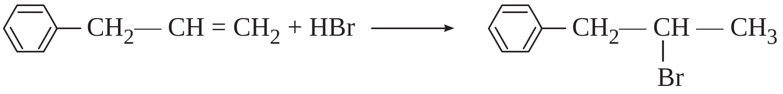
l-Tris-(ethane1,2-diamine) cobalt (III)

(*iii*) In complex $[NiCl_4]^{2-}$, Ni is in +2 oxidation state with the electronic configuration $3d^8\ 4s^0$. As Cl^- is a weak ligand it cannot pair up the electrons in 3*d* orbitals therefore $[NiCl_4]^{2-}$ is paramagnetic. In $[Ni(CO)_4]$, Ni is in zero oxidation state with the electronic configuration $3d^8\ 4s^2$. CO is a strong ligand it causes 4*s* electrons to shift to 3*d* and pair up 3*d* electrons. Since there is no unpaired electron in the complex $Ni(CO)_4$, therefore, it is diamagnetic.

24. (*a*) (*i*)



(*ii*)



(*b*) (*i*) CH_3—I. As iodine is better leaving group due to its larger size, it will be released at a faster rate in the presence of incoming nucleophile.

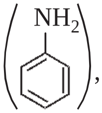
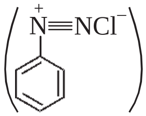
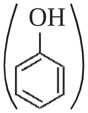
(*ii*) CH_3Cl. As three bulky methyl groups hinder the approach of nucleophile in $(CH_3)C$—Cl.

25. (*i*) In primary amines, two hydrogen atoms are present on N-atom and they undergo extensive intermolecular hydrogen bonding which results in association of molecules while in tertiary amines, no hydrogen atom is present on N-atom. Hence there is no hydrogen bonding in tertiary amines. As a result of this primary amines have higher boiling point than tertiary amines.

(*ii*) Aniline being a Lewis base reacts with $AlCl_3$ a Lewis acid and catalyst used in Friedel crafts reaction to form salt $C_6H_5\overset{+}{N}H_2\overset{-}{Al}Cl_3$. Due to presence of a +ve charge on N-atom in the salt, the group $\overset{+}{N}H_2AlCl_3$ acts as a strong deactivating group. It reduces the electron density in the benzene ring as a result of this aniline does not undergo Friedel-crafts reaction.

(*iii*) The basicity of amine in aqueous solution depends upon the stability of the substituted ammonium cation. Here the combination of three factors, +ve I effect of CH_3 groups, hydrogen bonding and steric hindrance favour greater stability for ammonium cation of dimethyl amine than ammonium cation of trimethyl amine. Hence dimethylamine is stronger base than trimethyl amine.

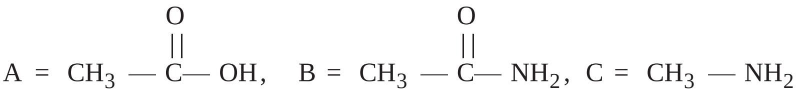
OR

(*i*) A = $C_6H_5NH_2$ , B = $C_6H_5\overset{+}{N_2}Cl^-$ , C = C_6H_5OH 

Aniline

Benzene diazoniumchloride

Phenol

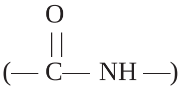
(*ii*) 

$$A = CH_3 - \overset{O}{\overset{||}{C}} - OH, \quad B = CH_3 - \overset{O}{\overset{||}{C}} - NH_2, \quad C = CH_3 - NH_2$$

Ethanoic acid

Ethanamide

Methanamine

26. (*i*) A peptide linkage is an amide  $(- \overset{O}{\overset{||}{C}} - NH -)$ linkage formed between —COOH group of one α-amino acid and $—NH_2$ group of other α-amino acid by loss of a water molecule.

(*ii*) The specific sequence in which various α-amino acids present in a protein are linked to one another is called its primary structure. Any change in its primary structure creates a new protein.

(*iii*) **Denaturation of Proteins:** When a protein in its native form is subjected to a change, such as change in temperature or change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation, 2° and 3° structures are destroyed but 1° structures remain intact, *e.g.*, coagulation of egg while on boiling, curdling of milk, etc.

27. (*i*) (*a*) The values shown by Dr. Satpal are concern for the health of others, dedicated towards work, kind, compassionate.

(*b*) The values shown by NHRC are responsiveness, having understanding of public health in rural area, dutiful, caring.

(*ii*) Narcotic analgesics such as morphine, heroin, codeine are used for the relief of pains of terminal cancer.

(*iii*) Saccharin, Sucrolose.

28. (*a*) (*i*) Molarity may be defined as number of moles of solute dissolved in one litre of solution.

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution (in litre)}}$$

(*ii*) Molal elevation constant may be defined as the elevation in boiling point when one mole of solute is dissolved in 1000 grams of the solvent.

(*b*) Osmotic pressure, $\pi = \dfrac{W_B \times R \times T}{M_B \times V}$

Osmotic pressure of urea solution = $\dfrac{15 \times R \times T}{60 \times 1}$

Osmotic pressure of glucose solution = $\dfrac{W_B \times R \times T}{180 \times 1}$

As, Osmotic pressure of urea solution = Osmotic pressure of glucose solution

Therefore, $\dfrac{15 \times R \times T}{60 \times 1} = \dfrac{W_B \times R \times T}{180 \times 1}$

Mass of glucose, $W_B = \dfrac{15 \times 180}{60} = 45$ g

OR

(*a*) A mixture of ethanol and acetone shows positive deviation from Raoults law.

In pure ethanol hydrogen bond exist between the molecules. On adding acetone to ethanol, acetone molecules get in between the molecules of ethanol thus breaking some of the hydrogen bonds and weakening molecular interactions considerably. Weakening of molecular interactions leads to increase in vapour pressure resulting in positive deviation from Raoults law.

(*b*) Let the mass of solution = 100 g

∴ Mass of glucose = 10 g

Number of moles of glucose = $\dfrac{\text{Mass of glucose}}{\text{Molar mass}}$

$= \dfrac{10 \text{ g}}{180 \text{ g mol}^{-1}} = 0.056$ mol

Volume of solution = $\dfrac{\text{Mass of solution}}{\text{Density of solution}}$

$= \dfrac{100 \text{ g}}{1.2 \text{ g mL}^{-1}} = 83.3$ mL

$= \dfrac{83.3}{1000}$ L = 0.083 L

Molarity = $\dfrac{\text{Moles of solute}}{\text{Volume of solution in litre}}$

$= \dfrac{0.056 \text{ mol}}{0.083 \text{ L}} = 0.67 \text{ mol L}^{-1}$

Mass of solvent, water = 100 g – 10 g = 90 g

$= \dfrac{90 \text{ g}}{1000 \text{ g kg}^{-1}} = 0.09$ kg

Molality = $\dfrac{\text{Moles of glucose}}{\text{Mass of water in kg}}$

$= \dfrac{0.056 \text{ mol}}{0.09 \text{ kg}} = 0.62 \text{ mol kg}^{-1}$

29. (*a*) (*i*) $Cr_2O_7^{2-} + 2OH^- \longrightarrow 2CrO_4^{2-} + H_2O$

(*ii*) $MnO_4^- + 4H^+ + 3e^- \xrightarrow{\text{Heat}} MnO_2 + 2H_2O$

(*b*) (*i*) As zinc atom has completely filled *d* orbitals $(3d^{10}\,4s^2)$ in its ground state as well as in its oxidised state, therefore zinc is not considered as transition element.

(*ii*) Transition metals form a large number of complexes due to following reasons:

- Small size and high charge of the ions of transition metals.
- Presence of vacant orbitals of appropriate energy which can accept lone pairs of electrons donated by ligand.

(*iii*) Mn^{2+}has the electronic configuration $[Ar]3d^5$ which is half filled and hence very stable. Due to this the third ionisation energy of Mn is very high. Thus the much large third ionisation energy of Mn (where the required change is d^5 to d^4) is mainly responsible for this.

OR

(*i*)

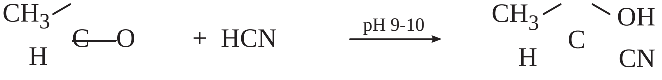
S.No.	Lanthanoids	Actinoids
(*i*)	Atomic or ionic radii does not show much variation.	Atomic or ionic radii show much variation.
(*ii*)	Besides +3 oxidation state, they show +2 and +4 oxidation states in few cases.	Besides +3 oxidation states, they show higher oxidation states of +4, +5, +6, +7 also.

(*ii*) Cerium, Ce ([Xe] $4f^2\,5d^0\,6s^2$). Formation of Ce^{4+} is favoured by its noble gas configuration ([Xe] $4f^0\,5d^0\,6s^0$).

(*iii*) $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

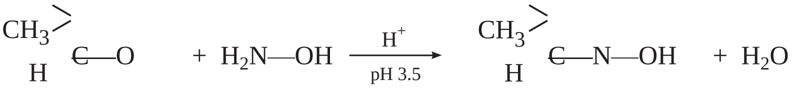
(*iv*) $Mn^{3+}(3d^4\,4s^0)$ has 4 unpaired electrons while $Cr^{3+}(3d^3\,4s^0)$ has 3 unpaired electrons therefore Mn^{3+} is more paramagnetic than Cr^{3+}.

30. (*a*) (*i*)



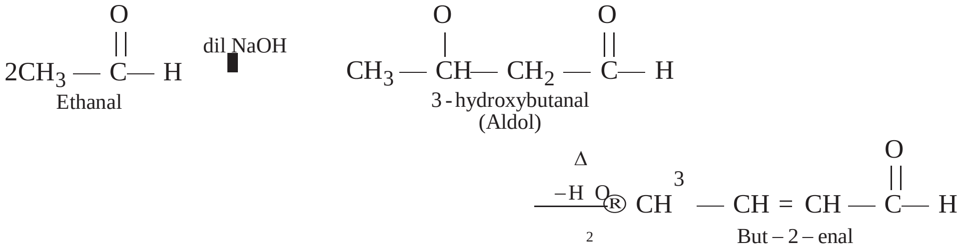
Ethanal Hydrogen cyanide Ethanal cyanohydrin

(*ii*)



Ethanal Ethanal oxime

(*iii*)



$$2CH_3-\overset{\overset{\large O}{||}}{C}-H \xrightarrow{\text{dil NaOH}} CH_3-\overset{\overset{\large O}{|}}{C}H-CH_2-\overset{\overset{\large O}{||}}{C}-H \xrightarrow[-H_2O]{\Delta} CH_3-CH=CH-\overset{\overset{\large O}{||}}{C}-H$$

Ethanal 3-hydroxybutanal (Aldol) But – 2 – enal (*b*) (*i*) Phenol gives a violet colour with neutral $FeCl_3$ solution while benzoic acid gives buff coloured precipitate of ferric benzoate.

$$6C_6H_5OH + FeCl_3 \longrightarrow \underset{\text{Violet coloured complex}}{[Fe(OC_6H_5)_6]^{3-}} + 3H^+ + 3HCl$$

$$\underset{\text{Benzoic acid}}{3C_6H_5COOH} + FeCl_3 \longrightarrow \underset{\substack{\text{Ferric benzoate}\\ \text{(Buff coloured ppt.)}}}{(C_6H_5COO)_3Fe} + 3HCl$$

(*ii*) Propanal being an aldehyde reduces Tollens' reagent to produce silver mirror but propanone being a ketone does not.

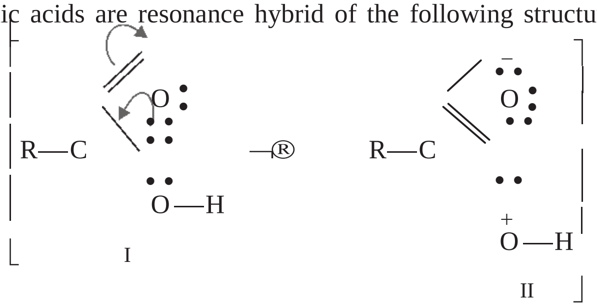
$$\underset{\text{Propanal}}{CH_3CH_2CHO} + 2[Ag(NH_3)_2]^+ + 3OH^- \longrightarrow CH_3CH_2COO^- + \underset{\substack{\text{Silver}\\ \text{mirror}}}{2Ag\downarrow} + 4NH_3 + 2H_2O$$

$$\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow{\text{Tollens' reagent}} \text{No silver mirror}$$

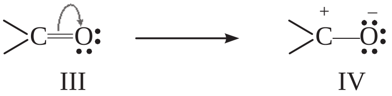
OR

(*a*) (*i*) Because of –I effect of Cl atom in $ClCH_2COOH$ and +I effect of CH_3 group in CH_3COOH the electron density in the O—H bond in $ClCH_2COOH$ is much lower than CH_3COOH. As a result O—H bond in $ClCH_2COOH$ is much weaker than in CH_3COOH therefore loses a proton more easily than CH_3COOH. Hence $ClCH_2COOH$ acid is stronger acid than CH_3COOH.

(*ii*) Carboxylic acids are resonance hybrid of the following structures:

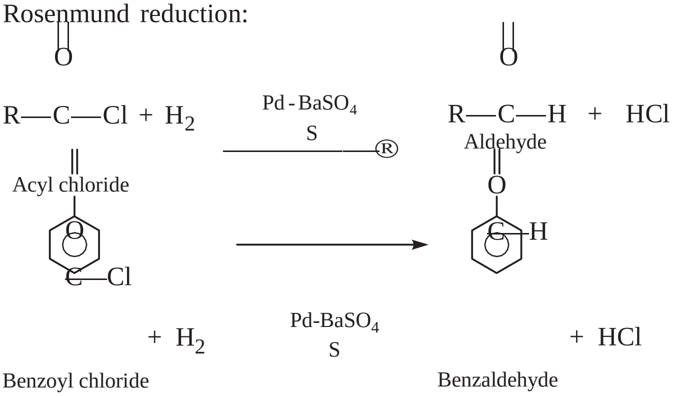


Similarly, a carbonyl group of aldehydes and ketones may regarded as resonance hybrid of following structures.



Because of contribution of structure (IV), the carbonyl carbon in aldehydes and ketones is electrophilic. On the other hand electrophilic character of carboxyl carbon is reduced due to contribution of structure (II). As carbonyl carbon of carboxyl group is less electropositive than carbonyl carbon in aldehydes and ketones therefore carboxylic acids do not give nucleophilic addition reactions of aldehydes and ketones.

(*b*) (*i*) Rosenmund reduction:

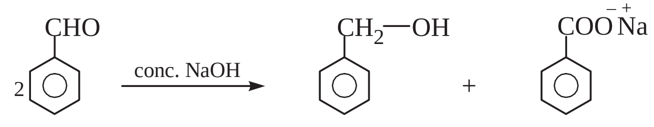


$$R—\overset{\overset{O}{||}}{C}—Cl + H_2 \xrightarrow[S]{Pd\text{-}BaSO_4} R—\overset{\overset{O}{||}}{C}—H + HCl$$

(*ii*) Cannizzaro reaction:

$$2HCHO \xrightarrow{\text{conc. KOH}} CH_3—OH + HCOO^- K^+$$

Formaldehyde Methyl alcohol Potassium formate



(*c*) $CH_3 — CH_2 — CH_2 — COCH_3$

SET–II

1. Adsorption occurs with decrease in entropy *i.e.*, ΔS is –ve. As $\Delta G = \Delta H - T\Delta S$ and for a process to be spontaneous ΔG must be –ve. This can be possible only when ΔH is –ve for the process *i.e.*, adsorption is exothermic.

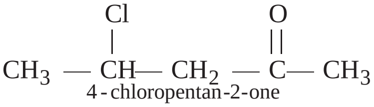
2. Mond process (Vapour phase refining)

3. NO_2 is an odd electron molecule in which N has seven electrons in its valence shell and hence is less stable. To become more stable by acquiring noble gas configuration having 8 electrons in the valence shell of N, it undergoes dimerisation to form N_2O_4.

4. Elastomer

5. Maltose on hydrolysis gives two molecules of glucose.

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{D-(+)-Glucose}}{C_6H_{12}O_6} + \underset{\text{D-(+)-Glucose}}{C_6H_{12}O_6}$$

6. 

$$CH_3 — \overset{\overset{Cl}{|}}{C}H — CH_2 — \overset{\overset{O}{||}}{C} — CH_3$$

4-chloropentan-2-one

9. (*i*) Ethylene glycol and terephthalic acid
   (*ii*) Hexamethylenediamine and adipic acid

10. (*i*) Copper matte chiefly consists of Cu_2S and some FeS. Silica acts as a flux in the extraction of copper from copper matte to remove ferrous oxide as ferrous silicate slag.

$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$$

$$FeO + \underset{\text{Flux}}{SiO_2} \longrightarrow \underset{\text{Slag}}{FeSiO_3}$$

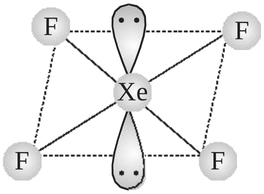
(*ii*) NaCN is used as depressant in froth floatation process. The role of a depressant is to prevent one type of sulphide particle from forming the froth with air bubble. For example to separate lead sulphide (PbS) ore from ZnS, NaCN is used as a depressant as it forms zinc complex, $Na_2[Zn(CN)_4]$ on the surface of ZnS thereby preventing it from forming froth. Under these conditions, only PbS forms froth and hence is separated from ZnS.

$$4NaCN + ZnS \text{ ——® } \underset{\text{Sodium tetracynozincate (II)}}{Na_2[Zn(CN)_4]} + Na_2S$$

11. (*i*) $2Ag + PCl_5 \text{ ——® } 2AgCl + PCl_3$

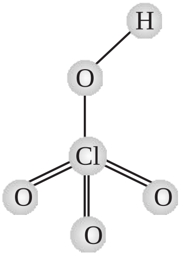
(*ii*) $CaF_2 + H_2SO_4 \text{ ——® } 2HF + CaSO_4$

12. (*i*) As there are 4 bond pairs and two lone pairs of electrons around central Xe atom in XeF_4 therefore according to VSEPR theory XeF_4 should be square planar.



(XeF_4) Square planar

(*ii*) Perchloric acid



$HClO_4$

13. (*i*) Antiferromagnetism

(*ii*) Frenkel defect

14. (*i*) A fuel cell is a device which converts the energy produced during the combustion of fuels like hydrogen, methanol, methane etc. directly into electrical energy. One of the most successful fuel cell is H_2—O_2 fuel cell.

(*ii*) When concentration approaches zero, the molar conductivity is known as limiting molar conductivity. It is represented by $\overset{\circ}{\Lambda}_m$.

$$\overset{\circ}{\Lambda}_m = (\Lambda_m)_{\text{when c ® 0}}$$

19. (*i*) The linkage between two monosaccharides through oxygen atom in an oligosaccharide or a polysaccharide is known as glycosidic linkage.

(*ii*) Sucrose is dextrorotatory (+ 66.5°) but after hydrolysis it gives an equimolar mixture of D-(+)-glucose and D-(–)-fructose, which is laevorotatory. This change of specific rotation from dextrorotation to laevorotation is called inversion of sugar and the mixture obtained is called invert sugar.

(*iii*) Carbohydrates which on hydrolysis give two to ten molecules of monosaccharides are called oligosaccharides *e.g.*, sucrose.

SET–III

1. In milk liquid fat acts as dispersed phase and water acts as dispersion medium.

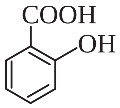
2. Electrolytic refining

3. N atom in NH_3 has one lone pair of electrons which is available for donation. Therefore it acts as a Lewis base.

5. Nylon

6. $$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Galactose}}{C_6H_{12}O_6}$$

8.

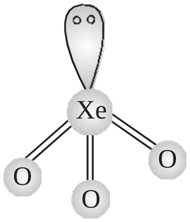


2-hydroxy-benzoic acid

9. (*i*) $C + 2H_2SO_4(\text{conc.}) \longrightarrow CO_2 + 2SO_2 + 2H_2O$

(*ii*) $2XeF_2(s) + 2H_2O(l) \longrightarrow 2Xe(g) + 4HF(aq) + O_2(g)$

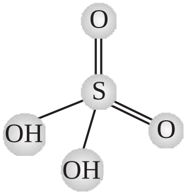
10. (*i*)



Pyramidal

XeO_3

(*ii*)



H_2SO_4

11. (*i*) Tetrafluoroethene

(*ii*) 1, 3–butadiene and acrylonitrile

13. (*i*) Ferrimagnetism

(*ii*) Schottky defect

14. (*i*) Molar conductivity, Λ_m of a solution at a dilution V is defined as the conductance of all the ions produced from one gram mole of the electrolyte dissolved in V cm^3 of the solution when the electrodes are one centimetre apart and the area of the electrodes is so large that the whole of the solution is contained between them.

$$\Lambda_m = \kappa \times V \quad \text{or} \quad \Lambda_m = \frac{\kappa \times 1000}{\text{Molarity}}$$

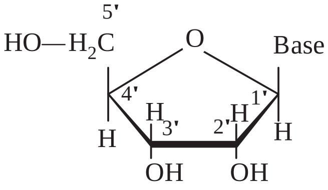
where κ is the conductivity and V is the volume of the solution containing 1 mole of the electrolyte.

(*ii*) Secondary batteries are those batteries which can be recharged by passing electric current through them and hence can be used over again e.g. lead storage battery.

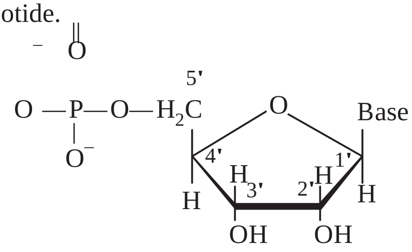
17.

This method of concentration of ore is based upon the principle that the surface of sulphide ore is preferentially wetted by oils while that of gangue is preferentially wetted by water. Collectors enhance the non-wettability of the ore particles in the froth floatation process e.g. pine oil.

23. (*i*) A nucleotide contains all the three basic components of nucleic acid *i.e.*, a pentose sugar, a nitrogeneous base and a phosphoric acid. When nucleoside is linked to phosphoric acid at 5’ position of sugar moiety, we get a nucleotide.



Nucleoside

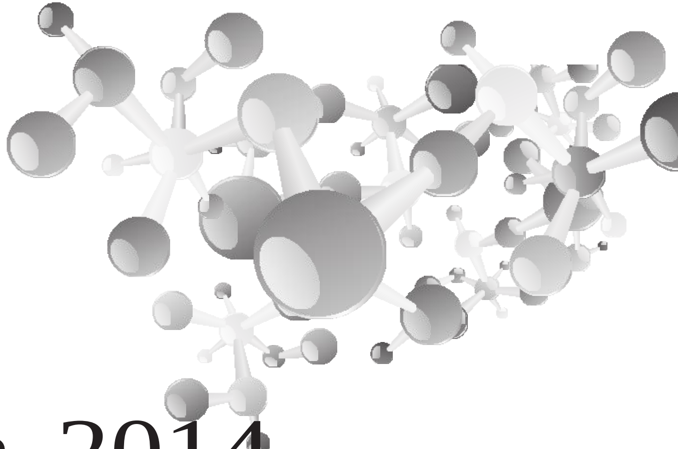


Nucleotide

(*ii*) A pair of stereoisomers such as α-D(+) glucose and β-D-(+) glucose which differ in configuration only around C_1 are called anomers.

(*iii*) The amino acids which cannot be synthesised in our body and must be obtained through diet are known as essential amino acids *e.g.*, valine, lysine, histidine.

z z z



CBSE Examination Paper Foreign-2014

Time allowed : 3 hours **Maximum marks: 70**

General Instructions: *Same as CBSE Examination Paper Delhi-2014.*

SET–I

1. What is the function of collectors in the froth floatation process for the concentration of ores?

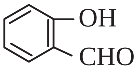
2. What type of forces are responsible for the occurrence of physisorption?

3. Why is the single N—N bond weaker than the single P—P bond?

4. What type of isomerism is shown by the following complex:
$[Co(NH_3)_6]\,[Cr(CN)_6]$

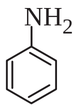
5. Express the relationship between atomic radius (r) and the edge length (a) in the b.c.c. unit cell.

6. Write the IUPAC name of the following compound:



7. Which of the two is more basic and why?

CH_3NH_2 or



8. Name the two components of α-glucose which constitute starch.

9. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5.0 ampere for 20 minutes. What mass of nickel will be deposited at the cathode?
(Given: At. Mass of Ni = 58.7 g mol^{-1}, 1 F = 96500 C mol^{-1})

10. Define half-life of a reaction. Write the expression of half-life for
(*i*) zero order reaction and
(*ii*) first order reaction.

11. Write the chemical reactions involved in the extraction of silver from silver ore.

12. Name the two most important allotropes of sulphur. Which one of the two is stable at room temperature? What happens when the stable form is heated above 370 K?

OR

(*i*) Write the conditions to maximise the yield of H_2SO_4 by contact process.
(*ii*) Why is $K_{a_2} << K_{a_1}$ for H_2SO_4 in water?

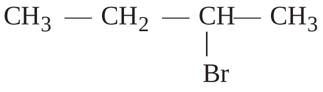
13. Complete the following equations:
(*i*) $2MnO_4^- + 5S^{2-} + 16H^+ \longrightarrow$
(*ii*) $Cr_2O_7^{2-} + 2OH^- \longrightarrow$

14. Write the state of hybridisation, shape and IUPAC name of the complex $[CoF_6]^{3-}$.

(Atomic no. of Co = 27)

15. Write chemical equations when
(*i*) ethyl chloride is treated with aqueous KOH.
(*ii*) chlorobenzene is treated with CH_3COCl in presence of anhydrous $AlCl_3$.

16. (*a*) Which alkyl halide from the following pairs would you expect to react more rapidly by S_N2 mechanism and why?



$CH_3 — CH_2 — \underset{\underset{Br}{|}}{CH} — CH_3$ $\qquad$ $CH_3 — CH_2 — CH_2 — CH_2 — Br$

(*b*) Racemisation occurs in S_N1 reactions. Why?

17. Write the mechanism of the following reaction:

$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

18. Name the reagents used in the following reactions:
(*i*) Bromination of phenol to 2, 4, 6-tribromophenol
(*ii*) Butan-2-one to Butan-2-ol
(*iii*) Friedel–Crafts alkylation of anisole
(*iv*) Oxidation of primary alcohol to carboxylic acid

19. (*i*) What type of stoichiometric defect is shown by KCl and why?
(*ii*) What type of semiconductor is formed when silicon is doped with As?
(*iii*) Which one of the following is an example of molecular solid:
CO_2 or SiO_2
(*iv*) What type of substances would make better magnets, ferromagnetic or ferrimagnetic?

20. (*i*) Write two advantages of $H_2 – O_2$ fuel cell over ordinary cell.
(*ii*) Equilibrium constant (K_c) for the given cell reaction is 10. Calculate E°_{cell}.

$$A(s) + B^{2+}(aq) \rightleftharpoons A^{2+}(aq) + B(s)$$

21. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:

$$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$$

Experiment	**Time/s^{-1}**	**Total pressure/atm**

1	0	0.4
2	100	0.7

Calculate the rate constant.

(Given: log 4 = 0.6021, log 2 = 0.3010)

22. (*a*) Write the expression for the Freundlich adsorption isotherm for the adsorption of gases on solids, in the form of an equation.

(*b*) What are the dispersed phase and dispersion medium of butter?

(*c*) A delta is formed at the meeting place of sea and river water. Why?

23. (*a*) What are the different oxidation states exhibited by the lanthanoids?

(*b*) Write two characteristics of the transition elements.

(*c*) Which of the 3d-block elements may not be regarded as the transition elements and why?

OR

Assign suitable reasons for the following:

(*a*) The Mn^{2+} compounds are more stable than Fe^{2+} towards oxidation to their +3 state.

(*b*) In the 3d series from Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomization of Zn is the lowest.

(*c*) Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured.

24. Give the structures of A, B and C in the following reactions:

(*i*) $CH_3Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273\ K]{HNO_2} C$

(*ii*) $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{Br_2 + KOH} B \xrightarrow{CHCl_3 + NaOH} C$

25. Define the following terms:

(*a*) Anomers

(*b*) Denaturation of proteins

(*c*) Essential amino acids

26. (*i*) Define Antihistamine with an example.

(*ii*) Which one of the following drugs is an antibiotic:

Morphine, Equanil, Chloramphenicol, Aspirin

(*iii*) Why is use of aspartame limited to cold food and drink?

27. ***After the ban on plastic bags, students of one school decided to create awareness among the people about the harmful effects of plastic bags on the environment and the Yamuna river. To make it more impactful, they organised a rally by joining hands with other schools and distributed paper bags to vegetable vendors, shopkeepers and departmental stores. All students pledged not to use polythene bags in future to save the Yamuna river.***

After reading the above passage, answer the following questions:

(i) What values are shown by the students?

(ii) What are biodegradable polymers? Give one example.

(iii) Is polythene a homopolymer or copolymer?

28. (*a*) State Raoult's law for a solution containing volatile components. Name the solution which follows Raoult's law at all concentrations and temperatures.

(*b*) Calculate the boiling point elevation for a solution prepared by adding 10 g of $CaCl_2$ to 200 g of water. (K_b for water = 0.512 K kg mol^{-1}, Molar mass of $CaCl_2$ = 111 g mol^{-1})

OR

(*a*) Define the following terms:

(*i*) Azeotrope

(*ii*) Osmotic pressure

(*iii*) Colligative properties

(*b*) Calculate the molarity of 9.8% (w/w) solution of H_2SO_4 if the density of the solution is 1.02 g mL^{-1}. (Molar mass of H_2SO_4 = 98 g mol^{-1})

29. (*a*) Account for the following:

(*i*) Bi is a strong oxidizing agent in the +5 state.

(*ii*) PCl_5 is known but NCl_5 is not known.

(*iii*) Iron dissolves in HCl to form $FeCl_2$ and not $FeCl_3$.

(*b*) Draw the structures of the following:

(*i*) $XeOF_4$

(*ii*) $HClO_4$

OR

(*a*) Draw the structures of the following:

(*i*) $H_2S_2O_8$

(*ii*) Red P_4

(*b*) Account for the following:

(*i*) Sulphur in vapour state exhibits paramagnetism.

(*ii*) Unlike xenon, no distinct chemical compound of helium is known.

(*iii*) H_3PO_2 is a stronger reducing agent than H_3PO_3.

30. (*a*) Write the products formed when ethanol reacts with the following reagents:

(*i*) CH_3MgBr and then H_3O^+

(*ii*) Zn-Hg/conc.HCl

(*iii*) C_6H_5CHO in the presence of dilute NaOH

(*b*) Give simple chemical tests to distinguish between the following pairs of compounds:

(*i*) Benzoic acid and Ethyl benzoate

(*ii*) Propanal and Butan-2-one

OR

(*a*) Account for the following:

(*i*) CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.

(*ii*) There are two $-NH_2$ groups in semicarbazide ($H_2NNHCONH_2$). However, only one is involved in the formation of semicarbazone.

(*b*) Write the chemical equation to illustrate each of the following name reactions:

(*i*) Rosenmund reduction

(*ii*) Hell-Volhard-Zelinsky reaction

(*iii*) Cannizzaro reaction

SET–II (Questions Uncommon to SET–I)

1. On what principle is the method of zone refining of metals based?

2. Name the temperature above which the formation of micelles takes place.

3. Arrange the following in the increasing order of their basic character:

NH_3, PH_3, AsH_3, SbH_3, BiH_3

4. What type of isomerism is exhibited by the following complex:

$[Co(NH_3)_5 SO_4]Cl$

5. Express the relationship between atomic radius (*r*) and the edge length (*a*) of the f.c.c. unit cell.

6. Which of the two is more basic and why?

CH_3NH_2 or NH_3

7. Name the compound which on polymerisation gives neoprene.

9. Write the role of the following:
(*i*) CO in the purification of nickel.
(*ii*) Graphite rod in the electrometallurgy of aluminium.

10. Complete the following equations:
(*i*) $2MnO_4^- + 5NO_2^- + 6H^+$
——® (*ii*) $Cr_2O_7^{2-} + 14H^+ + 6e^-$
——®

11. Write the state of hybridisation, shape and IUPAC name of the complex $[Ni(CN)_4]^{2-}$.
(Atomic no. of Ni = 28)

12. Write chemical equations when
(*i*) methyl chloride is treated with $AgNO_2$.
(*ii*) bromobenzene is treated with CH_3Cl in the presence of anhydrous $AlCl_3$.

13. Name the reagents used in the following reactions:
(*i*) Nitration of phenol to 2, 4, 6-trinitrophenol
(*ii*) Butanal to Butanol
(*iii*) Friedel-Crafts acetylation of anisole
(*iv*) Oxidation of primary alcohol to aldehyde

20. Define the following terms:
(*i*) Polysaccharides
(*ii*) Amino acids
(*iii*) Enzymes

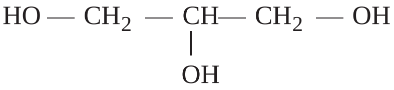
SET–III (Questions Uncommon to Set–I and II)

1. Name the depressant which is used to separate ZnS and PbS ores in froth floatation process.

2. Based on the type of dispersed phase, what type of colloid is micelles?

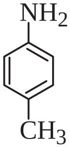
4. What type of isomerism is exhibited by the complex $[Co(NH_3)_5NO_2]^{2+}$?

5. Write IUPAC name of the following compound:

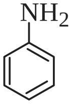


$$HO - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - OH$$

6. Which of the two is more basic and why?



or



7. What are biocatalysts? Give an example.

9. Write the role of the following:

(*i*) Iodine in the refining of zirconium.

(*ii*) Silica in the extraction of copper from copper matte.

11 Complete the following equations:

(*i*) $2MnO_4^- + 5SO_3^{2-} + 6H^+$ ——®

(*ii*) $2CrO_4^{2-} + 2H^+$ ——®

12. Write the state of hybridization, shape and IUPAC name of the complex $[Co(NH_3)_6]^{3+}$. (Atomic no. of Co = 27)

13. Write chemical equations when

(*i*) ethyl chloride is treated with alcoholic KOH.

(*ii*) chlorobenzene is treated with CH_3Cl in the presence of anhydrous $AlCl_3$.

15. Name the different reagents needed to perform the following reactions:

(*i*) Phenol to benzene

(*ii*) Dehydration of propan-2-ol to propene

(*iv*) Dehydrogenation of ethanol to ethanal

24. Define the following terms:

(*a*) Invert sugar

(*b*) Vitamins

(*c*) Nucleoside

z z z

Solutions

SET–I

1. Collectors (*e.g.*, pine oil, xanthates etc.) enhance non-wettability of the ore particles.
2. Van der Waals forces.
3. N—N bond is weaker than P—P bond because of large interelectronic repulsions between lone pairs of electrons present on the N atom of N—N bond having small bond length.
4. Co-ordination isomerism
5. r (atomic radius) $= \dfrac{\sqrt{3}}{4}\, a$ (edge length of unit cell)
6. 2-hydroxybenzaldehyde
7. In CH_3NH_2, the +I effect of $—CH_3$ group makes lone pair of electrons on N-atom more available for donation. On the other hand in $C_6H_5NH_2$, the resonance effect causes delocalisation of lone pair of electrons over benzene ring and makes it less available for donation. Hence, CH_3NH_2 is more basic than $C_6H_5NH_2$.
8. The two component of starch are amylose and amylopectin.
9. $Q = I \times t = 5\text{ A} \times 20 \times 60\text{ s} = 6000\text{ C}$

   $Ni^{2+} + 2e^- \longrightarrow Ni$

   2×96500 C deposit Ni = 58.7 g

   $$\therefore \quad 6000\text{ C will deposit Ni} = \frac{58.7\text{ g mol}^{-1}}{2 \times 96500\text{ C mol}^{-1}} \times 6000\text{ C} = 1.825\text{ g}$$

10. The half life ($t_{1/2}$)of a reaction is the time in which the concentration of a reactant is reduced to one half of its initial concentration.

    (*i*) $t_{1/2}$ for a zero order reaction $= \dfrac{[R]_0}{2k}$ where $[R]_0$ = initial concentration, k = rate constant

    (*ii*) $t_{1/2}$ for a first order reaction $= \dfrac{0.693}{k}$

11. The chemical reaction involved in the extraction of silver from silver ore are

    $$4Ag(s) + 8NaCN(aq) + 2H_2O(l) + O_2(g) \longrightarrow \underset{\substack{\text{Sodium dicyanoargentate (I)}\\ \text{(Soluble complex)}}}{4Na[Ag(CN)_2](aq)} + 4NaOH(aq)$$

    $$2Na[Ag(CN)_2](aq) + Zn(s) \longrightarrow Na_2[Zn(CN)_4](aq) + 2Ag(s)\downarrow$$

12. Two most important allotropes of sulphur are rhombic sulphur and monoclinic sulphur. The stable form at room temperature is rhombic sulphur. When rhombic sulphur is heated above 370 K it gets converted into monoclinic sulphur.

    OR

    (*i*) The key step in the manufacture of H_2SO_4 by contact process is

$$2\mathrm{SO_2}(g) + \mathrm{O_2}(g) \;\blacksquare\; 2\mathrm{SO_3}(g) \qquad \Delta_r H^\circ = -196.6\ \mathrm{kJ\ mol^{-1}}$$

The forward reaction is exothermic and proceed with decrease in number of moles. Therefore, low temperature (optimum temperature 720 K), high pressure (in practice 2 bar) and use of catalyst V_2O_5 to increase the rate of reaction at low temperature are the favourable conditions for maximum yield of H_2SO_4.

(*ii*) H_2SO_4 is a dibasic acid, it ionizes in two steps and has two dissociation constants.

$$H_2SO_4(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HSO_4^-(aq);\ K_a > 10$$

$$HSO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_4^{2-}(aq);\ K_{a_2} = 1.2 \times 10^{-2}$$

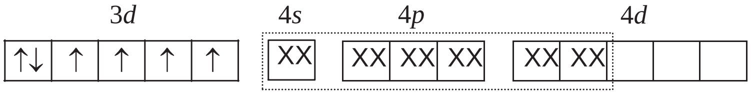
$K_{a_2} << K_a$, because the negatively charged HSO_4^- ion has much less tendency to donate a proton to H_2O as compared to neutral H_2SO_4.

13. (*i*)

$$\begin{array}{rl} MnO_4^- + 8H^+ + 5e^- \longrightarrow & Mn^{2+} + 4H_2O] \times 2 \\ S^{2-} \longrightarrow & S + 2e^-] \times 5 \\ \hline 2MnO_4^- + 5S^{2-} + 16H^+ \longrightarrow & 2Mn^{2+} + 5S + 8H_2O \\ \hline \end{array}$$

(*ii*) $Cr_2O_7^{2-} + 2OH^- \longrightarrow 2CrO_4^{2-} + H_2O$

14. $[CoF_6]^{3-}$: Hexafluoridocobaltate (III) ion; $Co^{3+} = [Ar]3d^6$



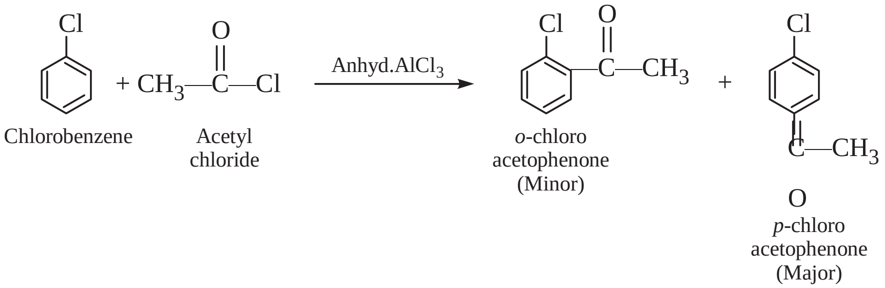
XX = Electron pair from ligand F^-

Hybridisation = sp^3d^2, Shape = Octahedral

15. (*i*) $CH_3—CH_2—Cl + KOH(aq)$ $CH_3—CH_2—OH + KCl$

Ethyl chloride Ethyl alcohol

(*ii*)



16. (*a*) $CH_3—CH_2—CH_2—CH_2—Br$. Being primary alkyl halide, there would be less steric hinderance.

(*b*) This is due to the fact that carbocations are the intermediates in S_N1 reactions. Carbocations being sp^2 hybridised are planar species, therefore, the attack of the nucleophile on it occurs from both the faces (front and rear) with almost equal ease resulting in the formation of 50 : 50 mixture of two enantiomers *i.e.*, racemic mixture.

17. Refer to Ans. 26 (a) Set-I CBSE Delhi 2014.

18. (*i*) Aqueous bromine (Br_2/H_2O)

(*ii*) Lithium aluminium hydride ($LiAlH_4$) or sodium borohydride ($NaBH_4$).

(*iii*) Anhydrous aluminium chloride (anhyd. $AlCl_3$)

(*iv*) Acidified potassium dichromate solution ($K_2Cr_2O_7/H_2SO_4$) or alkaline potassium permanganate solution ($KMnO_4/OH^-$) followed by hydrolysis with dil. H_2SO_4.

19. (*i*) KCl shows schottky defect as the cation, K^+ and anion, Cl^- are of almost similar sizes.

(*ii*) *n*-type semiconductor.

(*iii*) CO_2

(*iv*) Ferromagnetic

20. (*i*) The two main advantages of H_2–O_2 fuel cell over ordinary cell are as follows:

- It has high efficiency of 60%–70%.
- It does not cause any pollution.

(*ii*) $A(s) + B^{2+}(aq) \rightleftharpoons A^{2+}(aq) + B(s)$

Here, $n = 2$, $K = 10$

$$E^o_{cell} = \frac{0.059}{n} \times \log K_c$$

$$E^o_{cell} = \frac{0.059}{2} \times \log 10 = \frac{0.059}{2} \times 1 = 0.0295 \text{ V}$$

21. Refer to Ans. 22, Set-I CBSE Delhi 2014.

22. (*a*) Freundlich adsorption isotherm equation for adsorption of gases on solids:

$$\frac{x}{m} = kp^{1/n} (n > 1).$$

or $$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

where *x* is the mass of the gas adsorbed on mass *m* of the adsorbent at pressure *p*, *k* and *n* are constants which depends on the nature of the gas and adsorbent at a particular temperature.

(*b*) In butter, water acts as disperse phase and oil acts as dispersion medium.

(*c*) River water is a colloidal solution of clay. Sea water contains a variety of electrolytes.

When river water meets the sea water, the electrolytes present in sea water coagulate the colloidal solution of clay resulting in its deposition with the formation of delta.

23. (*a*) The common oxidation state of lanthanoid is +3. Besides this some of the lanthanoid also exhibit +2 and +4 oxidation states.

(*b*) The important characteristics of the transition elements are:

(*i*) All transition elements are metallic in nature.

(*ii*) Transition elements exhibit variable oxidation states.

(*iii*) Most of the transition elements form coloured compounds.

(*iv*) A number of transition elements and their compounds show catalytic properties.

(*c*) In 3*d* transition series zinc is not regarded as transition element as Zn atom has completely filled *d* orbitals ($3d^{10}$) in its ground state as well as in its oxidised state.

OR

(*a*) The electronic configuration of Mn^{2+} is [Ar] $3d^5$ which is half filled and hence stable. So Mn^{2+} cannot lose third electron easily. On the other hand, Fe^{2+} has electronic configuration [Ar] $3d^6$. It tends to lose one electron to acquire stable [Ar] $3d^5$ electronic configuration. Hence Mn^{2+} is more stable than Fe^{2+} towards oxidation.

(*b*) In the formation of metallic bonds, no electrons from 3*d*-orbitals are involved in case of zinc, while in all other metals of the 3*d* series, electrons from the *d*-orbitals are always involved in the formation of metallic bonds. That is why, the enthalpy of atomisation of zinc is the lowest in the series.

(*c*) Ti^{3+} has one electron in *d*-orbitals ($3d^1$) which can absorb light in visible region for *d–d* transition. Hence, it is coloured in aqueous solution. Sc^{3+} has no d electron ($3d^0$), therefore, no light is absorbed for *d–d* transition. Hence, it is colourless in aqueous solution.

24. Refer to Ans 27 Set-I CBSE Delhi 2014.

25. (*a*) The carbohydrates which differ in configuration at the glycosidic carbon (*i.e.*, C_1 in aldoses and C_2 in ketoses) are called anomers e.g., α–D-(+)-glucose and β–D-(+)-glucose.

(*b*) **Denaturation of Proteins:** When a protein in its native form is subjected to a change, such as change in temperature or change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation, 2° and 3° structures are destroyed but 1° structures remain intact, *e.g.*, coagulation of egg while on boiling, curdling of milk, etc.

(*c*) The amino acids which cannot be synthesised in our body and must be obtained through diet are known as essential amino acids e.g. valine, lysine, histidine.

26. (*i*) The drugs which interfere with the natural action of histamine by competing with histamine for binding of receptor where histamine exerts its effect are called anti histamine *e.g.*, brompheniramine, terfenadine, cetrizine etc.

(*ii*) Chloramphenicol

(*iii*) Use of aspartame is limited to cold foods because it is unstable at cooking temperature.

27. (*i*) Concern towards water pollution, concern for environmental protection, team work, socially aware.

(*ii*) The polymers which can be broken into small segments by enzyme catalysed reactions or to some extent by oxidation over a period of time are called biodegradable polymers. The required enzymes are produced by microorganism e.g., poly-β-hydroxybutyrate-co-β-hydroxyvalerate (PHBV), nylon-2-nylon-6 etc.

(*iii*) Polyethene is an addition polymer.

28. (*a*) It states that for a solution of volatile liquids, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction. Thus, for a solution of volatile liquids *A* and *B*, $P_A \propto x_A$ and $P_B \propto x_B$ or $P_A = P_A^o x_A$ and $P_B = P_B^o x_B$ where P_A and P_B are partial vapour pressures, x_A and x_B are mole fractions, P_A^o and P_B^o are vapour pressure of pure components *A* and *B* respectively.

Ideal solution.

(*b*) The given quantities are:

$W_B = 10$ g, $W_A = 200$ g, $K_b = 0.512$ K Kg mol^{-1},

$M_B = 111$ g mol^{-1}

$$CaCl_2 \longrightarrow Ca^{2+} + 2Cl^-$$

On assuming complete dissociating of $CaCl_2$, $i = \frac{3}{1} = 3$

Substituting these values in the formula, $\Delta T_b = \dfrac{i \times K_b \times W_B \times 1000}{M_B \times W_A}$, we get

$$\Delta T_b = \frac{3 \times 0.512\text{K Kg mol}^{-1} \times 10\text{ g} \times 1000\text{ g kg}^{-1}}{111\text{ g mol}^{-1} \times 200\text{ g}}$$

$$\Delta T_b = 0.692\text{K}$$

OR

(*a*) (*i*) The binary mixtures of liquids having same composition in liquid and vapour phase and boil at a constant temperature are called azeotropes.

(*ii*) The excess of pressure which must be applied to the solution side to prevent the passage of solvent into it through a semipermeable membrane is called osmotic pressure.

(*iii*) The properties of solutions which depend only on the number of solute particles in the solution but independent of their nature are called colligative properties.

(*b*) Let the mass of solution = 100 g

∴ Mass of H_2SO_4 = 9.8 g

$$\text{Number of mole of } H_2SO_4 = \frac{\text{Mass of } H_2SO_4}{\text{Molar mass}}$$

$$= \frac{9.8\text{ g}}{98\text{ g mol}^{-1}} = 0.1\text{ mol}$$

$$\text{Volume of solution} = \frac{\text{Mass of solution}}{\text{Density of solution}}$$

$$= \frac{100\text{ g}}{1.02\text{ g mL}^{-1}} = \frac{100}{1.02}\text{ mL}$$

$$= \frac{100}{1.02}\text{ mL} \times \frac{1}{1000\text{ mL L}^{-1}}$$

$$= \frac{1}{10.2}\text{ L}$$

$$\text{Molarity} = \frac{\text{Moles of solute, } H_2SO_4}{\text{Volume of solution (in L)}}$$

$$= \frac{0.1\text{ mol}}{\frac{1\text{ L}}{10.2}}$$

$$= 1.02\text{ mol L}^{-1} \text{ or } 1.02\text{ M}$$

29. (*a*) (*i*) Due to inert pair effect Bi in +3 state is much more stable than in +5 state. Therefore, Bi in +5 state accepts two electrons and get reduced to more stable +3 state. Hence Bi is strong oxidising in +5 state.

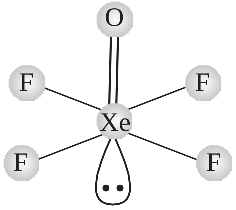
(*ii*) Nitrogen with $n = 2$, has *s* and *p* orbitals only. It does not have *d* orbitals to expand its covalency beyond four. Hence, NCl_5 is not known. PCl_5 is known as P has vacant 3*d* orbital to which 3*s* electrons can be excited to make available five half filled orbitals needed for the formation of five P—Cl bonds.

(*iii*) Iron reacts with HCl to form $FeCl_2$ and H_2.

$$Fe + 2HCl \longrightarrow FeCl_2 + H_2$$

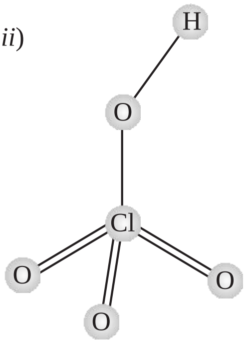
H_2 thus produced prevents the oxidation of $FeCl_2$ to $FeCl_3$.

(*b*) (*i*)



Square pyramidal

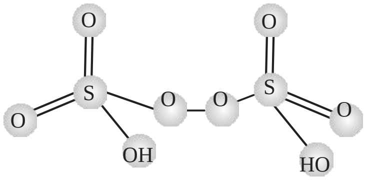
(*ii*)



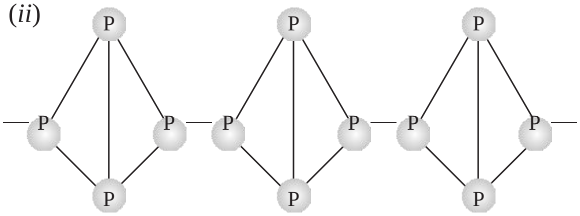
Perchloric acid

OR

(*a*) (*i*)



(*ii*)



(*b*) (*i*) In vapour form sulphur partly exists as S_2 molecules which have two unpaired electrons in the antibonding π^* molecular orbitals like O_2 molecule and hence, exhibits paramagnetism.

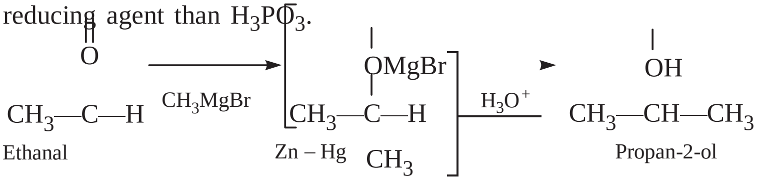
(*ii*) This is due to the following reasons:

He does not have d-orbitals in the valence shell and hence electron cannot be excited to higher energy levels like in Xe to form bonds.

Ionisation enthalpy of He is sufficiently higher than those of oxygen and fluorine.

(*iii*) Acids which contains P—H bonds have reducing character. Since H_3PO_2 contains two P—H bonds while H_3PO_3 contains only one P–H bond therefore H_3PO_2 is a stronger reducing agent than H_3PO_3.

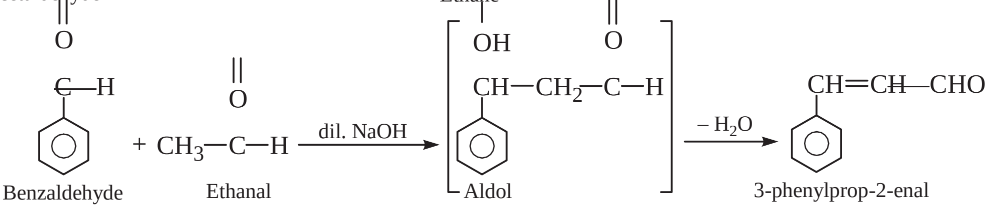
30. (*a*) (*i*)



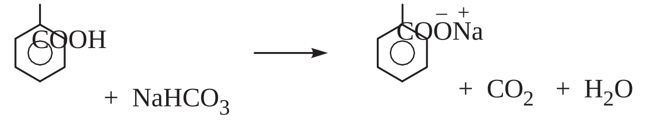
(*ii*) $CH_3CHO + 4\,[H] \xrightarrow[\text{conc. HCl}]{} CH_3 - CH_3 + H_2O$

Acetaldehyde Ethane

(*iii*)



(*b*) (*i*) Benzoic acid being an acid reacts with $NaHCO_3$ solution to produce brisk effervescence due to evolution of CO_2 while ethyl benzoate does not give this test.



Benzoic acid   Sod. benzoate

Ethyl benzoate

(*ii*) Propanal being an aldehyde reduces Tollens' reagent to silver mirror but butan-2-one being a ketone does not.

$CH_3CH_2CHO + 2[Ag(NH_3)_2]^+ + 3OH^-$ ® $CH_3–CH_2–COO^- + 2Ag\downarrow + 2H_2O + 4NH_3$

Propanal   Tollens' reagent   Silver mirror

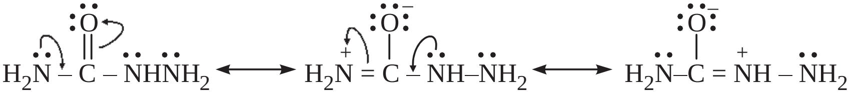
$CH_3CH_2COCH_3 \xrightarrow{\text{Tollens' reagent}}$ No silver mirror

Butan-2-one

OR

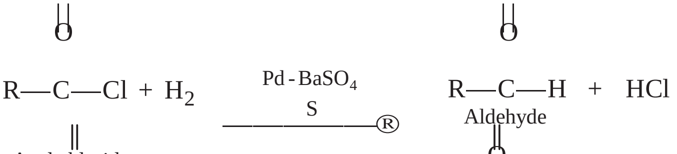
(*a*) (*i*) The methyl group due to its +I effect reduce the magnitude of positive charge on carbonyl carbon atom. Moreover it also hinder the approach of nucleophile CN^-. Since in acetaldehyde there is one methyl while in acetone there are two methyl groups attached to carbonyl group therefore acetaldehyde is more reactive than acetone towards nucleophilic addition with HCN.

(*ii*)

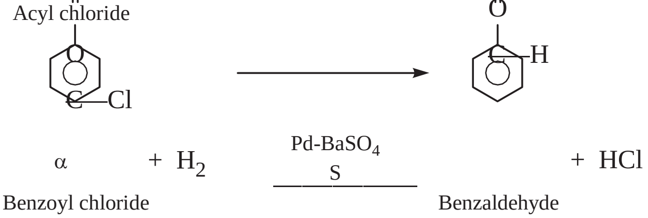


Semicarbazide has two $–NH_2$ groups but one of them (*i.e.*, directly attached to C = O) is involved in resonance as shown above. Thus, electron density on this NH_2 group decreases hence it does not act as a nucleophile. In contrast, the lone pair of electrons on the other NH_2 group (i.e., attached to —NH) is not involved in resonance and hence is available for nucleophilic attack on the C = O group of aldehydes and ketones.

(*b*) (*i*) Rosenmund reduction:

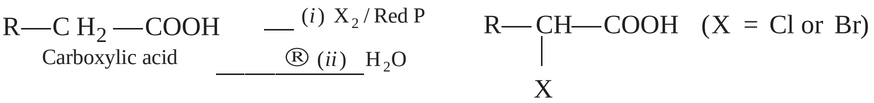


Acyl chloride   Aldehyde



Benzoyl chloride   Benzaldehyde

(*ii*)



$R—CH_2—COOH \xrightarrow[(ii)\ H_2O]{(i)\ X_2/\text{Red P}} R—\underset{\displaystyle X}{\underset{|}{CH}}—COOH$ (X = Cl or Br)

Carboxylic acid

α - Halocarboxylic acid

$$\underset{\text{Carboxylic acid}}{CH_3—COOH} \xrightarrow[(ii)\ H_2O]{(i)\ Cl_2/\text{Red P}} \underset{\text{Chloroacetic acid}}{Cl—CH_2—COOH}$$

(*iii*) Cannizzaro reaction:

$2HCHO \xrightarrow{\text{conc. KOH}} CH_3—OH +$

® Formaldehyde $HCOO^-K^+$ Methyl alcohol

Potassium formate

SET–II

1. Zone refining is based on the principle that the impurities are more soluble in melt than in the solid state of metal.

2. Kraft temperature

3. Order of basic character

$BiH_3 < SbH_3 < AsH_3 < PH_3 < NH_3$

4. Ionisation isomerism

5. Atomic radius (r) = $\dfrac{\text{Edge length } (a)}{2\sqrt{2}}$

6. CH_3NH_2 is more basic than NH_3. CH_3 group due to its +ve I effect pushes electron towards nitrogen in $CH_3\ddot{N}H_2$ and this makes the unshared electron pair more available for sharing with the proton of the acid.

7. Chloroprene $(CH_2 = \overset{\overset{\displaystyle Cl}{|}}{C} - CH = CH_2)$

9. (*i*) Impure nickel when heated in a current of CO forms volatile complex nickel tetracarbonyl, $Ni(CO)_4$ leaving behind impurities.

$$Ni + 4CO \xrightarrow{330-350K} Ni(CO)_4$$

The nickel tetracarbonyl complex thus obtained is then heated to a higher temperature so that it is decomposed to give pure metal.

$$Ni(CO)_4 \xrightarrow{450-470K} Ni + 4CO$$

(*ii*) Graphite rod acts as anode and graphite lined iron acts as cathode in the electrometallurgy of aluminium.

Carbon reacts with oxygen liberated at anode producing CO and CO_2 otherwise oxygen liberated at the anode may oxidise some of the liberated aluminium back to Al_2O_3.

At Anode: $C(s) + O^{2-}(\text{melt}) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}(\text{melt}) \longrightarrow CO_2(g) +$

$4e^-$At Cathode : $Al^{3+}(\text{melt}) + 3e^- \longrightarrow Al\ (l)$

10. (*i*) $2MnO_4^- + 5NO_2^- + 6H^+ \longrightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$

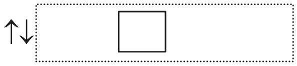
(*ii*) $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

11. $[Ni(CN)_4]^{2-}$: Tetracyanonickelate (II) ion, Ni^{2+} ($3d^8$)

↑↓ ↑↓ ↑↓

3*d*					4*s*	4*p*		
				XX	XX	XX	XX	

XX = Electron pair from CN^- ion

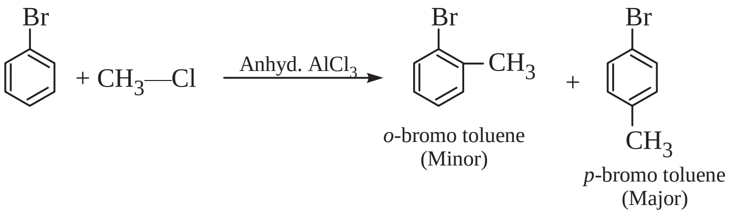


dsp^2 hybrid

dsp^2 hybridisation in $[Ni(CN)_4]^{2-}$ leads to square planar shape.

12. (*i*) $\underset{\text{Methylchloride}}{CH_3 - Cl} + AgNO_2 \longrightarrow \underset{\substack{\text{Nitromethane}\\ \text{(Major product)}}}{CH_3NO_2} + AgCl$

(*ii*)



o-bromo toluene (Minor)

p-bromo toluene (Major)

13. (*i*) Conc. HNO_3/conc. H_2SO_4

(*ii*) Lithium aluminium hydride ($LiAlH_4$) or sodium borohydride ($NaBH_4$)

(*iii*) Acetyl chloride (CH_3COCl) in the presence of catalyst anhydrous $AlCl_3$.

(*iv*) Pyridinium chlorochromate, PCC ($C_5H_5\overset{+}{N}HCrO_3\overset{-}{Cl}$ in CH_2Cl_2).

20. (*i*) Carbohydrates that yield a large number of monosaccharide units on hydrolysis are called polysaccharides *e.g.*, starch, cellulose, gums etc.

(*ii*) Amino acids are the compounds, whose molecule contains both the carboxylic acid (–COOH) group and the amino (–NH_2) group of the various amino acids, the α-amino acids are most important because they are the building blocks of proteins.

(*iii*) **Enzyme:** Enzymes are complex nitrogenous organic compounds produced in living cells of plants and animals. Chemically, enzymes are globular proteins with high molar mass ranging from 15,000 to 1,000,000 g mol^{-1}.

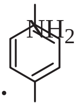
SET–III

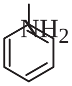
1. Sodium cyanide (NaCN)

2. Associated colloids

4. Linkage isomerism

5. Propane–1, 2, 3-triol

6. 

is stronger base than 

as CH_3 group is electron releasing by +I effect and hyperconjugation effect.

CH_3

7. Enzymes are termed as biocatalysts as they catalyse numerous reactions that occur in the bodies of animals and plants to maintain life process *e.g.*, invertase, pepsin, urease.

9. (*i*) When crude zirconium is heated in an evacuated vessel with iodine, volatile ZrI_4 is formed which vapourises leaving behind impurities. It is then decomposed by heating over a tungsten filament at 2075K to give pure zirconium.

$$\underset{\substack{\text{Impure}\\ \text{zirconium}}}{Zr(s)} + 2I_2(g) \xrightarrow{870\text{ K}} \underset{\substack{\text{Zirconium}\\ \text{tetraiodide}}}{ZrI_4(g)} \xrightarrow[\text{Tungsten filament}]{2075\text{ K}} \underset{\substack{\text{Pure}\\ \text{zirconium}}}{Zr(s)} + 2I_2(g)$$

(*ii*) Copper matte chiefly consist of Cu_2S and FeS. In the converter FeS gets converted into FeO. Silica (SiO_2) acts as a flux to remove FeO impurity as $FeSiO_3$ slag.

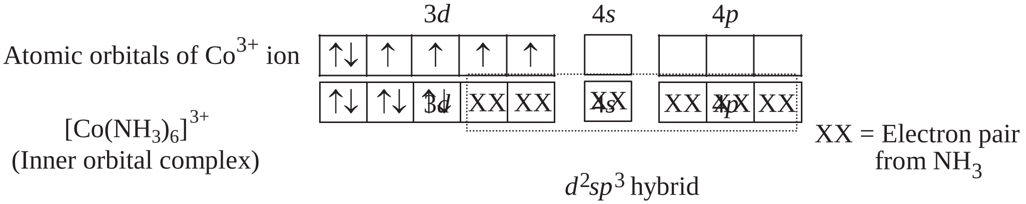
$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2\uparrow$$

$$\underset{\text{Impurity}}{FeO} + \underset{\text{Flux}}{SiO_2} \longrightarrow \underset{\text{Slag}}{FeSiO_3}$$

11 (*i*) $2MnO_4^- + 5SO_3^{2-} + 6H^+ \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$

(*ii*) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

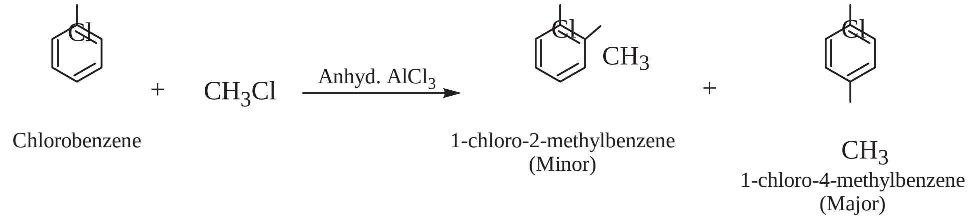
12. $[Co(NH_3)_6]^{3+}$: Hexaamminecobalt (III), Co^{3+} ($3d^6$)



d^2sp^3 hybridisation in $[Co(NH_3)_6]^{3+}$ leads to octahedral shape.

13. (*i*) $\underset{\text{Ethyl chloride}}{CH_3CH_2Cl} + \text{alc. KOH} \longrightarrow \underset{\text{Ethene}}{CH_2{=}CH_2} + KCl + H_2O$

(*ii*)



15. (*i*) Zinc dust

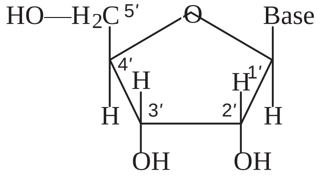
(*ii*) 85% H_2SO_4 at 440 K

(*iv*) Heat copper at 573 K (Cu/573 K)

24. (*a*) Sucrose is dextrorotatory (+66.5°) but after hydrolysis it gives an equimolar mixture of D-(+)-glucose and D-(–)-fructose, which is laevorotatory. This change of specific rotation from dextrorotation to laevorotation is called inversion of sugar and the mixture obtained is called invert sugar.

(*b*) Vitamins are generally regarded as organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism.

(*c*) Nucleoside is a unit formed by the combination of nitrogen containing heterocyclic base and pentose sugar.



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