30. Cation and anion combines in a crystal to form following type of compound
  (a) ionic
  (b) metallic
  (c) covalent
  (d) dipole-dipole.
        (2000)

31. In cube of any crystal A-atom placed at every corners and B-atom placed at every centre of face. The formula of compound is
  (a) AB
  (b) AB_3
  (c) A_2B_2
  (d) A_2B_3
     (2000)

32. In crystals of which one of the following ionic compounds would you expect maximum distance between centres of cations and anions?
  (a) CsI
  (b) CsF
  (c) LiF
  (d) LiI
    (1998)

33. The second order Bragg diffraction of X-rays with $\lambda = 1.00$ Å from a set of parallel planes in a metal occurs at an angle 60°. The distance between the scattering planes in the crystal is
  (a) 2.00 Å
  (b) 1.00 Å
  (c) 0.575 Å
  (d) 1.15 Å
    (1998)

34. The edge length of face centred unit cubic cells is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is
  (a) 144 pm
  (b) 398 pm
  (c) 288 pm
  (d) 618 pm
    (1998)

35. Schottky defect in crystals is observed when
  (a) density of the crystal is increased
  (b) unequal number of cations and anions are missing from the lattice
  (c) an ion leaves its normal site and occupies an interstitial site
  (d) equal number of cations and anions are missing from the lattice.
    (1998)

36. The high density of water compared to ice is due to
  (a) dipole-induced dipole interactions
  (b) induced dipole induced dipole interactions
  (c) hydrogen bonding interactions
  (d) dipole-dipole interactions.
    (1997)

37. For two ionic solids CaO and KI, identify the wrong statement among the following
  (a) CaO has high melting point
  (b) Lattice energy of CaO is much larger than that of KI
  (c) KI has high melting point
  (d) KI is soluble in benzene.
    (1997)

38. The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is
  (a) face-centred cube
  (b) simple cube
  (c) body-centred cube
  (d) none of these.
    (1997)

39. The *fcc* crystal contains how many atoms in each unit cell?
  (a) 6
  (b) 8
  (c) 4
  (d) 5
    (1996)

40. If we mix a pentavalent impurity in a crystal lattice of germanium, what type of semiconductor formation will occur?
  (a) n-type semiconductor
  (b) p-type semiconductor
  (c) both (a) and (b)
  (d) None of these.
    (1996)

41. An element (atomic mass = 100 g/mol) having *bcc* structure has unit cell edge 400 pm. The density of element is
  (a) 7.289 g/cm^3
  (b) 2.144 g/cm^3
  (c) 10.376 g/cm^3
  (d) 5.188 g/cm^3
    (1996)

42. The number of atoms in 100 g of a *fcc* crystal with density $d = 10$ g/cm^3 and cell edge equal to 100 pm, is equal to
  (a) 2×10^{25}
  (b) 1×10^{25}
  (c) 4×10^{25}
  (d) 3×10^{25}
    (1994)

43. Ionic solids, with Schottky defects, contain in their structure
  (a) cation vacancies only
  (b) cation vacancies and interstitial cations
  (c) equal number of cation and anion vacancies
  (d) anion vacancies and interstitial anions.
    (1994)

44. The pure crystalline substance on being heated gradually first forms a turbid liquid at constant temperature and still at higher temperature turbidity completely disappears. The behaviour is a characteristic of substance forming
  (a) allotropic crystals
  (b) liquid crystals
  (c) isomeric crystals
  (d) isomorphous crystals.
    (1993)

45. On doping Ge metal with a little of In or Ga, one gets
  (a) p-type semiconductor
  (b) n-type semiconductor
  (c) insulator
  (d) rectifier.
    (1993)

46. In the fluorite structure, the coordination number of Ca^{2+} ion is
  (a) 4
  (b) 6
  (c) 8
  (d) 3
    (1993)

47. The number of atoms contained in a *fcc* unit cell of a monoatomic substance is

(a) 1   (b) 2

(c) 4   (d) 6   *(1993)*

48. For orthorhombic system axial ratios are $a \neq b \neq c$ and the axial angles are

(a) $\alpha = \beta = \gamma \neq 90^\circ$

(b) $\alpha = \beta = \gamma = 90^\circ$

(c) $\alpha = \gamma = 90^\circ, \beta \neq 90^\circ$

(d) $\alpha \neq \beta \neq \gamma \neq 90^\circ$ *(1991)*

49. Most crystals show good cleavage because their atoms, ions or molecules are

(a) weakly bonded together

(b) strongly bonded together

(c) spherically symmetrical

(d) arranged in planes.   *(1991)*

Answer Key

1. (c, d)	**2.** (c)	**3.** (d)	**4.** (c)	**5.** (c)	**6.** (b)	**7.** (d)	**8.** (d)	**9.** (a)	**10.** (d)
11. (a)	**12.** (a)	**13.** (d)	**14.** (c)	**15.** (a)	**16.** (a)	**17.** (d)	**18.** (d)	**19.** (c)	**20.** (b)
21. (c)	**22.** (d)	**23.** (b)	**24.** (b)	**25.** (a)	**26.** (c)	**27.** (a)	**28.** (d)	**29.** (c)	**30.** (a)
31. (b)	**32.** (a)	**33.** (d)	**34.** (a)	**35.** (d)	**36.** (c)	**37.** (d)	**38.** (c)	**39.** (c)	**40.** (a)
41. (d)	**42.** (c)	**43.** (c)	**44.** (b)	**45.** (a)	**46.** (c)	**47.** (c)	**48.** (b)	**49.** (d)	

||||||||||||||||||||||||| EXPLANATIONS |||||||||||||||||||||||||

1. (c, d) : Frenkel defect is favoured in those ionic compounds in which there is large difference in the size of cations and anions.

Non-stoichiometric defects due to metal deficiency is shown by Fe_xO where $x = 0.93$ to 0.96.

2. (c) : In fluorite structure, Ca^{2+} ions are in the face centred cubic arrangement. Each Ca^{2+} is connected to 4 F^- ions below it and to another set of 4 F^- ions above it *i.e.* Ca^{2+} has a coordination number of 8 and each F^- ion has a coordination number 4.

3. (d) : For *bcc*, $Z = 2$, $\rho = 530 \text{ kg m}^{-3}$, at. mass of Li $= 6.94 \text{ g mol}^{-1}$, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

$$\rho = 530 \text{ kg m}^{-3} = \frac{530 \times 1000 \text{ g}}{1 \times (100)^3 \text{ cm}^3} = 0.53 \text{ g cm}^{-3}$$

$$\rho = \frac{Z \times \text{At. mass}}{N_A \times a^3}$$

$$a^3 = \frac{Z \times \text{At. mass}}{N_A \times \rho} = \frac{2 \times 6.94}{6.02 \times 10^{23} \times 0.53}$$

$$= 43.5 \times 10^{-24} \text{ cm}^3$$

$$\Rightarrow a = 352 \times 10^{-10} \text{ cm} = 352 \text{ pm}$$

4. (c) : Radius ratio, $\dfrac{r^+}{r^-} = \dfrac{0.98 \times 10^{-10}}{1.81 \times 10^{-10}} = 0.541$

It lies in the range of 0.414 to 0.732 hence, coordination number of each ion will be 6 as the compound will have NaCl type structure *i.e.*, octahedral arrangement.

**5. (c) :** Packing efficiency of *bcc* lattice = 68%
Hence, empty space = 32%.

6. (b) : Frenkel defect is a dislocation defect as smaller ions (usually cations) are dislocated from normal sites to interstitial sites. Frenkel defect is shown by compounds having large difference in the size of cations and anions hence, alkali metal halides do not show Frenkel defect. Also, Schottky defect decreases the density of crystal while Frenkel defect has no effect on the density of crystal.

7. (d) : $Z = 4$, *i.e.*, structure is *fcc*.

Hence, $r = \dfrac{a}{2\sqrt{2}} = \dfrac{361}{2\sqrt{2}} = 127.65 \text{ pm} \approx 127 \text{ pm}$

8. (d) : The distance between the body centered atom and one corner atom is $\dfrac{\sqrt{3}a}{2}$ *i.e.* half of the body diagonal.
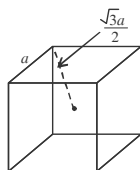
9. (a) : $d = \dfrac{ZM}{N_A a^3}$ $(Z = 4$ for *fcc*$)$

$$M = \frac{d \times N_A \times a^3}{Z} = \frac{2.72 \times 6.023 \times 10^{23} \times (404 \times 10^{-10})^3}{4}$$

$M = 26.99 \approx 27 \text{ g mol}^{-1}$

10. (d) : Diamond is like ZnS (Zinc blende).
Carbon forming *ccp* (*fcc*) and also occupying half of tetrahedral voids.
Total no. of carbon atoms per unit cell

$$= \underset{\text{(Corners)}}{8 \times \frac{1}{8}} + \underset{\text{(Face centred)}}{6 \times \frac{1}{2}} + \underset{\text{(Tetrahedral void)}}{4} = 8$$

11. (a) : For a face centred cubic (*fcc*) structure,

$r = \dfrac{a}{2\sqrt{2}}$, $a = 408$ pm, $r = \dfrac{408}{2\sqrt{2}} = 144 \text{ pm}$

Diameter $= 2r = 2 \times 144 = 288 \text{ pm}$

12. (a) : Number of octahedral voids is same as number of atoms.

13. (d) : Number of atoms in *ccp* = 4 = O^{2-}
Number of tetrahedral voids = 2 × N = 2 × 4

Number of A^{2+} ions $= 8 \times \dfrac{1}{4} = 2$

Number of octahedral voids
$\qquad\qquad$ = Number of B^+ ions = $N = 4$
Ratio, $O^{2-} : A^{2+} : B^+ = 4 : 2 : 4 = 2 : 1 : 2$
Formula of oxide = AB_2O_2

14. (c) : For NaCl, $\dfrac{r^+}{r^-} = 0.414$

Given radius of cation = 100 pm

$$\frac{100}{r^-} = 0.414 \Rightarrow \frac{100}{0.414} = r^- \Rightarrow r^- = 241.5 \text{ pm}$$

15. (a) : For a *bcc* lattice, $2(r^+ + r^-) = \sqrt{3}a$
where r^+ = radius of cation, r^- = radius of anion
a = edge length

$$\therefore (r^+ + r^-) = \frac{\sqrt{3} \times 387}{2} = 335.142 \text{ pm} \approx 335 \text{ pm}$$

16. (a) : Since Li crystallises in body-centred cubic crystal, atomic radius, $r = \dfrac{\sqrt{3}a}{4}$ $(a$ = edge length$)$

$$\therefore r = \frac{\sqrt{3}}{4} \times 351 = 151.8 \text{ pm} \text{ (given } a = 351 \text{ pm)}$$

17. (d) : Since Cu crystallises in a face-centred cubic lattice,

Atomic radius, $r = \dfrac{a}{2\sqrt{2}}$ (a = edge length = 361 pm)

$\therefore\ r = \dfrac{361}{2\sqrt{2}} = 127.6 \approx 128$ pm

18. (d) : The ratio of volumes occupied by atoms in unit cell to the total volume of the unit cell is called as packing fraction or density of packing. For body centred cubic structure, packing fraction = 0.68 $i.e.$, 68% of the unit cell is occupied by atoms and 32% is empty.

19. (c) : Packing fraction for a cubic unit cell is

given by $f = \dfrac{z \times \dfrac{4}{3}\pi r^3}{a^3}$

where a = edge length, r = radius of cation and anion. Efficiency of packing in simple cubic or primitive cell = $\pi/6$ = 0.52 $i.e.$ 52% of unit cell is occupied by atoms and 48% is empty.

20. (b) : If silicon is doped with any of the element of group III (B, Al, Ga, In, Th) of the periodic table, p-type of semiconductor will be obtained.

21. (c) : For Simple cubic : $r^+ + r^- = a/2$
For Body centred : $r^+ + r^- = a\sqrt{3}/4$
where a = edge length, $r^+ + r^-$ = interatomic distance,

For Face centered: $r^+ + r^- = \dfrac{a}{2\sqrt{2}}$

$\therefore$ Ratio of radii of the three will be $\dfrac{a}{2} : \dfrac{a\sqrt{3}}{4} : \dfrac{a}{2\sqrt{2}}$

22. (d) : The maximum properties of the available volume which may be filled by hard sphere in simple cubic arrangement is $\pi/6$ or 0.52.

23. (b) : As each Sr^{2+} ion introduces one cation vacancy, therefore, concentration of cation vacancies = mole % of $SrCl_2$ added.

$\therefore$ Concentration of cation vacancies

$= 10^{-4}$ mole% $= \dfrac{10^{-4}}{100} \times 6.023 \times 10^{23} = 6.023 \times 10^{17}$

24. (b) : F-centres are the sites where anions are missing and instead electrons are present. They are responsible for colours.

25. (a) : Density of CsBr $= \dfrac{Z \times M}{V \times N_A}$

$= \dfrac{1 \times 213}{(436.6 \times 10^{-10})^3 \times 6.023 \times 10^{23}} = 4.25$ g/cm^3

26. (c) : Here given unit cell is shared equally by six faces in the fcc which is shared equally by six different unit cells.
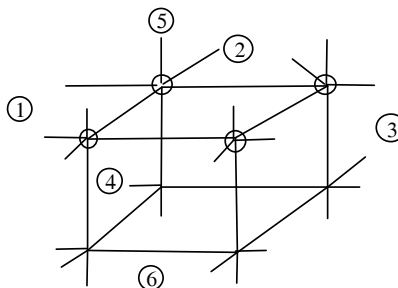
27. (a) : In a unit cell, X atoms at the corners

$= \dfrac{1}{8} \times 8 = 1$

Y atoms at the face centres $= \dfrac{1}{2} \times 6 = 3$

Ratio of X and Y = 1 : 3. Hence formula is XY_3.

28. (d) : Molar volume from pyknometric density

$= \dfrac{M}{2.165 \times 10^3}$ m^3

Molar volume from X-ray density

$= \dfrac{M}{2.178 \times 10^3}$ m^3

Volume unoccupied $= \dfrac{M}{10^3}\left(\dfrac{1}{2.165} - \dfrac{1}{2.178}\right)$ m^3

Fraction unoccupied

$= \left(\dfrac{0.013\,M \times 10^{-3}}{2.165 \times 2.178}\right) \Big/ \left(\dfrac{M \times 10^{-3}}{2.165}\right) = 5.96 \times 10^{-3}$

29. (c) : hcp is a closed packed arrangement in which the unit cell is hexagonal and co-ordination number is 12.

30. (a) : The electrostatic force of attraction which exists between oppositely charged ions is called as ionic bond.

31. (b) : 'A' atoms are at '8' corners of the cube. Thus,

no. of 'A' atoms per unit cell $= 8 \times \dfrac{1}{8} = 1$

'B' atoms are at the face centre of six faces. Thus, no.

of 'B' atoms per unit cell $= 6 \times \dfrac{1}{2} = 3$

The formula is AB_3.

32. (a) : As Cs^+ ion has larger size than Li^+ and I^- has larger size than F^-, so maximum distance between centres of cations and anions is in CsI.

33. (d) : According to Bragg's equation.
$n\lambda = 2d \sin\theta$
As, $n = 2$, $\lambda = 1.00$Å, $\theta = 60°$, $d = ?$

$\Rightarrow\ d = \dfrac{1}{\sin 60°} = \dfrac{2}{\sqrt{3}} = 1.15$Å

34. (a) : In the face centred cubic lattice, the edge length of the unit cell, $a = r + 2R + r$
where r = Radius of cation
R = Radius of anion
$\Rightarrow$ $508 = 2 \times 110 + 2R \Rightarrow R = 144$ pm

35. (d) : In Schottky defect equal no. of cations and anions are missing from the lattice. So the crystal remains neutral. Such defect is more common in highly ionic compounds of similar cationic and anionic size, *i.e.* NaCl.

36. (c) : Due to polar nature, water molecules are held together by intermolecular hydrogen bonds. The structure of ice is open with large number of vacant spaces. Thus the density of ice is less.

37. (d) : KI is an ionic compound while benzene is not.

38. (c) : A body centred cubic unit cell consists of 8 atoms at the corners and one atom at the centre.

39. (c) : The contribution of eight atoms of face centred cubic unit cell = $8 \times \dfrac{1}{8}$ = 1 atom. There is one atom at each of six faces, which is shared by 2 unit cells each. The contribution of 6 face centred atoms = $6 \times \dfrac{1}{2}$ = 3. Therefore $n = 1 + 3 = 4$

40. (a) : When an impurity atom with 5 valence electrons (as arsenic) is introduced in a germanium crystal, it replaces one of the germanium atoms. Four of the five valence electrons of the impurity atom form covalent bonds with each valence electron of four germanium atoms and fifth valence electron becomes free to move in the crystal structure. This free electron acts as a charge carrier. Such as an impure germanium crystal is called *n*-type semiconductor because in it charge carriers are negative (free electrons).

41. (d) : Cell edge = 400 pm; Number of atoms in *bcc* (Z) = 2 and atomic mass = 100 g/mol.
Since atomic mass is 100 g/mol, therefore mass of each atom (m) = $\dfrac{100}{6.023 \times 10^{23}}$ = 16.6×10^{-23} g
We know that volume of unit cell = $(400 \text{ pm})^3$
= $(64 \times 10^6)\text{pm}^3 = 64 \times 10^{-24} \text{ cm}^3$ and
mass of unit cell = $Z \times m = 2 \times (16.6 \times 10^{-23})$
= 33.2×10^{-23} g

Therefore density = $\dfrac{\text{Mass of unit cell}}{\text{Volume of unit cell}}$

= $\dfrac{33.2 \times 10^{-23}}{64 \times 10^{-24}}$ = 5.188 g/cm^3

42. (c) : Mass (m) = 100 g; Density (d) = 10 g/cm^3
and length (l) = 100 pm = 100×10^{-12} m
= 100×10^{-10} cm
We know that volume of the unit cell
= $(l)^3 = (100 \times 10^{-10} \text{ cm})^3 = 10^{-24}\text{cm}^3$

and volume of 100 g of element = $\dfrac{\text{Mass}}{\text{Density}} = \dfrac{100}{10} = 10$ cm^3

Therefore number of unit cells = $\dfrac{10}{10^{-24}} = 1 \times 10^{25}$

Since each *fcc* cube contains 4 atoms,
therefore total number of atoms in 100 g
= $4 \times (1 \times 10^{25}) = 4 \times 10^{25}$

43. (c) : When an atom is missing from its normal lattice site, a lattice vacancy is created. Such a defect, which involves equal number of cation and anion vacancies in the crystal lattice is called a Schottky defect.

44. (b) : Liquid crystals on heating first become turbid and then on further heating turbidity completely disappears.

45. (a) : *p*-type of semiconductors are produced (a) due to metal deficiency defects (b) by adding impurity containing less electrons (*i.e.* atoms of group 13). Ge belongs to Group 14 and In to Group 13. Hence on doping *p*-type semiconductor is obtained.
This doping of Ge with In increase the electrical conductivity of the Ge crystal.

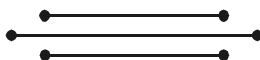**46. (c) :** In fluorite (CaF_2) structure, C.N. of Ca^{2+} = 8, C.N. of F^- = 4.

47. (c) : *fcc* crystal contains
= $8 \times \dfrac{1}{8} + 6 \times \dfrac{1}{2} = 4$ atoms in a unit cell
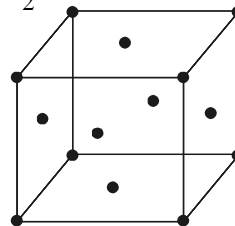
48. (b) : For orthorhombic system $\alpha = \beta = \gamma = 90°$

49. (d) : Crystals show good cleavage because their constituent particles are arranged in planes.

1. If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be
   - (a) halved
   - (b) tripled
   - (c) unchanged
   - (d) doubled.

   (NEET 2017)

2. Which of the following is dependent on temperature?
   - (a) Molarity
   - (b) Mole fraction
   - (c) Weight percentage
   - (d) Molality

   (NEET 2017)

3. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is
   - (a) 0
   - (b) 1
   - (c) 2
   - (d) 3

   (NEET-II 2016)

4. Which one of the following is incorrect for ideal solution?
   - (a) $\Delta H_{mix} = 0$
   - (b) $\Delta U_{mix} = 0$
   - (c) $\Delta P = P_{obs} - P_{calculated\ by\ Raoult's\ law} = 0$
   - (d) $\Delta G_{mix} = 0$

   (NEET-II 2016)

5. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, vapour pressure data at 25°C, benzene = 12.8 kPa, toluene = 3.85 kPa)
   - (a) The vapour will contain equal amounts of benzene and toluene.
   - (b) Not enough information is given to make a prediction.
   - (c) The vapour will contain a higher percentage of benzene.
   - (d) The vapour will contain a higher percentage of toluene.

   (NEET-I 2016)

6. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If $K_b = 0.52$, the boiling point of this solution will be
   - (a) 102°C
   - (b) 103°C
   - (c) 101°C
   - (d) 100°C

   (NEET-I 2016)

7. What is the mole fraction of the solute in a 1.00 m aqueous solution?
   - (a) 1.770
   - (b) 0.0354
   - (c) 0.0177
   - (d) 0.177

   (2015, 2011)

8. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case?
   - (a) Molecular mass of X is less than the molecular mass of Y.
   - (b) Y is undergoing dissociation in water while X undergoes no change.
   - (c) X is undergoing dissociation in water.
   - (d) Molecular mass of X is greater than the molecular mass of Y.

   (2015, Cancelled)

9. Which one of the following electrolytes has the same value of van't Hoff factor (i) as that of $Al_2(SO_4)_3$ (if all are 100% ionised)?
   - (a) $Al(NO_3)_3$
   - (b) $K_4[Fe(CN)_6]$
   - (c) K_2SO_4
   - (d) $K_3[Fe(CN)_6]$

   (2015, Cancelled)

10. Which of them is not equal to zero for an ideal solution?
    - (a) ΔV_{mix}
    - (b) $\Delta P = P_{observed} - P_{Raoult}$
    - (c) ΔH_{mix}
    - (d) ΔS_{mix}

    (2015, Cancelled)

11. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression?
    - (a) KCl
    - (b) $C_6H_{12}O_6$
    - (c) $Al_2(SO_4)_3$
    - (d) K_2SO_4

    (2014)

12. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70% HNO_3.
 (a) 70.0 g conc. HNO_3
 (b) 54.0 g conc. HNO_3
 (c) 45.0 g conc. HNO_3
 (d) 90.0 g conc. HNO_3 *(NEET 2013)*

13. Which condition is not satisfied by an ideal solution?
 (a) $\Delta_{mix} V = 0$ (b) $\Delta_{mix} S = 0$
 (c) Obeyance to Raoult's Law
 (d) $\Delta_{mix} H = 0$ *(Karnataka NEET 2013)*

14. p_A and p_B are the vapour pressure of pure liquid components, A and B, respectively of an ideal binary solution. If x_A represents the mole fraction of component A, the total pressure of the solution will be
 (a) $p_A + x_A(p_B - p_A)$ (b) $p_A + x_A(p_A - p_B)$
 (c) $p_B + x_A(p_B - p_A)$ (d) $p_B + x_A(p_A - p_B)$
  (2012)

15. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 25°C are 200 mm Hg and 41.5 mm Hg respectively. Vapour pressure of the solution obtained by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at the same temperature will be
 (Molecular mass of $CHCl_3 = 119.5$ u and molecular mass of $CH_2Cl_2 = 85$ u)
 (a) 173.9 mm Hg (b) 615.0 mm Hg
 (c) 347.9 mm Hg (d) 285.5 mm Hg
  (Mains 2012)

16. The freezing point depression constant for water is −1.86° C m⁻¹. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O, the freezing point is changed by −3.82°C. Calculate the van't Hoff factor for Na_2SO_4.
 (a) 2.05 (b) 2.63
 (c) 3.11 (d) 0.381 *(2011)*

17. The van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively
 (a) less than one and greater than one
 (b) less than one and less than one
 (c) greater than one and less than one
 (d) greater than one and greater than one.
  (2011)

18. A 0.1 molal aqueous solution of a weak acid is 30% ionized. If K_f for water is 1.86°C/m, the freezing point of the solution will be
 (a) − 0.18°C (b) − 0.54°C
 (c) − 0.36°C (d) − 0.24°C
  (Mains 2011)

19. 200 mL of an aqueous solution of a protein contains its 1.26 g. The osmotic pressure of this solution at 300 K is found to be 2.57×10^{-3} bar. The molar mass of protein will be
 ($R = 0.083$ L bar mol⁻¹ K⁻¹)
 (a) 51022 g mol⁻¹ (b) 122044 g mol⁻¹
 (c) 31011 g mol⁻¹ (d) 61038 g mol⁻¹
  (Mains 2011)

20. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase?
 (a) Addition of NaCl
 (b) Addition of Na_2SO_4
 (c) Addition of 1.00 molal KI
 (d) Addition of water *(2010)*

21. A solution of sucrose (molar mass = 342 g mol⁻¹) has been prepared by dissolving 68.5 g of sucrose in 1000 g of water. The freezing point of the solution obtained will be (K_f for water = 1.86 K kg mol⁻¹)
 (a) − 0.372°C (b) − 0.520°C
 (c) + 0.372°C (d) − 0.570°C
  (2010)

22. A 0.0020 m aqueous solution of an ionic compound $[Co(NH_3)_5(NO_2)]Cl$ freezes at − 0.00732°C. Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be
 ($K_f = -1.86$°C/m)
 (a) 3 (b) 4
 (c) 1 (d) 2 *(2009)*

23. 0.5 molal aqueous solution of a weak acid (HX) is 20% ionised. If K_f for water is 1.86 K kg mol⁻¹, the lowering in freezing point of the solution is
 (a) 0.56 K (b) 1.12 K
 (c) −0.56 K (d) −1.12 K
  (2007)

24. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 g mL⁻¹. Volume of acid required to make one litre of 0.1 M H_2SO_4 solution is
 (a) 16.65 mL (b) 22.20 mL
 (c) 5.55 mL (d) 11.10 mL
  (2007)

25. During osmosis, flow of water through a semipermeable membrane is
(a) from solution having lower concentration only
(b) from solution having higher concentration only
(c) from both sides of semipermeable membrane with equal flow rates
(d) from both sides of semipermeable membrane with unequal flow rates.
(2006)

26. A solution of acetone in ethanol
(a) obeys Raoult's law
(b) shows a negative deviation from Raoult's law
(c) shows a positive deviation from Raoult's law
(d) behaves like a near ideal solution. *(2006)*

27. 1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is 5.12 K kg mol^{-1}, the freezing point of benzene will be lowered by
(a) 0.2 K   (b) 0.4 K
(c) 0.3 K   (d) 0.5 K *(2006)*

28. A solution containing 10 g per dm^3 of urea (molecular mass = 60 g mol^{-1}) is isotonic with a 5% solution of a nonvolatile solute is
(a) 200 g mol^{-1} (b) 250 g mol^{-1}
(c) 300 g mol^{-1} (d) 350 g mol^{-1}
(2006)

29. The mole fraction of the solute in one molal aqueous solution is
(a) 0.009   (b) 0.018
(c) 0.027   (d) 0.036 *(2005)*

30. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 mole of P and 2 mol of Q would be
(a) 72 torr   (b) 140 torr
(c) 68 torr   (d) 20 torr *(2005)*

31. A solution has a 1 : 4 mole ratio of pentane to hexane. The vapour pressures of the pure hydrocarbons at 20°C are 440 mm Hg for pentane and 120 mm Hg for hexane. The mole fraction of pentane in the vapour phase would be
(a) 0.200   (b) 0.549
(c) 0.786   (d) 0.478 *(2005)*

32. A solution of urea (mol. mass 56 g mol^{-1}) boils at 100.18°C at the atmospheric pressure. If K_f and K_b for water are 1.86 and 0.512 K kg mol^{-1} respectively, the above solution will freeze at
(a) 0.654°C   (b) − 0.654°C
(c) 6.54°C   (d) − 6.54°C
(2005)

33. A solution containing components A and B follows Raoult's law
(a) A - B attraction force is greater than A - A and B - B
(b) A - B attraction force is less than A - A and B - B
(c) A - B attraction force remains same as A - A and B - B
(d) volume of solution is different from sum of volume of solute and solvent. *(2002)*

34. A solution contains non volatile solute of molecular mass M_2. Which of the following can be used to calculate the molecular mass of solute in terms of osmotic pressure?
(a) $M_2 = \left(\dfrac{m_2}{\pi}\right)VRT$

(b) $M_2 = \left(\dfrac{m_2}{V}\right)\dfrac{RT}{\pi}$

(c) $M_2 = \left(\dfrac{m_2}{V}\right)\pi RT$

(d) $M_2 = \left(\dfrac{m_2}{V}\right)\dfrac{\pi}{RT}$

(m_2 = mass of solute, V = volume of solution, π = osmotic pressure) *(2002)*

35. 2.5 litre of 1 M NaOH solution is mixed with another 3 litre of 0.5 M NaOH solution. Then find out molarity of resultant solution.
(a) 0.80 M   (b) 1.0 M
(c) 0.73 M   (d) 0.50 M *(2002)*

36. The beans are cooked earlier in pressure cooker because
(a) boiling point increases with increasing pressure
(b) boiling point decreases with increasing pressure
(c) extra pressure of pressure cooker softens the beans
(d) internal energy is not lost while cooking in pressure cooker. *(2001)*

37. Pure water can be obtained from sea water by
(a) centrifugation   (b) plasmolysis
(c) reverse osmosis   (d) sedimentation.
(2001)

38. From the colligative properties of solution, which one is the best method for the determination of molecular weight of proteins and polymers?
(a) Osmotic pressure
(b) Lowering in vapour pressure
(c) Lowering in freezing point
(d) Elevation in boiling point   *(2000)*

39. The vapour pressure of benzene at a certain temperature is 640 mm of Hg. A non-volatile and non-electrolyte solid, weighing 2.175 g is added to 39.08 of benzene. The vapour pressure of the solution is 600 mm of Hg. What is the molecular weight of solid substance?
(a) 69.5   (b) 59.6
(c) 49.50   (d) 79.8   *(1999)*

40. How many g of dibasic acid (mol. weight 200) should be present in 100 mL of the aqueous solution to give strength of 0.1 N?
(a) 10 g   (b) 2 g
(c) 1 g   (d) 20 g   *(1999)*

41. If 0.15 g of a solute, dissolved in 15 g of solvent, is boiled at a temperature higher by 0.216°C, than that of the pure solvent. The molecular weight of the substance (Molal elevation constant for the solvent is 2.16°C) is
(a) 10.1   (b) 100
(c) 1.01   (d) 1000   *(1999)*

42. The vapour pressure of a solvent decreased by 10 mm of mercury when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent if the decrease in the vapour pressure is to be 20 mm of mercury?
(a) 0.4   (b) 0.6
(c) 0.8   (d) 0.2   *(1998)*

43. A 5% solution of cane sugar (mol. wt. = 342) is isotonic with 1% solution of a substance X. The molecular weight of X is
(a) 68.4   (b) 171.2
(c) 34.2   (d) 136.8   *(1998)*

44. Which of the following 0.10 m aqueous solution will have the lowest freezing point?
(a) KI   (b) $C_{12}H_{22}O_{11}$
(c) $Al_2(SO_4)_3$ (d) $C_5H_{10}O_5$
                                          (1997)

45. What is the molarity of H_2SO_4 solution, that has a density 1.84 g/cc at 35°C and contains 98% by weight?
(a) 18.4 M   (b) 18 M
(c) 4.18 M   (d) 8.14 M *(1996)*

46. The vapour pressure of CCl_4 at 25°C is 143 mm Hg. If 0.5 g of a non-volatile solute (mol. weight = 65) is dissolved in 100 mL CCl_4, the vapour pressure of the solution will be
(a) 199.34 mm Hg   (b) 143.99 mm Hg
(c) 141.43 mm Hg   (d) 94.39 mm Hg.
                                          (1996)

47. The relationship between osmotic pressure at 273 K when 10 g glucose (p_1), 10 g urea (p_2), and 10 g sucrose (p_3) are dissolved in 250 mL of water is
(a) $p_1 > p_2 > p_3$
(b) $p_3 > p_1 > p_1$
(c) $p_1 > p_2 > p_3$
(d) $p_3 > p_1 > p_2$ *(1996)*

48. The concentration unit, independent of temperature, would be
(a) normality
(b) weight volume percent
(c) molality
(d) molarity.   *(1995, 1992)*

49. According to Raoult's law, the relative lowering of vapour pressure for a solution is equal to
(a) mole fraction of solute
(b) mole fraction of solvent
(c) moles of solute
(d) moles of solvent.   *(1995)*

50. How many grams of CH_3OH should be added to water to prepare 150 mL solution of 2 M CH_3OH?
(a) 9.6×10^3 (b) 2.4×10^3
(c) 9.6   (d) 2.4   *(1994)*

51. At 25°C, the highest osmotic pressure is exhibited by 0.1 M solution of
(a) glucose   (b) urea
(c) $CaCl_2$ (d) KCl   *(1994)*

52. Which of the following salt has the same value of vant's Hoff factor (i) as that of $K_3[Fe(CN)_6]$?
(a) Na_2SO_4 (b) $Al(NO_3)_3$
(c) $Al_2(SO_4)_3$ (d) NaCl   *(1994)*

53. If 0.1 M solution of glucose and 0.1 M solution of urea are placed on two sides of the semipermeable membrane to equal heights, then it will be correct to say that
(a) there will be no net movement across the membrane
(b) glucose will flow towards glucose solution
(c) urea will flow towards glucose solution
(d) water will flow from urea solution to glucose. *(1992)*

54. Which one is a colligative property?
(a) Boiling point (b) Vapour pressure
(c) Osmotic pressure (d) Freezing point *(1992)*

55. Blood cells retain their normal shape in solution which are
(a) hypotonic to blood
(b) isotonic to blood
(c) hypertonic to blood
(d) equinormal to blood. *(1991)*

56. Which of the following aqueous solution has minimum freezing point?
(a) 0.01 m NaCl

(b) 0.005 m C_2H_5OH
(c) 0.005 m MgI_2
(d) 0.005 m $MgSO_4$ *(1991)*

57. The relative lowering of the vapour pressure is equal to the ratio between the number of
(a) solute molecules to the solvent molecules
(b) solute molecules to the total molecules in the solution
(c) solvent molecules to the total molecules in the solution
(d) solvent molecules to the total number of ions of the solute. *(1991)*

58. All form ideal solution except
(a) C_6H_6 and $C_6H_5CH_3$
(b) C_2H_6 and C_2H_5I
(c) C_6H_5Cl and C_6H_5Br
(d) C_2H_5I and C_2H_5OH *(1988)*

59. An ideal solution is formed when its components
(a) have no volume change on mixing
(b) have no enthalpy change on mixing
(c) have both the above characteristics
(d) have high solubility. *(1988)*

Answer Key

1.	(c)	**2.**	(a)	**3.**	(d)	**4.**	(d)	**5.**	(c)	**6.**	(c)	**7.**	(c)	**8.**	(c)	**9.**	(b)	**10.**	(d)
11.	(c)	**12.**	(c)	**13.**	(b)	**14.**	(d)	**15.**	(None)			**16.**	(b)	**17.**	(c)	**18.**	(d)	**19.**	(d)
20.	(d)	**21.**	(a)	**22.**	(d)	**23.**	(b)	**24.**	(c)	**25.**	(d)	**26.**	(c)	**27.**	(b)	**28.**	(c)	**29.**	(b)
30.	(a)	**31.**	(d)	**32.**	(b)	**33.**	(c)	**34.**	(b)	**35.**	(c)	**36.**	(a)	**37.**	(c)	**38.**	(a)	**39.**	(a)
40.	(c)	**41.**	(b)	**42.**	(b)	**43.**	(a)	**44.**	(c)	**45.**	(a)	**46.**	(c)	**47.**	(a)	**48.**	(c)	**49.**	(a)
50.	(c)	**51.**	(c)	**52.**	(b)	**53.**	(a)	**54.**	(c)	**55.**	(b)	**56.**	(a)	**57.**	(a)	**58.**	(d)	**59.**	(c)