NEET - 2014

Questions with Solutions

Time: 3 Hours **Total Marks: 720**

General Instructions:

1. The test is of **3 hours** duration.
2. The Test Paper contains **180** questions. There are **three** parts in the question paper consisting of **Physics and Chemistry** having **45** questions each and **Biology** with **90 questions.**
3. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For each incorrect response, **1 mark** will be deducted from the total scores. The maximum marks are **720**.
4. Out of the four options given for each question, only one option is the correct answer. If more than one response is marked in any question, it will be treated as wrong response and marked up for wrong response will be deducted.
5. No deduction from the total score will be made if no response is indicated for an item in the answer box.
6. Use of Electronic/Manual Calculator is prohibited.

PHYSICS

Q 1. If force (F), velocity (V) and time (T) are taken as fundamental units, then the dimensions of mass are:-

Option A [F V T^{-1}]

Option B [F V T^{-2}]

Option C [F V^{-1} T^{-1}]

Option D [F V^{-1} T]

Correct Option D

Solution:

$$\text{Force} = \text{mass} \times \text{acceleration}$$

$$\text{mass} = \frac{\text{Force}}{\text{Acceleretion}} = \left[\frac{\text{Force}}{\text{Velocity / time}}\right]$$

$$= \left[\text{F V}^{-1}\ \text{T}\right]$$

Q 2. A projectile is fired from the surface of the earth with a velocity of 5 ms^{-1} and angle θ with the horizontal. Another projectile fired from another planet with a velocity of 3 ms^{-1} at the same angle follows a trajectory while is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is (in ms^{-2}) is: (given g = 9.8 m/s^2)

Option A 3.5

Option B 5.9

Option C 16.8

Option D 110.8

Correct Option A

Solution:

As range $= \dfrac{u^2 \sin 2\theta}{g}$ so $g \propto u^2$

Therefore, $g_{planet} = \left(\dfrac{3}{5}\right)^2 \left(9.8\ m/s^2\right) = 3.5\ m/s^2$

Q 3. A particle is moving such that its position coordinate (x, y) are

(2m, 3m) at time t = 0

(6m, 7m) at time t = 2 s and

(13m, 14) at time t = 5 s

Average velocity $\left(\vec{V}_{av}\right)$ from t = 0 to t = 5 s is

Option A $\dfrac{1}{5}\left(13\hat{i} + 14\hat{j}\right)$

Option B $\dfrac{7}{3}\left(\hat{i} + \hat{j}\right)$

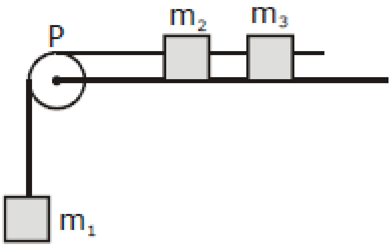
Option C $2\left(\hat{i} + \hat{j}\right)$

Option D $\dfrac{11}{5}\left(\hat{i} + \hat{j}\right)$

Correct Option D

Solution: $\vec{v}_{av} = \dfrac{\Delta \vec{r}}{\Delta t}\ \dfrac{(13-2)\hat{i} + (14-3)\hat{j}}{5-0} = \dfrac{11}{5}(i + j)$

Q 4. A system consists of three masses m_1, m_2 and m_3 connected by a string passing over a pulley P. The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (the coefficient of friction = μ). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is (Assume $m_1 = m_2 = m_3 = m$)



Option A $\dfrac{g(1-2\mu)}{9}$

Option B $\dfrac{2g\mu}{3}$

Option C $\dfrac{g(1-2\mu)}{3}$

Option D $\dfrac{g(1-2\mu)}{2}$

Correct Option C

Solution:

$m_1g - T_1 = m_1a ------(1)$

$T_1 - f_1 - T_2 = m_2a -----(2)$

$T_3 - f_1 = m_3a -----(3)$

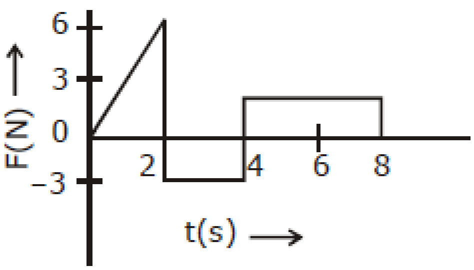
On soving above equation we get

$(\mathbf{m_1} = \mathbf{m_2} = \mathbf{m_3} = \mathbf{m})$

$mg - 2\mu mg = 3ma$

$a = \dfrac{g(1-2\mu)}{3}$

Q 5. The force 'F acting on a particle of mass 'm' is indicated by the force – time graph shown below. The change in momentum of the particle over the time Interval from zero to 8 s Is:



Option A 24 N s

Option B 20 N s

Option C 12 N s

Option D 6 N s

Correct Option C

Solution:

Change in momentum, Δp

$\Delta p = \text{Area of } F - t \text{ graph}$

$= \frac{1}{2} \times 2 \times 6 - 3 \times 2 + 4 \times 3$

$= 12 \text{ N} - \text{s}$

Q 6. A balloon with mass 'm' is descending down with an acceleration 'a' (where a < g). How much mass should be removed from it so that it starts moving up with an acceleration 'a'?

Option A $\frac{2ma}{g + a}$

Option B $\frac{2ma}{g - a}$

Option C $\frac{ma}{g + a}$

Option D $\frac{ma}{g - a}$

Correct Option A

Solution: Let up thrust of air be F_b then for downward motion

$mg - F_b = ma$

Lets assume that mass m' be removed from the balloon

So when it start moving upward

$F_b - (m - m') = (m - m')a$

$m' = \frac{2ma}{g + a}$

Q 7. A body of mass (4m) is lying in x-y plane at rest. It suddenly explodes into three pieces. Two pieces, each of mass (m) move perpendicular to each other with equal speeds (v), The total kinetic energy generated due to explosion is

Option A mv^2

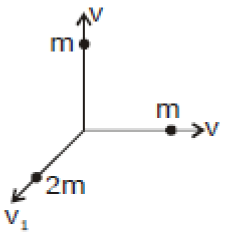
Option B $\frac{3}{2} mv^2$

Option C $2 mv^2$

Option D $4 mv^2$

Correct Option B

Solution:



Totalmomentum before explosion=0

Total momentum after explosion=$\sqrt{2}$ mv + 2mv_1

By conservation of linear momentum

$$\sqrt{2}\ mv + 2mv_1 = 0$$

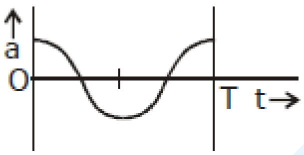
$$2mv_1 = -\sqrt{2}\ mv \Rightarrow v_1 = -\frac{v}{\sqrt{2}}$$

$$\text{Total KE generated} = 2\times\frac{1}{2}mv^2 + \frac{1}{2}(2m)\,v_1^{\,2}$$

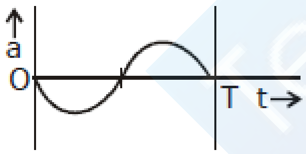
$$= mv^2 + \frac{mv^2}{2} = \frac{3}{2}mv^2$$

Q 8. The oscillation of body on a smooth horizontal surface is represented by the equation,
X = A cos (ωt)
Where
X = displacement at time t
ω = frequency of oscillation
Which one of the following graphs shows correctly the variation 'a' with 't'?

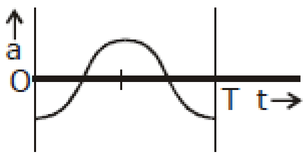
Option A



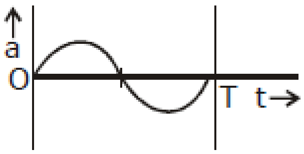
Option B



Option C



Option D



Correct Option C
Solution:

Displacement, x = A cos (ωt)

$$\text{Velocity, } v = \frac{dx}{dt} = -A\omega \sin(\omega t)$$

$$\text{Acceleration, } a = \frac{dv}{dt} = -A\omega^2 \cos(\omega t)$$

Hence C is the correct option.

Q 9. A solid cylinder of mass 50 kg and radius 0.5 m is free to rotate about the horizontal axis. Massless string is wound round the cylinder with one end attached to it and other hanging freely. Tension in the string required to produce an angular acceleration of 2 revolutions S^{-2} is :-

Option A 25 N
Option B 50 N
Option C 78.5 N
Option D 157 N

Correct Option D

Solution:

α = 2 revolution /s^2 = 4π rad/s^2

$$I = \frac{1}{2} MR^2$$

As $\tau = I\alpha$ so $TR = I\alpha$

$$TR = I\alpha$$

$$TR = \frac{MR^2}{2}\alpha$$

$$T = \frac{MR}{2}\alpha$$

$$\Rightarrow T = \frac{I\alpha}{R} = \frac{50 \times 0.5 \times (4\pi)}{2} \text{ N}$$

$$= 50\,\pi\text{N} = 157 \text{ N}$$

Q 10. The ratio of the accelerations for a solid sphere (mass 'm' and radius 'R') rolling down an incline of angle 'θ' without slipping and slipping down the incline without rolling is:

Option A 5 : 7
Option B 2 : 3
Option C 2 : 5
Option D 7 : 5

Correct Option A

Solution:

For rolling motion without slipping on inclined plane acceleration is given by

$$a_{\text{rolling}} = \frac{g \sin\theta}{1 + \frac{K^2}{R^2}} = \frac{g \sin\theta}{1 + \frac{2}{5}}$$

$$\text{For solid sphere, } \left(\frac{k^2}{R^2} = \frac{2}{5}\right)$$

And for slipping motion on inclined plane

$a_{slipping} = g\sin\theta$

$$\text{Required ratio} = \frac{a_{rolling}}{a_{slipping}} = \frac{1}{1+\frac{2}{5}} = \frac{5}{7}$$

Q 11. A black hole is an object whose gravitational fields is so strong that even light cannot escape from it. To what approximate radius would earth (mass = 5.98 × 10^{24} kg) have to be compressed to be a black hole?

Option A 10^{-9} m

Option B 10^{-6} m

Option C 10^{-2} m

Option D 100 m

Correct Option C

Solution:

$$\text{Escape velocity} = \sqrt{\frac{2GM}{R}}$$

c = speed of light

$$c = \sqrt{\frac{2GM}{R}}$$

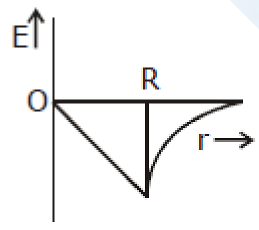
Squaring both side

$$\Rightarrow R = \frac{2GM}{c^2} = \frac{2 \times 6.6 \times 10^{-11} \times 5.98 \times 10^{24}}{\left(3 \times 10^8\right)^2}$$

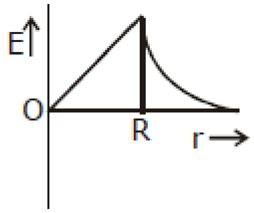
$$= 10^{-2} \text{ m}$$

Q 12. Dependence of intensity of gravitational field (E) of earth with distance (r) from centre of earth is correctly represented by : -

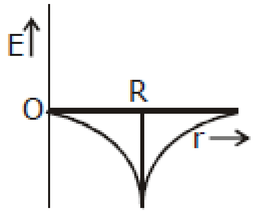
Option A



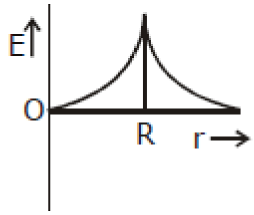
Option B



Option C



Option D



Correct Option A

Solution:

$$E_{inside} = \frac{GMr}{R^3}$$

$$E_{surface} = \frac{GM}{R^2}$$

$$E_{outside} = \frac{GM}{r^2}$$

at r=0 i.e at the centr of the earth E=0

Q 13. Copper of fixed volume V; is drawn into wire of length ‘l. When this wire is subjected to a constant force ‘F’, the extension produced in the wire is Δl. Which of the following graphs is a straight line?

Option A $\quad \Delta l$ versus $\frac{1}{l}$

Option B $\quad \Delta l$ versus l^2

Option C $\quad \Delta l$ versus $\frac{1}{l^2}$

Option D $\quad \Delta l$ versus l

Correct Option B

Solution:

Young's modulus

$$Y = \frac{\frac{F}{A}}{\frac{\Delta\ell}{\ell}} \Rightarrow \Delta\ell = \frac{F\ell}{AY}$$

But $V = A\ell$

Therefore $A = \frac{V}{\ell}$

Therefore $\Delta\ell = \frac{F\ell^2}{VY}$

$\Delta\ell \propto \ell^2$

Q 14. A certain number of spherical drops of a liquid of radius 'r' coalesce to form a single drop of radius 'R' and volume 'V'. If 'T' is the surface tension of the liquid, then:

Option A energy $= 4VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is relesed

Option B energy $= 3VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is absorbed

Option C energy $= 3VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is relesed

Option D Energy is neither released nor absorbed

Correct Option C

Solution:

As surface area decrease so energy is released.

Volumewill remain constant

$$n\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$r = \frac{R}{n^{1/3}}$$

Energy release

$$T \times n4\pi r^2 - T \times 4\pi R^2$$

On solving we get

$$= 4\pi R^2 T\left[n^{1/3} - 1\right] \text{ where} R = n^{1/3}\ r$$

$$= 4\pi R^3 T\left[\frac{1}{r} - \frac{1}{R}\right]$$

$$= 3VT\left[\frac{1}{r} - \frac{1}{R}\right]$$

Q 15. Steam at 100° C is passed into 20 g of water at 10°C. When water acquires a temperature of 80°C, the mass of water present will be: [Take specific heat of water = 1 cal g^{-1} $°C^{-1}$ and latent heat of steam = 540 cal g^{-1}]

Option A 24 g

Option B 31.5 g

Option C 42.5 g

Option D 22.5 g

Correct Option D

Solution:

According to the principle of calorimetry

Heat lost = Heat gained

$$mL_{vapourisation} + ms_w\Delta T = m_w s_w \Delta T$$

$$m \times 540 + m \times 1 \times (100 - 80) = 20 \times 1 \times (80 - 10)$$

$$m = 2.5\ g$$

$$\text{Total mass of water} = (20 + 2.5)\ g = 22.5\ g$$

Q 16. Certain quantity of water cools from 70° C to 60° C in the first 5 minutes and to 54°C in the next 5 minutes. The temperature of the surroundings is:-

Option A 45°C

Option B 20°C

Option C 42°C

Option D 10°C

Correct Option A

Solution:

according to newtons law of cooling

$$\frac{T_1 - T_2}{\Delta t} = k\left[\frac{T_1 + T_2}{2} - T_0\right]$$

$$\frac{70-60}{5} = k\left[\frac{70+60}{2} - T_0\right]$$

$$\frac{10}{5} = k[65 - T_0] \text{....(i)}$$

and $\frac{60-54}{5} = k\left[\frac{60+54}{2} - T_0\right]$

$$\Rightarrow \frac{6}{5} = k[57 - T_0] \quad \text{.....(ii)}$$

By dividing (i) by (ii) we have

$$\frac{10}{6} = \frac{65 - T_0}{37 - T_0}$$

$$\Rightarrow \quad T_0 = 45°$$

Q 17. A monoatomic gas at a pressure p, having a volume V expands isothermally to a volume 2V and then adiabatically to a volume 16V. The final pressure of the gas is : (take $\gamma = \frac{5}{3}$)

Option A 64P

Option B 32P

Option C $\frac{P}{64}$

Option D 16P

Correct Option C

Solution:

For isothermal process

PV=constant

$$\Rightarrow P_0V = P'(2V) \Rightarrow P' = \frac{P_0}{2}$$

For adiabatic process $PV^{\gamma} = \text{constant}$

$$P'(2V)^{\gamma} = P_f(16V)^{\gamma}$$

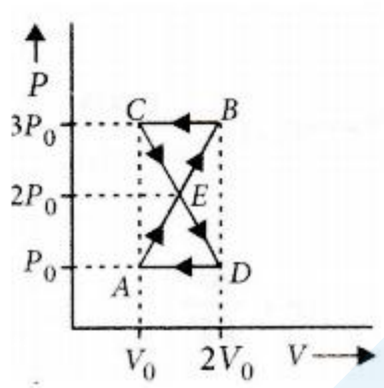
$$\Rightarrow \left(\frac{P_0}{2}\right)(2v)^{\gamma} = P_f\,(16v)^{\gamma}$$

For monoatomic gas

$$\gamma = \frac{5}{3}$$

$$\Rightarrow P_{\text{final}} = \frac{3}{2}\left(\frac{1}{8}\right)^{5/3} = \frac{P_0}{64}$$

Q 18. A thermodynamic system undergoes cyclic process ABCDA as shown in fig. The work done by the system in the cycle is:



Option A $P_0 V_0$

Option B $2P_0 V_0$

Option C $\frac{P_0\ V_0}{2}$

Option D zero

Correct Option D

Solution:

Work done by the system in the cycle

= Area under P – V curve & V – axis

For clockwise work done is positive

For anticlockwise work done is negative

$$W_{ADEA} = +\frac{1}{2}(2P_0 - P_0)\,(2V_0 - V_0)$$

$$W_{EBCE} = -\left(\frac{1}{2}\right)(3P_0 - 2P_0)\,(2V_0 - V_0)$$

$$= \frac{P_0V_0}{2} - \frac{P_0V_0}{2} = 0$$

Q 19. The mean free path of molecules of a gas, (radius 'r') is inversely proportional to:-

Option A r^3

Option B r^2

Option C r

Option D $\sqrt{r}$

Correct Option B

Solution:

Mean free path

$$\lambda = \frac{1}{\sqrt{2}\,\pi d^2 n}$$

$$d = 2r$$

$$\lambda = \frac{1}{4\sqrt{2}\,\pi r^2 n}$$

$$\lambda = \frac{1}{r^2}$$

Q 20. If n_1, n_2, and n_3 are the fundamental frequencies of three segments into which a string is divided, then the original fundamental frequency n of the string is given by –

Option A $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$

Option B $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}} + \frac{1}{\sqrt{n_3}}$

Option C $\sqrt{n} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3}$

Option D $n = n_1 + n_2 + n_3$

Correct Option A

Solution:

$$\ell = \ell_1 + \ell_2 + \ell_3$$

$$f \propto \frac{1}{\ell}$$

$$\text{so } \frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$$

Q 21. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are: (Velocity of sound = 340 ms^{-1})

Option A 4

Option B 5

Option C 7

Option D 6

Correct Option D

Solution:

For pipe closed at one end

$$f = (2n+1)\frac{v}{4L}$$

For

$$f_0 = \frac{340}{4\times 85\times 10^{-2}} = 100Hz$$

Therefore

$n \; 0, f_0 = 100$ Hz

$n = 1, f_1 = 300$ Hz

$n = 2, f_2 = 500$ Hz

$n = 3, f_3 = 700$ Hz

$n = 4, f_4 = 900$ Hz

$n = 5, f_5 = 1100$ Hz

Which are less than 1250 Hz

Q 22. A speeding motorcyclist sees traffic jam ahead of him. He slows down to 36 km/hour. He finds that traffic has eased and a car moving ahead of him at 18 km/hour is honking at a frequency of 1392 Hz. If the speeds of sound is 343 m/s, the frequency of the honk as heard by him will be

Option A 1332 Hz

Option B 1372 Hz

Option C 1412 Hz

Option D 1454 Hz

Correct Option C

Solution:

Apparent frequency

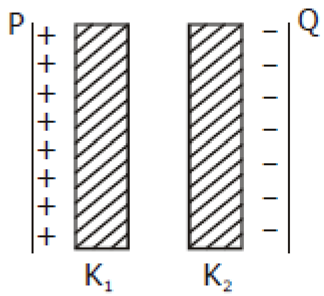
$$f' = f_0\left(\frac{v \pm v_0}{v \pm v_s}\right)$$

$$f' = f_0\left(\frac{v + v_0}{v + v_s}\right)$$

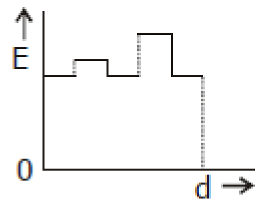
$$= 1392\left(\frac{343+10}{343+5}\right)$$

$= 1412$ HZ

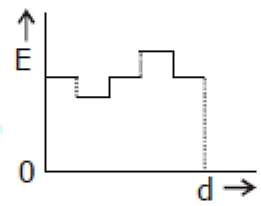
Q 23. Two thin dielectric slabs of dielectric constants K_2 and K_2 ($K_1 < K_2$) are interested between plates of a parallel plate capacitor, as shown in the figure. The variation of electric field 'E' between the plates with distance'd' as measured from plate P is correctly shown by:



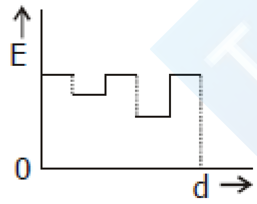
Option A



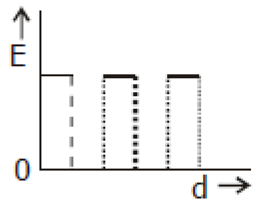
Option B



Option C



Option D



Correct Option C
Solution:

Electric field, $E' \propto \frac{E_0}{K}$

As $K_1 < K_2$ so $E_1 > E_2$

Q 24. A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the center of the sphere respectively are –

Option A zero and $\frac{Q}{4\pi \in_0 R^2}$

Option B $\frac{Q}{4\pi \in_0 R}$ zero and

Option C $\frac{Q}{4\pi \in_0 R}$ and $\frac{Q}{4\pi \in_0 R^2}$

Option D Both and zero

Correct Option B

Solution:

Electric field inside a conducting shell is zero

So E at center and potential remains constant

at any point insude the shell.

Therefore

$$E = 0 \ \& \ V = \frac{Q}{4\pi \in_0 R}$$

Q 25. In a region, the potential is represented by V(x, y, z) = 6x -8xy – 8y + 6yz, where V is in volts and x, y, z are in meters. The electric force experienced by a charge of 2 coulomb situated at point (1, 1, 1) is –

Option A $6\sqrt{5}$ N

Option B 30 N

Option C 24 N

Option D $4\sqrt{35}$

Correct Option D

Solution:

$$\vec{E} = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$$

$$\vec{E}_x = -\frac{\partial V}{\partial x}\hat{i} = (6 - 8y)\hat{i}$$

$$\vec{E}_y = -\frac{\partial V}{\partial y}\hat{j} = (-8x - 8 + 6z)\hat{j}$$

$$\vec{E}_z = -\frac{\partial V}{\partial z}\hat{k} = (6y)\hat{k}$$

$$\vec{E} = \vec{E}_x + \vec{E}_y + \vec{E}_z$$

$$= \left[(6 - 8y)\hat{i} \ (-8x - 8 + 6z)\hat{j} \ + (6y)\hat{k}\right]$$

At $(1,1,1)$, $\vec{E} = 2\hat{i} + 10\hat{j} - 6\hat{k}$

$$= \left(\vec{E}\right) = \sqrt{2^2 + 10^2 + 6^2} = \sqrt{140} = 2\sqrt{35}$$

$$\text{Force} = qE = 2 \times 2\sqrt{35} = 4\sqrt{35}\ \text{N}$$

Q 26. Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5 Ω. The power loss in the wires is-

Option A 19.2 W

Option B 19.2 kW

Option C 19.2 J

Option D 12.2 kW

Correct Option B

Solution: Resistance = (0.5 Ω/km) (150 km) = 75Ω

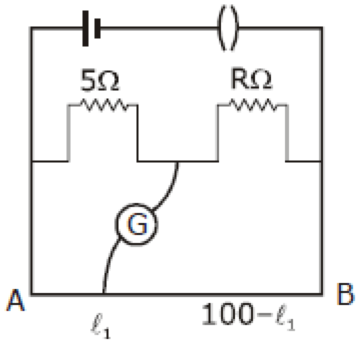
Total voltage drop = (8V/km) (150 km) = 1200 V

$$I = \frac{V}{R} = \frac{1200V}{75} = 16A$$

$$P = I^2R$$

$$P = 16^2 \times 75 = 19.2kW$$

Q 27. The resistance in the two arms of the meter bridge are 5Ω and RΩ , respectively. When the resistance R is shunted with an equal resistance, the new balance point is at 1.6 ℓ_1. The resistance 'R' is-



Option A	100Ω
Option B	15Ω
Option C	20Ω
Option D	25Ω

Correct Option B

Solution:

At balance point

$$\frac{5}{R} = \frac{\ell_1}{100 - \ell_1}$$

After shunting

$$\frac{5}{R/2} = \frac{1.6\ell_1}{100 - 1.6\ell_1}$$

On solving

$\Rightarrow R = 15\ \Omega$

Q 28. A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 4m long, when the resistance R, connected across the given cell, has values of.

(i) Infinity **(ii) 9.5 Ω**

The balancing lengths', on the potentiometer wire are found to be 3m and 2.85 m, respectively. The value of internal resistance of the cell is.

Option A	0.25 Ω
Option B	0.95 Ω
Option C	0.5 Ω
Option D	0.75 Ω

Correct Option C

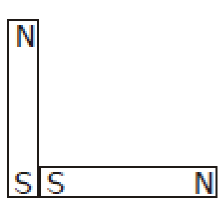
Solution:

Internal resistance,

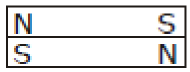
$$r = \left(\frac{E - V}{V}\right) R = \left(\frac{\ell_2 - \ell_1}{\ell_2}\right) R$$

$$= \left(\frac{0.15}{2.85}\right)(9.5)\ \Omega = 0.5\ \Omega$$

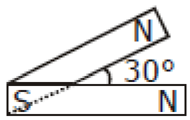
Q 29. Following figures show the arrangement of bar magnetism in different configurations. Each magnet has magnetic dipole moment $\vec{m}$. Which configuration has highest net magnetic dipole moment?



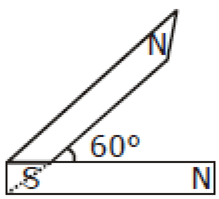
a)



b)



c)



d)

Option A (a)
Option B (b)
Option C (c)
Option D (d)

Correct Option C

Solution:

Net magnetic moment = $\sqrt{m_1^2 + m_2^2 + 2m_1 m_2 \operatorname{Cos}\theta}$

So out of the given configuration C has the maximum net dipole magnetic moment.

Q 30 In an ammeter 0.2 % of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance ammeter will be-

Option A $\frac{1}{499}$ G

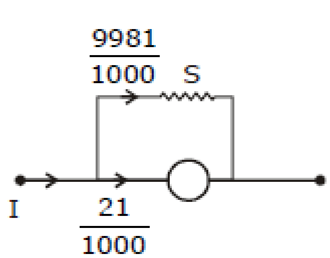
Option B $\frac{499}{500}$ G

Option C $\frac{1}{500}$ G

Option D $\frac{500}{499}$ G

Correct Option C

Solution:



Potential drop is same for both

$$0.002I_0 \times G = 0.998I_0 \times S$$

$$\left(\frac{21}{1000}\right)G = \left(\frac{9981}{1000}\right)S$$

$$\Rightarrow S = \frac{G}{499}$$

Total resistance of ammeter R

$$R = \frac{SG}{S+G} = \frac{\left(\frac{G}{499}\right)F}{\left(\frac{G}{499}\right)+G} = \frac{G}{500}$$

Q 31. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' their common point for the two. The wires carry I_1 and I_2 currents respectively. Point 'P' is lying at distance'd' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be-

Option A $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$

Option B $\frac{\mu_0}{2\pi d}\left(I_1 + I_2\right)$

Option C $\frac{\mu_0}{2\pi d}\left(I_1^2 - I_2^2\right)$

Option D $\frac{\mu_0}{2\pi d}\left(I_1^2 + I_2^2\right)^{1/2}$

Correct Option D

Solution:

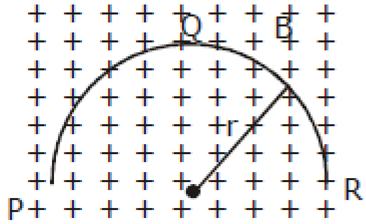
Resultant magnetic field

$$, B = \left(B_1^2 + B_2^2\right)^{1/2}$$

$$= \left(\left(\frac{\mu_0 I_1}{2\pi d}\right)^2 + \left(\frac{\mu_0 I_1}{2\pi d}\right)^2\right)^{\frac{1}{2}}$$

$$= \frac{\mu_0}{2\pi d}\sqrt{I_1^2 + I_2^2}$$

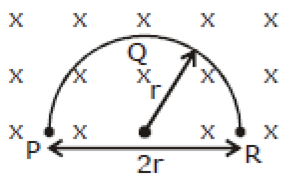
Q 32. A thin semicircular conducting ring (PQR) of radius 'r' is falling with its plane vertical in a horizontal magnetic field B/ as shown in figure. The potential difference developed across the ring when its speed is v, is-

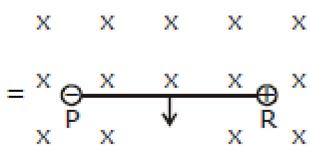


Option A zero
Option B $Bv\pi r^2/2$ and P is at higher potential
Option C πrBv and R is at higherpotential
Option D 2rBv and R is at higher potential

Correct Option D

Solution:





emf = $Bvl = Bv(2r) = 2rBv$

Q 33. A transformer having efficiency of 90% is working on 200V and 3kW power supply. If the current in the secondary coil is 6A, the voltage across the secondary coil and the current in the primary coil respectively are –

Option A 300 V, 15 A
Option B 450 V, 15 A
Option C 450 V, 13.5 A
Option D 600 V, 15 A

Correct Option B

Solution:

$$\text{Efficiency } \eta = \frac{P_{out}}{P_{in}}$$

$$\eta = \frac{V_s I_s}{V_p I_p} \Rightarrow$$

$$0.9 = \frac{V_S(6)}{3 \times 10^3} \Rightarrow$$

$$V_S = 450 \text{ V}$$

As $V_P I_P = 3000$ so

$$I_P = \frac{3000}{200} \text{ A} = 15\text{A}$$

Q 34. Light with an energy flux of 25 × 10⁴ Wm⁻² falls on a perfectly reflecting surface at normal incidence. If the surface area is 15 cm², the average force exerted on the surface is –

Option A 1.25×10^{-6} N

Option B 2.50×10^{-6} N

Option C 1.20×10^{-6} N

Option D 3.0×10^{-6} N

Correct Option B

Solution:

$$\text{Average force for reflecting surface} = \frac{\Delta p}{\Delta t} \quad \frac{2IA}{c}$$

$$= \frac{2 \times 25 \times 10^4 \times 15 \times 10^{-4}}{3 \times 10^8}$$

$$= 2.50 \times 10^{-6} \text{ N}$$

Q 35. A beam of light of λ = 600 nm from a distance source falls on a single alit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between first dark fringes on either side of the central bright fringe is –

Option A 1.2 cm

Option B 1.2 mm

Option C 2.4 cm

Option D 2.4 mm

Correct Option D

Solution:

Distance between the first dark fringes on either is called width of central maxima.

$$= \frac{2\lambda D}{b} = \frac{2 \times 600 \times 10^{-6} \times 2}{3 \times 10^{-3}} \text{ m}$$

$$= 2.4 \times 10^{-3} \text{ m}$$

$$= 2.4 \text{ mm}$$

Q 36. In the Young's double-slit experiment, the intensity of light at a point on the screen where the path difference is λ is K, (λ being the wave length of light used). The intensity at a point where the path difference is λ/4, will be –

Option A K
Option B K/4
Option C K/2
Option D zero
Correct Option C
Solution:

For path difference λ, phase difference = $\frac{2\pi}{\lambda}\times\Delta x=\frac{2\pi}{\lambda}\times\lambda=2\pi$

For path difference $\frac{\lambda}{4}$, phase difference = $\frac{2\pi}{\lambda}\times\Delta x=\frac{2\pi}{\lambda}\times\frac{\lambda}{4}=\frac{\pi}{2}$

$$I=4I_0\cos^2\left(\frac{\theta}{2}\right)=4I_0\cos^2\left(\frac{2\pi}{4}\right)=4I_0=K$$

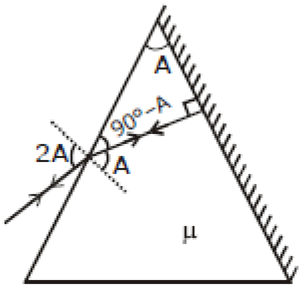
$$I=4I_0\cos^2\left(\frac{\pi}{4}\right)=2I_0\Rightarrow\frac{K}{2}$$

Q 37. If the focal length of objectives lens is increased then magnifying power of :-
Option A microscope will increase but that of telescope
Option B microscope and telescope both will increase
Option C microscope and telescope both will decrease
Option D microscope will decrease but that of telescope increase
Correct Option D
Solution:

For microscope , Magnifying power $=\frac{LD}{f_0f_e}\infty\frac{1}{f_0}$

For telescope , Magnifying power $=\frac{f_0}{f_e}\propto f_0$

Q 38. The angle of a prism is 'A'. One of its refracting surface is silvered. Light rays falling at an angle of incident 2A on the first surface returns back through the same path after suffering reflection at the silvered surface. The refractive index μ, of the prism is –
Option A 2 sin A
Option B 2 cos A
Option C $\frac{1}{2}$ cos A
Option D tan A
Correct Option B
Solution:



As per Snell's law

$1 \times \text{Sin } 2A = (\mu) \sin A$

$$\mu = \frac{2\sin A \cos A}{\sin A} = 2\cos A$$

Q 39. When the energy of the incident radiation is increased by 20%, the kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5 eV to 0.8 eV. The work functions of the metal is –

Option A 0.65 eV

Option B 1.0 eV

Option C 1.3 eV

Option D 1.5 eV

Correct Option B

Solution:

By using $hv = \phi_0 + K_{max}$

We have

$Hv = \phi_0 + 0.5$ ...(i)

And $1.2\ hv = \phi_0 + 0.8$ ...(ii)

Therefore $\phi_0 = 1.0$ eV

Q 40. If the kinetic energy of the particle is increased to 16 times its previous value, the percentage change in the de-Broglie wavelength of the particle is –

Option A 25

Option B 75

Option C 60

Option D 50

Correct Option B

Solution:

$$\lambda \frac{h}{\sqrt{2mK}}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{K_2}{K_1}} = \sqrt{\frac{16K}{K}} = \frac{4}{1}$$

$$\text{Percentage change} = \frac{1-4}{4} \times 100 = -75\%$$

Q 41. Hydrogen atom in ground state is excited by a monochromatic radiation of λ = 975 Å. Number of spectral lines in the resultant spectrum emitted will be

Option A 3

Option BV 2

Option C 6

Option D 10

Correct Option C

Solution:

$$E = \frac{hc}{\lambda}$$

$$E = \frac{6.63\times10^{-34}\times3\times10^{8}}{975\times10^{-10}\times1.6\times10^{-19}}\,eV$$

$$E = 12.75eV$$

$$\Delta E = 12.75eV$$

It jumps to n=4 because the energy difference between the n=1 and n=4 is 12.75ev

So number of spectral lines emitted will be

$$\frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$$

Q 42. The binding energy per nucleon of $^{7}_{3}Li$ and $^{4}_{2}He$ nuclei are 5.60 MeV and 7.06 MeV, respectively. In the nuclear reaction $^{7}_{3}Li + ^{1}_{1}H \rightarrow ^{4}_{2}He + Q$, the value of energy Q released is : -

Option A 19.6 MeV

Option B -2.4 MeV

Option C 8.4 MeV

Option D 17.3 MeV

Correct Option D

Solution:

Binding Energy of $_2He^4 = 4 \times 7.06 = 28.24$ MeV

Binding energy of $^{7}_{3}Li = 7 \times 5.60 = 39.20$ MeV

$$^{7}_{3}Li + ^{1}_{1}H \rightarrow 2\left(_2He^4\right) + Q$$

39.20 $\quad$ 28.24×2

$$Q = 2\times28.24 - 39.20 = 17.28 \text{ MeV}$$

Q 43. A radio isotope 'X' with a half-life 1.4×10^9 years decays to 'Y' which is stable. A sample of the rock from a cave was found to contain 'X' and 'Y' in the ratio 1 : 7. The age of the rock is-

Option A 1.96×10^9 years

Option B 3.92×10^9 years

Option C 4.20×10^9 years

Option D 8.40×10^9 years

Correct Option C

Solution:

Let the number of nuclei present at the begining be N_0

when X decays

Let N_1 be the number of nuclei that decays

Therefore number of nuclei remaining in X is N-N_1

Number of nuclei in y N_1

$$\frac{N_0 - N_1}{N_1} = \frac{1}{7}$$

$$7N_0 - 7N_1 = N_1$$

$$\frac{N_0}{N_1} = \frac{8}{7}$$

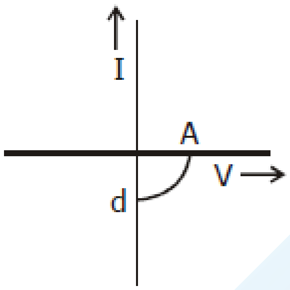
Remaining nuclei of X

$$N_0\text{-}N_1 \Rightarrow N_0 - \frac{7N_0}{8} = \frac{N_0}{8} = \left(\frac{1}{2}\right)^3 \times N_0$$

hence there are three half live

total time=$3\times1.4\times10^9\ yrs = 4.2\times10^9\ yrs$

Q 44. The given graph represents V-I characteristic for a semiconductor device



Which of the following statement is correct?

Option A It is V-I characteristic for solar cell where, point A represents open circuit voltage and point B short circuit current.

Option B It is for a solar cell and point A and B represent open circuit voltage and current, respectively

Option C It is for photodiode and points A and B represent open circuit voltage and current respectively.

Option D It is for a LED and points A and B represent open circuit voltage and short circuit current, respectively.

Correct Option A

Solution:

It is V-I characteristic for solar cell where, point A represents open circuit voltage and point B short circuit current.

Q 45. The barrier potential of a p-n junction depends on:

a) type of semiconductor material

b) amount of doping

c) temperature

Which one of the following is correct?

Option A	(a) and (b) only
Option B	(b) only
Option C	(b) and (c) only
Option D	(a), (b) and (c)

Correct Option D

Solution:

It depends on type of semiconductor, amount of doping and temperature.

CHEMISTRY

Q 1. What is the maximum number of orbitals that can be identified with the following quantum numbers?
$n = 3, \ell = 1, m_\ell = 0$
Option A 1
Option B 2
Option C 3
Option D 4
Correct Option A
Solution: $n = 3, \ell = 1, m = 0$
Orbital is $3p_z$
So only one orbital can be identified with these quantum numbers.

Q 2. Calculate the energy in joule corresponding to light of wavelength 45 nm: (planck's constant $h = 6.63 \times 10^{-34}$ Js; speed of light $c = 3 \times 10^8\ ms^{-1}$)
Option A 6.67×10^{15}
Option B 6.67×10^{11}
Option C 4.42×10^{-15}
Option D 4.42×10^{-18}
Correct Option D
Solution:

$$\text{Energy} = E = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{45\times10^{-9}}$$

$E = 4.42 \times 10^{-18} J$

Q 3. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27°C in identical conditions. The ratio of the volumes of gases H_2: O_2: methane would be:
Option A 8: 16: 1
Option B 16: 8: 1
Option C 16: 1: 2
Option D 8: 1: 2
Correct Option C
Solution: volume $\propto$ moles

$$n_{H_2} = \frac{w}{2}$$

$$n_{O_2} = \frac{w}{32}$$

$$n_{CH_4} = \frac{w}{16}$$

$$\text{So, ratio is } \frac{w}{2} : \frac{w}{32} : \frac{w}{16}$$

$$= 16:1:2$$

Q 4. If a is the length of the side of a cube, the distance between the body centered atom and one corner atom in the cube will be:

Option A $\frac{2}{\sqrt{3}}a$

Option B $\frac{4}{\sqrt{3}}a$

Option C $\frac{\sqrt{3}}{4}a$

Option D $\frac{\sqrt{3}}{2}a$

Correct Option D

Solution: The distance between the body centered atom and one corner atom is $\frac{\sqrt{3}a}{2}$.

Q 5. Which property of colloids is not dependent on the charge on colloidal particles?

Option A Coagulation

Option B Electrophoresis

Option C Electro–osmosis

Option D Tyndall effect

Correct Option D

Solution: Tyndall effect is optical property. It is not dependent on the charge on colloidal particles.

Q 6. Which of the following salts will give highest pH in water?

Option A KCl

Option B NaCl

Option C Na_2CO_3

Option D $CuSO_4$

Correct Option C

Solution: Salt of strong base and weak acid will give highest pH in water.

Q 7. When 22.4 litres of H_2 (g) is mixed with 11.2 litres of Cl_2 (g), each at S.T. P., the moles of HCl (g) formed is equal to:

Option A KCI

Option B $C_6H_{12}O_6$

Option C $Al_2(SO_4)_3$

Option D K_2SO_4

Correct Option C

Solution:

Depression in freezing point ∝ van’t Hoff's factor (i)

for $Al_2(SO_4)_3$, i = 5

Q 8. When 22.4 litres of H_2 (g) is mixed with 11.2 litres of Cl_2 (g), each at S.T. P., the moles of HCl (g) formed is equal to:

Option A 1 mol of HCl (g)

Option B 2 mol of HCl (g)

Option C 0 .5 mol of HCl

Option D 1.5 mol of HCl (g)

Correct Option A

Solution:

$$n_{H_2} = \frac{V(L)}{22.4L} = \frac{22.4}{22.4} = 1$$

$$n_{Cl_2} = \frac{11.2}{22.4} = 0.5 \text{ mole}$$

$$\begin{array}{lcccc} & H_{2(g)} & + \quad Cl_{2(g)} & \rightarrow & 2HCl_{(g)} \\ \text{Intially} - & 1\text{mole} & 0.5\text{mole} & & 0 \\ \text{after reaction} & (1-0.5) & & & 0.5\times2 \\ & 0.5\text{mole} & 0 & & =1\text{ mole} \end{array}$$

Q 9. When 0.1 mol MnO_4^{2-} is oxidised the quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^- is: –

Option A 96500 C

Option B 2 × 96500 C

Option C 9650 C

Option D 96.50 C

Correct Option C

Solution:

$$\overset{+6}{Mn}O_4^{-2} \rightarrow \overset{+7}{Mn}O_4^- + e^-$$

$$0.1 \text{ mole} \qquad 0.1 \text{ mole}$$

charge required = 0.1 F

$=0.1\times69500$

$=9650$ C

Q 10. Using the Gibbs energy change,

ΔG° = +63.3 kJ, for the following reaction,

$Ag_2CO_3 \rightarrow 2Ag^+(aq) + CO_3^{2-}(aq)$

The K_{sp} of Ag_2CO_3(s) in water at 25°C is: - (R=8.314 J $K^{-1}mol^{-1}$)

Option A 3.2×10^{-26}

Option B 8.0×10^{-12}

Option C 2.9×10^{-3}

Option D 7.9×10^{-2}

Correct Option B

Solution:

$\Delta G^\circ = -2.303\ RT \log K_{sp}$

$63.3 \times 1000 = -2.303 \times 8.314 \times 298 \log Ksp$
$\log Ksp = -11.09$
$Ksp = \text{Antilog}(-11.09) = 8 \times 10^{-12}$

Q 11. The weight of silver (at wt. = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be:–

Option A 5.4 g
Option B 10.8 g
Option C 54.0 g
Option D 108.0 g

Correct Option D

Solution:

According to Faraday's 2nd law

$$\frac{w_{Ag}}{E_{Ag}} = \frac{w_{O_2}}{E_{O_2}}$$

$$\frac{w_{Ag}}{108} = \frac{\left(\frac{5600}{22400}\right)\times 32}{8}$$

$$\therefore w_{Ag} = 108 \text{ g}$$

Q 12. Which of the following statements is correct for the spontaneous adsorption of a gas?

Option A ΔS is negative and, therefore, ΔH should be highly positive
Option B ΔS is negative and therefore, ΔH should be highly negative
Option C ΔS is positive and, therefore, ΔH should be negative
Option D ΔS is positive and, therefore, ΔH should also be highly positive

Correct Option B

Solution:

During adsorption entropy decreases, so $\Delta S < 0$
$\Delta G = \Delta H - T\Delta S$
For spontaneous adsorption $\Delta G < 0$ so ΔH should be highly negative as process of adsorption is exothermic in nature.

Q 13. For the reversible reaction:
$N_2 (g) + 3H_2 (g) \rightleftharpoons 2NH_3 (g) + \text{Heat}$
The equilibrium shifts in forward direction:

Option A By Increasing the concentration of NH_3 (g)
Option B By decreasing the pressure
Option C By decreasing the concentrations of N_2 (g) and H_2 (g)
Option D By increasing pressure and decreasing temperature

Correct Option D

Solution: According to Le-Chatelier's Principle
→ In exothermic reactions low temperature favours the forward reaction.
→ On increasing pressure equilibrium shifts towards less number of moles.

Q 14. For the reaction:
$X_2O_4\,(\ell) \rightarrow 2\,XO_2\,(g)$
$\Delta U = 2.1$ k cal, $\Delta S = 20$ cal K^{-1} at 300 K Hence ΔG is:-

Option A 2.7 k cal
Option B –2.7 k cal
Option C 9.3 k cal
Option D –9.3 k cal

Correct Option B
Solution:

$X_2O_4\,(\ell) \rightarrow 2\,XO_2\,(g)$; $\Delta n_g = 2 - 0 = 2$

$\Delta H = \Delta U + \Delta n_g RT$

$= 2.1 + 2 \times \dfrac{2}{1000} \times 300$

$\Delta H = 3.3$ kcal

$\Delta G = \Delta H - T.\Delta S$

$= 3.3 - 300 \times \dfrac{20}{1000}$

$\Delta G = -2.7\text{kcal}$

Q 15. For a given exothermic reaction K_p and K'_p are the equilibrium constant at temperatures T_1 and T_2, respectively. Assuming that heat of reaction is constant in temperature range between T_1 and T_2, it is readily observed that:-

Option A $K_p > K'_p$
Option B $K_p < K'_p$
Option C $K_P = K_P'$
Option D $K_p = \dfrac{1}{K'_p}$

Correct Option A
Solution:

In exothermic reactions on increasing temperature value of K_p decreases.
So, $K_p > K_P'$

Q 16. Which of the following orders of ionic radii is correctly represented?

Option A $H^- > H > H^+$
Option B $Na^+ > F^- > O^{2-}$
Option C $F^- > O^{2-} > Na^+$
Option D $Al^{3+} > Mg^{2+} > N^{3-}$

Correct Option A

Solution: H has one electron and one proton. If one more electron is added to the shell, the effective nuclear charge per electron decreases and electron cloud move away from the nucleus hence radius increases.

On the other side, when the only electron of H is removed, single proton is left in atom having positive charge. There is no electron cloud as in to move away so atomic radius decreases as compared to previous one.

So order will be-
$H^- > H > H^+$

Q 17. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much? (At. wt. Mg = 24; O = 16)

Option A Mg, 0.16 g

Option B O_2, 0.16 g

Option C Mg, 0.44 g

Option D O_2, 0.28 g

Correct Option A

Solution:

$$\begin{array}{lccccc} & Mg(s) & + & \frac{1}{2}O_2(g) & \rightarrow & MgO(s) \\ \text{Initially} & \frac{1}{24}\text{ mole} & & \frac{0.56}{32}\text{ mole} & & \\ & 0.0416\text{ mole} & & 0.0175\text{ mole} & & 0 \\ \text{after} & (0.0416-2\times0.0175) & & 0 & & 2\times0.0175\text{ mole} \\ & =0.0066\ \text{ mole} & & & & \end{array}$$

∴ Mass of Mg = 0.0066 × 24g = 0.16 g

Q 18. The pair of compounds that can exist together is:

Option A $FeCl_3$, $SnCl_2$

Option B $HgCl_2$, $SnCl_2$

Option C $FeCl_2$, $SnCl_2$

Option D $FeCl_3$. KI

Correct Option C

Solution: $FeCl_2$, $SnCl_2$are reducing agents

Q 19. Be^{2+} is isoelectronic with which of the following ions?

Option A H^+

Option B Li^+

Option C Na^+

Option D Mg^{2+}

Correct Option B

Solution: Li^+, Be^{+2} & Li^+ have 2 electron.

Q 20. Which of the following molecules has the maximum dipole moment?

Option A CO_2

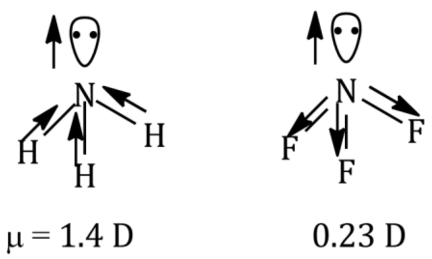
Option B CH_4

Option C NH_3

Option D NF_3

Correct Option C

Solution:



Q 21. Which one of the following species has plane triangular shape?

Option A N_3

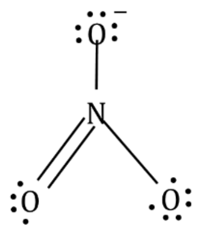
Option B NO_3^-

Option C NO_2^-

Option D CO_2

Correct Option B

Solution: NO_3^- has Sp^2 hybridisation i.e. has planar shape.



Q 22. Acidity of diprotic acids in aqueous solutions increases in the order:–

Option A $H_2S < H_2Se < H_2Te$

Option B $H_2Se < H_2S < H_2Te$

Option C $H_2Te < H_2S < H_2Se$

Option D $H_2Se < H_2Te < H_2S$

Correct Option A

Solution: On moving down the group bond length increases, and bond strength decreases so release of H becomes easier and acidic strength increases.

Q 23. (a) $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$

(b) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$

Role of hydrogen peroxide in the above reactions is respectively-

Option A Oxidizing in (a) and reducing in (b)

Option B Reducing in (a) and oxidizing in (b)

Option C Reducing in (a) and (b)

Option D Oxidizing in (a) and (b)

Correct Option C

Solution: Hydrogen peroxide acts as reducing agent in presence of strong oxidizing agents $KMnO_4$, $K_2Cr_2O_7$, ozone etc.

Q 24. Artificial sweetner which is stable under cold conditions only is:–

Option A Saccharine

Option B Sucralose

Option C Aspartame

Option D Alitame

Correct Option C

Solution: Aspartame artificial sweetner which is stable under cold conditions only.

Q 25. In acidic medium, H_2O_2 changes $Cr_2O_7^{-2}$ to CrO_5 which has two (–O–O) bonds. Oxidation state of Cr in CrO_5 is:–

Option A +5

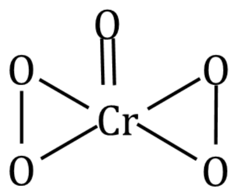
Option B +3

Option C +6

Option D -10

Correct Option C

Solution:



CrO_5 has 2 peroxy linkage.

Q 26. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives:–

Option A Mn^{4+} and O_2

Option B Mn^{2+} and O_2

Option C Mn^{2+} and O_3

Option D Mn^{4+} and MnO_2

Correct Option B

Solution: $KMnO_4$ is a strong oxidlsing agent & will oxidise H_2O_2 to O_2.

$$KMnO_4 + H_2O_2 \longrightarrow Mn^{+2} + O_2$$

Q 27. Among the following complexes the one which shows zero crystal field stabilization energy (CFSE) is:–

Option A $[Mn(H_2O)_6]^{3+}$

Option B $[Fe(H_2O)_6]^{3+}$

Option C $[Co(H_2O)_6]^{2+}$

Option D $[Co(H_2O)_6]^{3+}$

Correct Option B

Solution: Due to d^5 configuration and H_2O is a weak ligand.

Fe^{3+}: $t_{2g}^3 e_g^2$

Q 28. Magnetic moment 2.83 BM is given by which of the following ions? (At. nos. Ti = 22, Cr = 24, Mn = 25, Ni = 28):

Option A Ti^{3+}

Option B Ni^{2+}

Option C Cr^{3+}

Option D Mn^{2+}

Correct Option B

Solution: Ni^{+2} has two unpaired electron.

Ni^{+2} :[Ar]$3d^8$ configuration

Q 29. Which of the following complexes is used to be as an anticancer agent?

Option A

mer-[Co $(NH_3)_3Cl_3$]

Option B cis-[$PtCl_2$ $(NH_3)_2$]

Option C cis-K_2 [$PtCl_2Br_2$]

Option D Na_2CoCl_4

Correct Option B

Solution: Cis-platin is used as an anticancer agent.

Q 30. Reason of lanthanoid contraction is:–

Option A Negligible screening effect of 'f' orbitals

Option B Increasing nuclear charge

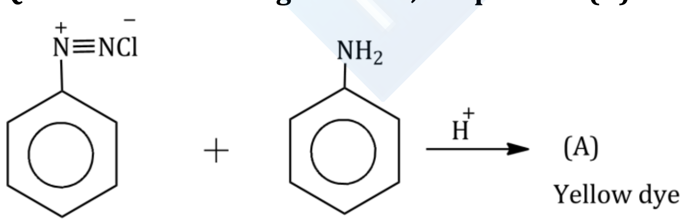
Option C Decreasing nuclear charge

Option D Decreasing screening effect

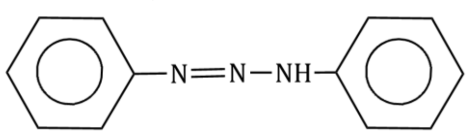
Correct Option A

Solution: Due to poor shielding of f-orbitals, nucleus will exert a strong attraction, causes lanthanoid contraction.

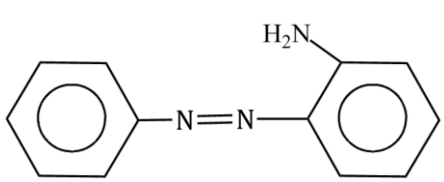
Q 31. In the following reaction, the product (A)



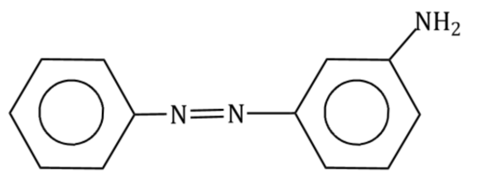
Option A



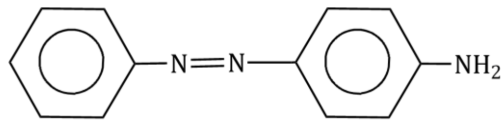
Option B



Option C



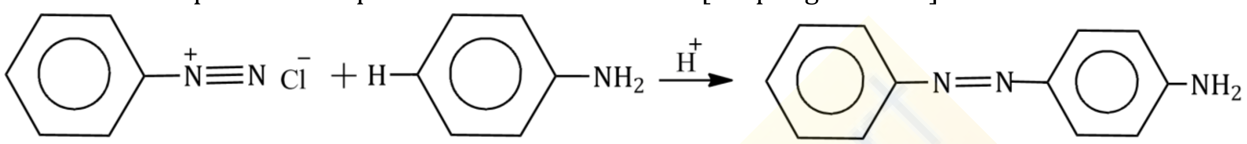
Option D



Correct Option D

Solution:

This is an example of electrophilic substitution reaction [coupling reaction]



Q 32. Which of the following will be most stable diazonium salt $RN_2^+X^-$?

Option A $CH_3N_2^+X^-$

Option B $C_6H_5N_2^+X^-$

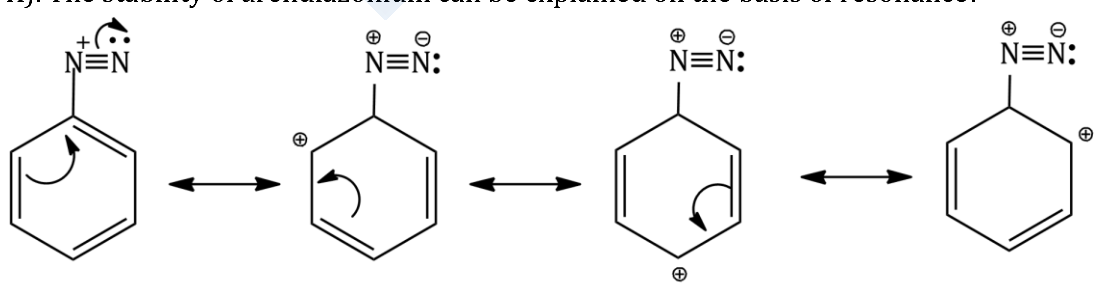
Option C $CH_3CH_2N_2^+X^-$

Option D $C_6H_5CH_2N_2^+X^-$

Correct Option B

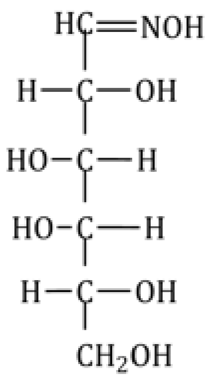
Solution:

Primary aliphatic amines form highly unstable alkyldiazonium salts. Primary aromatic amines form arene diazonium salts which are stable for a short time in solution at low temperature (273 – 278 K). The stability of arendiazonium can be explained on the basis of resonance.

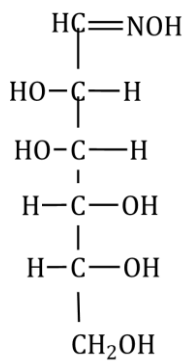


Q 33. D (+) glucose reacts with hydroxylamine and yields an oxime. The structure of the oxime would be:

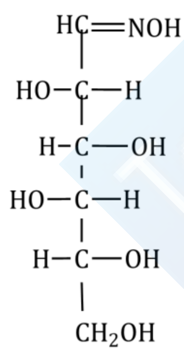
Option A



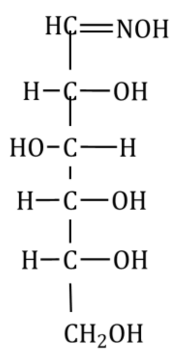
Option B



Option C



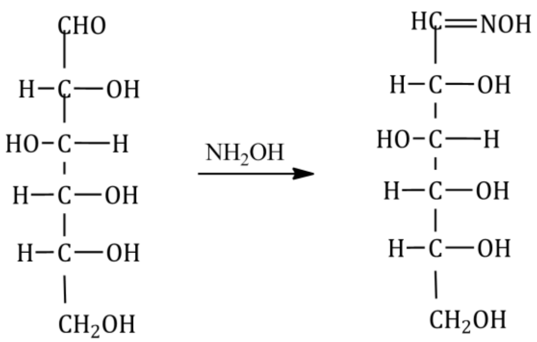
Option D



Correct Option D

Solution:

Glucose reacts with hydroxyl amine to form an oxime.



Q 34. Which of the following hormones is produced under the condition of stress which stimulates glycogenolysis in the liver of human beings?

Option A Thyroxin

Option B Insulin

Option C Adrenaline

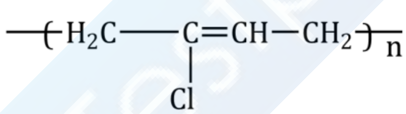
Option D Estradiol

Correct Option C

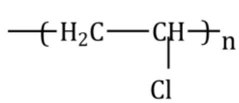
Solution: Adrenaline is produced under the condition of stress which stimulates glycogenolysis in the liver of human beings.

Q 35. Which one of the following is an example of a thermosetting polymer?

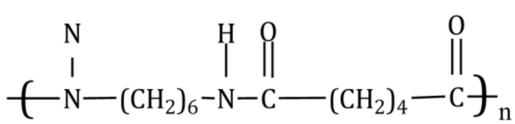
Option A



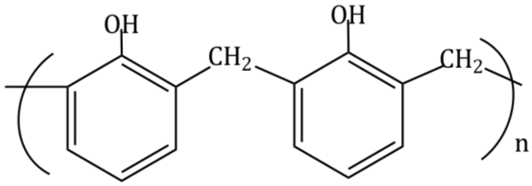
Option B



Option C



Option D



Correct Option D

Solution: Bakelite is **a** thermosetting polymer. Thermosetting polymers are cross linked or heavily branched molecules

Q 36. Which of the following organic compounds polymerizes to form the polyester Dacron?

Option A Propylene and para HO – (C_6H_4) – OH

Option B Benzoic acid and ethanol

Option C Terephthalic acid and ethylene glycol

Option D Benzoic acid and para HO – (C_6H_4) – OH

Correct Option C

Solution: Dacron or terylene is the best known example of polyesters. It is manufactured by heating a mixture of ethylene glycol and terephthalic acid at 420 to 460 K in the presence of zinc acetate-antimony trioxide catalyst.

Q 37. Which one of the following is not a common component of Photochemical Smog?

Option A Ozone

Option B Acrolein

Option C Peroxyacetyl nitrate

Option D Chlorofluorocarbons

Correct Option D

Solution: The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate (PAN). Hence chlorofluoro carbon is not common component of photochemical smog.

Q 38. In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 gm of sample neutralized 10 mL of 1 M H_2SO_4, The percentage of nitrogen in the soil is;

Option A 37.33

Option B 45.33

Option C 35.33

Option D 43.33

Correct Option A

Solution:

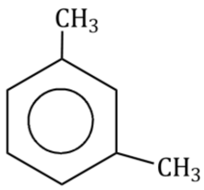
In Kjeldahl's method, percentage of N is given by –

$$\% \text{of N} = \frac{1.4 \times \text{Normality of acid} \times \text{Volume of acid}}{\text{weight of compound}}$$

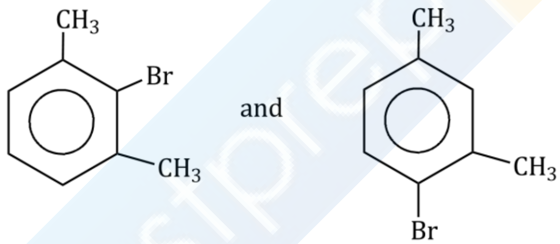
Normality of $H_2SO_4 = 1 \times 2M = 2N$

$$\%N = \frac{1.4 \times 2 \times 1}{0.75} = 37.33\%$$

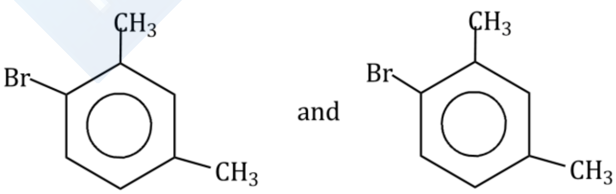
Q 39. What products are formed when the following compound is treated with Br_2 in the presence of $FeBr_3$?



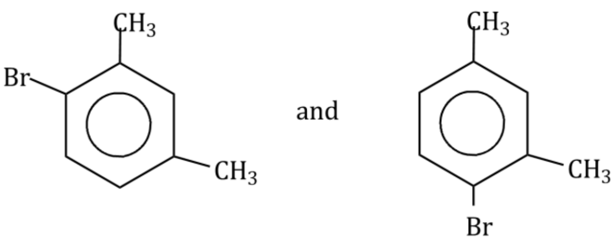
Option A



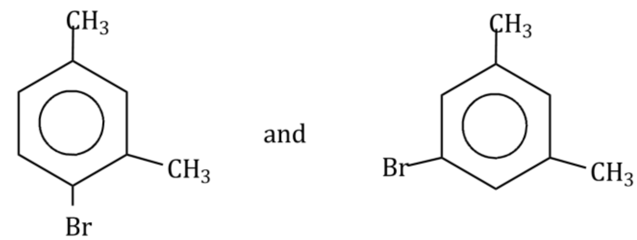
Option B



Option C

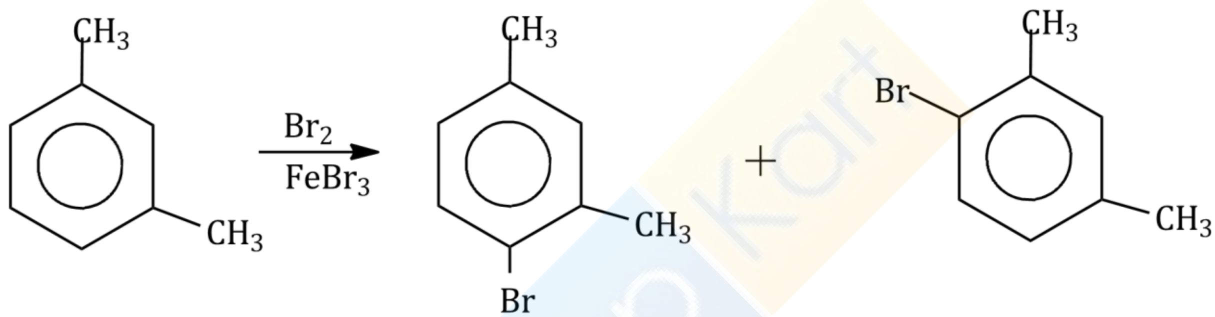


Option D



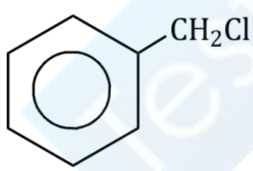
Correct Option C

Solution: -CH_3 group is ortho, para directing.



Q 40. Which of the following compounds will undergo racemisation when solution of KOH hydrolyses?

Option A

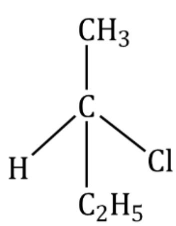


Option B $CH_3CH_2CH_2Cl$

Option C

$$\begin{array}{c} CH_3 \\ | \\ H_3C-CH-CH_2Cl \end{array}$$

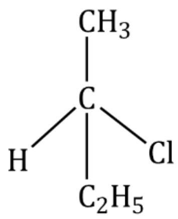
Option D



Correct Option B

Solution:

Only compound (iv)



results in formation of racemic product due to chirality.

Q 41. Among the following sets of reactants which one produces anisole?

Option A CH_3CHO; RMgX

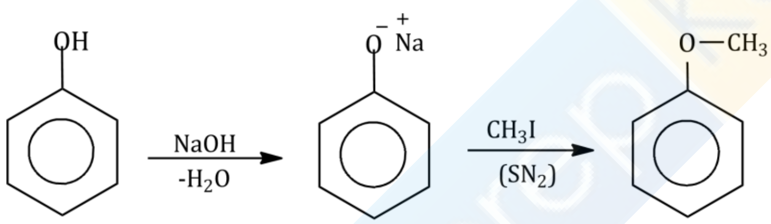
Option B C_6H_5OH; NaOH; CH_3I

Option C C_6H_5OH; neutral $FeCl_3$

Option D $C_6H_5 - CH_3$; CH_3COCl; $AlCl_3$

Correct Option B

Solution:



Q 42. Which of the following will not be soluble in sodium hydrogen carbonate?

Option A 2, 4, 6-trinitrophenol

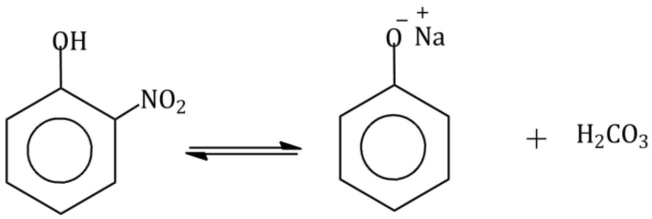
Option B Benzoic acid

Option C o-Nitrophenol

Option D Benzenesulphonic acid

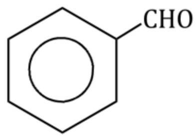
Correct Option C

Solution:

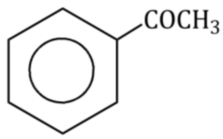


o-nitrophenol is weaker acid than HCO_3^-. So this reaction is not possible in forward direction.

Q 43. Which one is most reactive towards Nucleophilic addition reaction?
Option A



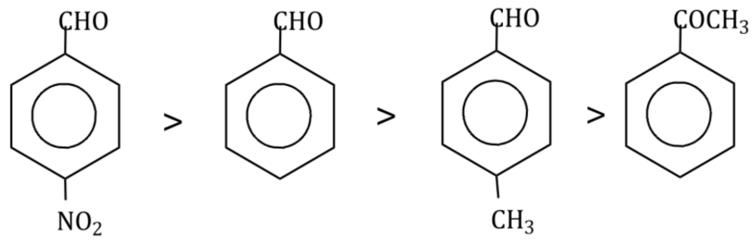
Option B



Option C

Option D

Correct Option D
Solution:
Reactivity of carbonyl compounds towards NAR depends on steric and electronic effects.
NAR reactivity:



–M of –NO_2 increase (+)ve charge on Sp^2 C of $\underset{\underset{\displaystyle O}{||}}{-C-}$

Q 44. Identify Z in the sequence of reactions:

$$\mathbf{CH_3CH_2CH=CH_2 \xrightarrow{HBr/H_2O_2} Y \xrightarrow{C_2H_5ONa} Z}$$

Option A

$CH_3-(CH_2)_3-OCH_2CH_3$

Option B $(CH_3)_2CH_2-O-CH_2CH_3$

Option C $CH_3(CH_2)_4-O-CH_3$

Option D $CH_3CH_2-CH(CH_3)-O-CH_2CH_3$

Correct Option A

Solution:

$$CH_3-CH_2CH=CH_2 \xrightarrow[\text{Peroxide effect}]{HBr/H_2O_2} \underset{(Y)}{CH_3-CH_2-\underset{\underset{\displaystyle Br}{|}}{CH}-CH_3}$$

$$\downarrow C_2H_5O^- Na^+$$

$$\underset{(Z)}{CH_3 - CH_2\ _3 - O - CH_2 - CH_3}$$

Q 45. Which of the following organic compounds has same hybridization as its combustion product CO_2?

Option A Ethane

Option B Ethyne

Option C Ethene

Option D Ethanol

Correct Option B

Solution:

$$C_2H_2 + {}^{5}\!/_{2}O_2 \rightarrow 2CO_2 + H_2O$$

Both C_2H_2 & CO_2 has same hybridization of carbon atom. (sp).

BIOLOGY

Q 1. Five kingdom system of classification suggested by R.H. Whittaker is not based on:

Option A Mode of reproduction

Option B Mode of nutrition

Option C Complexity of body organisation

Option D Habitat

Correct Option D

Solution: Five kingdom system of classification suggested by R.H. Whittaker is based on cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships.

Q 2. The main function of mammalian corpus luteum is to produce:

Option A Progesterone

Option B Human chorionic gonadotropin

Option C Relaxin only

Option D Estrogen only

Correct Option A

Solution: The corpus luteum secretes a large amount of progesterone which is essential for the maintenance of endometrium.

Q 3. In which one of the following processes CO_2 is not released?

Option A Aerobic respiration in animals

Option B Alcoholic fermentation

Option C Lactate fermentation

Option D Aerobic respiration in plants

Correct Option C

Solution: End products of aerobic respiration in animals, alcoholic fermentation and aerobic respiration in plants release CO_2. However, lactate fermentation does not release CO_2.

Q 4. Choose the correctly matched pair:

Option A Moist surface of buccal cavity – Glandular epithelium

Option B Tubular parts of nephrons – Cuboidal epithelium

Option C Inner surface of bronchioles – Squamous epithelium

Option D Inner lining of salivary ducts – Ciliated epithelium

Correct Option B

Solution: The cuboidal epithelium is composed of a single layer of cube-like cells. It is found in tubular parts of nephrons in kidneys and its main functions are secretion and absorption.

Q 5. Which of the following shows coiled RNA strand and capsomeres?

Option A Tobacco mosaic virus

Option B Measles virus

Option C Retrovirus

Option D Polio virus

Correct Option A

Solution: Tobacco mosaic virus shows coiled RNA strand and a protein coat called capsid made of small subunits or capsomeres.

Q 6. Just as a person moving from Delhi to Shimla to escape the heat for the duration of hot summer, thousands of migratory birds from Siberia and other extremely cold northern regions move to:

Option A Meghalaya
Option B Corbett National Park
Option C Keoladeo National Park
Option D Western Ghat

Correct Option C

Solution: The migratory birds from Siberia and other extremely cold northern regions move to Keoladeo National Park formerly known as the Bharatpur Bird Sanctuary in Bharatpur, Rajasthan, India during the months of October – February.

Q 7. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two?

Option A Secondary phloem
Option B Protoxylem
Option C Cortical cells
Option D Secondary xylem

Correct Option B

Solution: In stems, the protoxylem lies towards the centre (pith) and the metaxylem lies towards the periphery of the organ. This type of primary xylem is called endarch. In roots, the protoxylem lies towards periphery and the metaxylem lies towards the centre. Such arrangement of primary xylem is called exarch.

Q 8. In 'S' phase of the cell cycle:

Option A The amount of DNA remains same in each cell.
Option B The chromosome number is increased.
Option C The amount of DNA is reduced to half in each cell.
Option D The amount of DNA doubles in each cell.

Correct Option D

Solution: S or synthesis phase marks the period during which DNA synthesis or replication takes place. Hence, the amount of DNA doubles in each cell during S phase of the cell cycle.

Q 9. A species facing extremely high risk of extinction in the immediate future is called:

Option A Endemic
Option B Critically endangered
Option C Extinct
Option D Vulnerable

Correct Option B

Solution: A species facing extremely high risk of extinction in the immediate future is called critically endangered species.

Q 10. Fruit colour in squash is an example of:
Option A Dominant epistasis
Option B Complementary genes
Option C Inhibitory genes
Option D Recessive epistasis
Correct Option A
Solution: Fruit colour in squash is an example of dominant epistasis in which the dominant /epistatic gene masks the effect of recessive gene giving it a white colour appearance.

Q 11. Identify the hormone with its correct matching of source and function.
Option A Melatonin – Pineal gland – regulates the normal rhythm of sleep-wake cycle.
Option B Progesterone – corpus luteum – secondary sex organs.
Option C Atrial natriuretic factor –ventricular wall – increases the blood pressure.
Option D Oxytocin – posterior pituitary – growth and maintenance of mammary glands.
Correct Option A
Solution: The pineal gland secretes melatonin hormone which helps to regulate the normal rhythm of sleep-wake cycle.

Q 12. An example of edible underground stem is
Option A Groundnut
Option B Sweet potato
Option C Potato
Option D Carrot
Correct Option C
Solution: Potato is an edible underground stem which stores food.

Q 13. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?
Option A Increase in antidiuretic hormone levels
Option B Decrease in aldosterone levels
Option C Decrease in antidiuretic hormone levels
Option D Increase in aldosterone levels
Correct Option D
Solution: Aldosterone causes reabsorption of Na^+ and water from the distal convoluted tubule which also leads to an increase in blood pressure and glomerular filtration rate (GFR).

Q 14. Which structures perform the function of mitochondria in bacteria?
Option A Ribosomes
Option B Cell wall
Option C Mesosomes
Option D Nucleoid
Correct Option C
Solution: Mesosomes are formed by the extensions of plasma membrane into the cell. They perform the function of mitochondria in bacteria.

Q 15. Select the option which is not correct with respect to enzyme action:

Option A	Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate.
Option B	A non-competitive inhibitor binds the enzyme at a site distinct from that which binds the substrate.
Option C	Malonate is a competitive inhibitor of succinic dehydrogenase.
Option D	Substrate binds with the enzyme at its active site.

Correct Option A

Solution: Malonate is a competitive inhibitor of succinic dehydrogenase. Because of its close structural similarity with the substrate, malonate competes with the substrate for the substrate binding site of the enzyme. Consequently, the substrate cannot bind and as a result, the enzyme action declines and hence, its activity is reversed by adding a lot of succinic dehydrogenase.

Q 16. Which is the particular type of drug that is obtained from the plant whose one flowering branch is shown below?

Option A	Depressant
Option B	Stimulant
Option C	Pain-killer
Option D	Hallucinogen

Correct Option D

Solution: The image shows the flowering branch of plant *Datura* having hallucinogens that are normally used as medicines to help patients cope with mental illnesses like depression and insomnia.

Q 17. Fructose is absorbed into the blood through mucosa cells of intestine by the process called:

Option A	Facilitated transport
Option B	Simple diffusion
Option C	Co-transport mechanism
Option D	Active transport

Correct Option A

Solution: Fructose is absorbed into the blood through mucosa cells of intestine by the process called facilitated transport which is the spontaneous passive transport of the molecules of ions across a biological membrane via specific transmembrane integral proteins.

Q 18. The solid linear cytoskeletal elements having a diameter of 6 nm and made up of a single type of monomer are known as

Option A Microfilaments
Option B Intermediate filaments
Option C Lamins
Option D Microtubules

Correct Option A

Solution: Microfilaments are solid linear cytoskeletal elements having a diameter of 6 nm and made up of a single type of monomer in eukaryotic cells.

Q 19. Which one of the following living organisms completely lacks a cell wall?

Option A Sea-fan (*Gorgonia*)
Option B *Saccharomyces*
Option C Blue-green algae
Option D Cyanobacteria

Correct Option A

Solution: Sea-fan (*Gorgonia*) belongs to kingdom Animalia and phylum Cnidaria, which completely lacks a cell wall.

Q 20. Tracheids differ from other tracheary elements in:

Option A Being imperforate
Option B Lacking nucleus
Option C Being lignified
Option D Having casparian strips

Correct Option A

Solution: Tracheids and vessels together are called tracheary elements as both take part in transport of sap. Tracheids differ from other tracheary elements in being imperforate and their wall is more thickened.

Q 21. Select the correct matching of the type of joint with the example in human skeletal system:

	Type of Joint	**Example**
Option A	Pivot joint	Between third and fourth cervical vertebrae
Option B	Hinge joint	Between humerus
Option C	Gliding joint	Between carpals
Option D	Cartilaginous joint	Between frontal and parietal

Correct Option C

Solution:

Gliding joint does not allow much movement, just a small amount of gliding between the bones. It is found between the carpals.

Q 22. A man whose father was colour blind marries a woman who had a colour blind mother and a normal father. What percentage of male children of this couple will be colour blind?

Option A 0%

Option B 50%

Option C 75%

Option D 25%

Correct Option B

Solution: Colour blindness is an autosomal recessive disorder present on the X chromosome. Thus, a man whose father was colour blind will be normal (XY), marries a woman who had a colour blind mother and a normal father, i.e. the woman will be a carrier (XX^C).

When the carrier woman marries a normal man then 50% of their son will be colour blind as

Parents.... **Husband** × **Wife**

Genes.... XY × X^CX

Gametes.....X Y × X^C, X

	X	**Y**
X^C	X^CX	X^CY
X	**XX**	**XY**

Hence, the probability of the male child being colour blind would be 50%.

Q 23. A few normal seedlings of tomato were kept in a dark room. After a few days they were found to have become white-coloured lime albinos. Which of the following terms will you use to describe them?

Option A Embolised

Option B Etiolated

Option C Defoliated

Option D Mutated

Correct Option B

Solution: The process in which flowering plants are grown in partial or complete absence of light characterised by long and weak stem and smaller, sparse pale yellow colour of leaves is called etiolation. Hence, the white coloured tomato seedlings are etiolated.

Q 24. Function of filiform apparatus is to:

Option A Stimulate division of generative cell

Option B Produce nectar

Option C Guide entry of pollen tube

Option D Recognise the suitable pollen at stigma

Correct Option C

Solution: The filiform apparatus plays an important role in guiding the pollen tube into the synergid.

Q 25. Choose the correctly matched pair:

Option A Adipose tissue – Dense connective tissue
Option B Areolar tissue – Loose connective tissue
Option C Cartilage – Loose connective tissue
Option D Tendon – Specialized connective tissue

Correct Option B

Solution: Areolar tissue is a loose connective tissue in which the cells and fibres are loosely arranged in a semi-fluid ground substance.

Q 26. Forelimbs of cat and lizard used in walking and forelimbs of whale used in swimming and forelimbs of bats used in flying are examples of:

Option A Adaptive radiation
Option B Homologous organs
Option C Convergent evolution
Option D Analogous organs

Correct Option B

Solution: Forelimbs of cat and lizard used in walking, forelimbs of whale used in swimming and forelimbs of bats used in flying are examples of homologous organs as they are similar in structure and origin but are dissimilar in function and form.

Q 27. Which one of the following is a non-reducing carbohydrate?

Option A Sucrose
Option B Lactose
Option C Ribose 5 – phosphate
Option D Maltose

Correct Option A

Solution: Non-reducing sugars do not have an OH group attached to the anomeric carbon, so they cannot reduce other compounds. Sucrose is a non-reducing carbohydrate whereas lactose, ribose 5 – phosphate and maltose are reducing carbohydrates.

Q 28. At which stage of HIV infection does one usually show symptoms of AIDS?

Option A When the infected retro virus enters the host cells.
Option B When HIV damages large number of helper T – lymphocytes.
Option C When the viral DNA is produced by reverse transcriptase.
Option D Within 15 days of sexual contact with an infected person.

Correct Option B

Solution: HIV released in the blood attack other helper T-lymphocytes leading to a decrease in the number of helper T-lymphocytes in the body of the infected person and the person starts suffering from infections and henc,e shows symptoms of AIDS.

Q 29. What gases are produced in anaerobic sludge digesters?

Option A Methane, hydrogen sulphide and CO_2
Option B Methane, hydrogen sulphide and O_2
Option C Hydrogen sulphide and CO_2
Option D Methane and CO_2 only

Correct Option A

Solution: In anaerobic sludge digesters, other kinds of bacteria which grow anaerobically, digest the bacteria and the fungi in the sludge and produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide.

Q 30. Anoxygenic photosynthesis is characteristic of:

Option A *Spirogyra*
Option B *Chlamydomonas*
Option C *Ulva*
Option D *Rhodospirillum*

Correct Option D

Solution: In anoxygenic photosynthesis, O_2 is not released. It is a characteristic of *Rhodospirillum* which traps light energy and stores it as chemical energy.

Q 31. Match the following and select the correct option:

a.	**Earthworm**	**i.**	**Pioneer species**
b.	**Succession**	**ii.**	**Detritivore**
c.	**Ecosystem service**	**iii.**	**Natality**
d.	**Population growth**	**iv.**	**Pollination**

	a.	b.	c.	d.
Option A	i.	ii.	iii.	iv.
Option B	iv.	i.	iii.	ii.
Option C	iii.	ii.	iv.	i.
Option D	ii.	i.	iv.	iii.

Correct Option D

Solution:

a. Earthworm is a detritivore.
b. Succession occurs by pioneer species.
c. Ecosystem service includes pollination.
d. Population growth is affected by natality.

Q 32. A location with luxuriant growth of lichens on the trees indicates that the:

Option A Trees are heavily infested.
Option B Location is highly polluted.
Option C Location is not polluted.
Option D Trees are very healthy.

Correct Option C

Solution: Lichens are used as indicators of air pollution. They derive essential nutrients from air. So, if the air is polluted in a particular area, lichens are absent in that area. Hence, a location with luxuriant growth of lichens on the trees indicates that the location is not polluted.

Q 33. In-vitro clonal propagation in plants is characterised by:

Option A Northern blotting

Option B Electrophoresis and HPLC

Option C Microscopy

Option D PCR and RAPD

Correct Option D

Solution: In in-vitro clonal propagation in plants, the gene of interest is amplified by PCR. RAPD is a PCR reaction in which the DNA segments are amplified randomly.

Q 34. An alga which can be employed as food for human beings is:

Option A *Chlorella*

Option B *Spirogyra*

Option C *Polysiphonia*

Option D *Ulothrix*

Correct Option A

Solution: *Chlorella* is a green alga which can be used as a food supplement or food.

Q 35. Which one of the following growth regulators is known as 'stress hormone'?

Option A Ethylene

Option B GA_3

Option C Indole acetic acid

Option D Abscisic acid

Correct Option D

Solution: Abscisic acid stimulates the closure of stomata in the epidermis and increases the tolerance of plants to various kinds of stresses. Therefore, it is also called the stress hormone.

Q 36. The enzyme recombinase is required at which stage of meiosis:

Option A Zygotene

Option B Diplotene

Option C Diakinesis

Option D Pachytene

Correct Option D

Solution: During pachytene crossing over occurs which is an enzyme-mediated process that requires the enzyme recombinase.

Q 37. Assisted reproductive technology, IVF involves transfer of:

Option A Zygote into the fallopian tube.

Option B Zygote into the uterus

Option C Embryo with 16 blastomeres into the fallopian tube

Option D Ovum into the fallopian tube

Correct Option A

Solution: In vitro fertilisation (IVF), ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory and then the zygote is transferred into the fallopian tube.

Q 38. An example of ex situ conservation is:

Option A	Seed bank
Option B	Wildlife sanctuary
Option C	Sacred grove
Option D	National park

Correct Option A

Solution: Seeds of different genetic strains of commercially important plants kept for long periods in seed banks are an example of ex situ conservation.

Q 39. The osmosis of a cell kept in water is chiefly regulated by:

Option A	Vacuoles
Option B	Plastids
Option C	Ribosomes
Option D	Mitochondria

Correct Option A

Solution: The vacuole is bounded by a single membrane called tonoplast. In plants, the tonoplast facilitates the transport of a number of ions and other materials against concentration gradient into the vacuole. Hence, the osmosis of a cell kept in water is chiefly regulated by vacuoles.

Q 40. Which one of the following is wrong about *Chara*?

Option A	Globule and nucule present on the same plant.
Option B	Upper antheridium and lower oogonium.
Option C	Globule is the male reproductive structure.
Option D	Upper oogonium and lower round antheridium.

Correct Option B

Solution: In *Chara*, the male sex organ is rounded called antheridium (globule) which lies below ovate shaped female sex organ called oogonium (nucule).

Q 41. The first human hormone produced by recombinant DNA technology is:

Option A	Estrogen
Option B	Thyroxine
Option C	Progesterone
Option D	Insulin

Correct Option D

Solution: Insulin is the first human hormone produced by recombinant DNA. In 1983, Eli Lilly an American company prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E.coli* to produce insulin chains.

Q 42. Which one of the following statements is not correct?

Option A	In retina the rods have the photo pigment rhodopsin while cones have three different photo pigments.
Option B	Retinal is a derivative of Vitamin (C).
Option C	Rhodopsin is the purplish red protein present in rods only.
Option D	Retinal is the light absorbing portion of visual photo pigment.

Correct Option B

Solution: Retinal is a derivative of Vitamin A.

Q 43. Which one of the following statements is correct?

Option A Mango is a parthenocarpic fruit.
Option B A proteinaceous aleurone layer is present in maize grain.
Option C A sterile pistil is called a staminode.
Option D The seed in grasses is not endospermic.

Correct Option B

Solution: Mango is a seeded fruit. A sterile stamen is called a staminode. The seed in grasses is endospermic. However, in maize grain, the endosperm is surrounded by a proteinaceous aleurone layer.

Q 44. Pollen tablets are available in the market for:

Option A Breeding programmes
Option B Supplementing food
Option C Ex situ conservation
Option D In vitro fertilisation

Correct Option B

Solution: Pollen tablets are rich in nutrients and hence, are available in market for supplementing food.

Q 45. Select the correct option:

	Direction of RNA synthesis	**Direction of reading the template DNA strand**
Option A	3′ – 5′	5′ – 3′
Option B	5′ – 3′	5′ – 3′
Option C	3′ – 5′	3′ – 5′
Option D	5′ – 3′	3′ – 5′

Correct Option D

Solution:

The mRNA is synthesised on the DNA template in 5′ – 3′ direction and so, successive nucleotides are attached at the 3'–OH end of the growing mRNA strand.

The strand that has the polarity 3′ – 5′ acts as a template, and is also referred to as template strand.

Q 46. The organisation which publishes the Red List of species is:

Option A IUCN
Option B UNEP
Option C WWF
Option D ICFRE

Correct Option A

Solution: IUCN is International Union of Conservation of Nature and Natural Resources, now called World Conservation Union maintains and publishes the Red List of species facing the risk of extinction.

Q 47. A human female with Turner's syndrome:

Option A	Has one additional X chromosome.
Option B	Exhibits male characters.
Option C	Is able to produce children with normal husband.
Option D	Has 45 chromosomes with XO.

Correct Option D

Solution: Turner's syndrome results due to loss of an X chromosome in human females and has 45 chromosomes with XO.

Q 48. Match the following and select the correct answer:

a.	**Centriole**	**i.**	**Infoldings in mitochondria**
b.	**Chlorophyll**	**ii.**	**Thylakoids**
c.	**Cristae**	**iii.**	**Nucleic acids**
d.	**Ribozymes**	**iv.**	**Basal body cilia or flagella**

	a.	b.	c.	d.
Option A	i.	ii.	iv.	iii.
Option B	i.	iii.	ii.	iv.
Option C	iv.	iii.	i.	ii.
Option D	iv.	ii.	i.	iii.

Correct Option D

Solution:

a. Centriole is a basal body.
b. Chlorophyll contains thylakoids.
c. Cristae are the infoldings in the inner layer of mitochondria.
d. Ribozymes is a catalytic RNA (nucleic acid).

Q 49. Approximately seventy percent of carbon dioxide absorbed by the blood will be transported to the lungs:

Option A	In the form of dissolved gas molecules
Option B	By binding to RBC
Option C	As carbamino haemoglobin
Option D	As bicarbonate ions

Correct Option D

Solution: Nearly 20-25 percent of CO_2 is transported by RBCs whereas 70 percent of it is carried as bicarbonate to the lungs. About 7 percent of CO_2 is carried in a dissolved state through plasma.

Q 50. Which vector can clone only a small fragment of DNA?

Option A	Yeast artificial chromosome
Option B	Plasmid
Option C	Cosmid
Option D	Bacterial artificial chromosome

Correct Option B

Solution: The plasmid DNA act as vectors to transfer the piece of DNA attached to it.

Q 51. The zone of atmosphere in which the ozone layer is present is called:

Option A Mesosphere
Option B Stratosphere
Option C Troposphere
Option D Ionosphere

Correct Option B

Solution: The ozone layer is found in the upper part of the atmosphere called the stratosphere.

Q 52. Which one of the following fungi contains hallucinogens?

Option A *Amanita muscaria*
Option B *Neurospora sp.*
Option C *Ustilago sp.*
Option D *Morchella esculenta*

Correct Option A

Solution: *Amanita muscaria* contains hallucinogens which are medicines to help patients cope with mental illnesses like depression and insomnia.

Q 53. A scrubber in the exhaust of a chemical industrial plant removes:

Option A Particulate matter of the size 5 micrometer or above
Option B Gases like ozone and methane
Option C Particulate matter of the size 2.5 micrometer or less
Option D Gases like sulphur dioxide

Correct Option D

Solution: A scrubber in the exhaust of a chemical industrial plant removes gases like sulphur dioxide.

Q 54. Select the taxon mentioned that represents both marine and fresh water species:

Option A Ctenophora
Option B Cephalochordata
Option C Cnidaria
Option D Echinoderms

Correct Option C

Solution: Phylum Cnidaria includes both marine and fresh water species. However, most of them are marine only a few are fresh water species.

Q 55. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as:

Option A Imbricate
Option B Twisted
Option C Valvate
Option D Vexillary

Correct Option A

Solution: If the margins of sepals or petals overlap one another but not in any particular direction as in *Cassia* and Gulmohur, the aestivation is called imbricate.

Q 56. An aggregate fruit is the one which develops from:

Option A Multicarpellary apocarpus gynoecium

Option B Complete inflorescence

Option C Multicarpellary superior ovary

Option D Multicarpellary syncarpous gynoecium

Correct Option A

Solution: When more than one carpel is present, they may be free and are called apocarpous. An aggregate fruit develops from multicarpellary apocarpous gynoecium.

Q 57. Commonly used vector for human genome sequencing are:

Option A BAC and YAC

Option B Expression vectors

Option C T/A cloning vectors

Option D t-DNA

Correct Option A

Solution: BAC (Bacterial artificial chromosomes) and YAC (Yeast artificial chromosomes) are vectors in which the fragments of DNA are inserted and cloned in suitable hosts.

Q 58. To obtain virus-free healthy plants from a diseased one by tissue culture technique, which part/parts of the diseased plant will be taken?

Option A Palisade parenchyma

Option B Both apical and axillary meristems

Option C Epidermis only

Option D Apical meristem only

Correct Option B

Solution: Both apical and axillary meristems are free of virus due to strong interferon activity in this region. Hence, to obtain virus free healthy plants these regions are to be taken.

Q 59. Fight-or-flight reactions cause activation of:

Option A The kidney, leading to suppression of renin angiotensin-aldosterone pathway.

Option B The adrenal medulla, leading to increased secretion of epinephrine and norepinephrine.

Option C The pancreas, leading to a reduction in the blood sugar levels.

Option D The parathyroid glands, leading to an increased metabolic rate.

Correct Option B

Solution: Epinephrine (adrenaline) and nor-epinephrine (nor-adrenaline) are rapidly secreted by the adrenal medulla in response to stress of any kind and during emergency situations and are called emergency hormones or hormones of fight or flight.

Q 60. Stimulation of a muscle fibre by a motor neuron occurs at the:

Option A Transverse tubules

Option B Myofibril

Option C Sarcoplasmic reticulum

Option D Neuromuscular junction

Correct Option D

Solution: Muscle contraction is initiated by a signal sent by the central nervous system (CNS) via a motor neuron. A motor neuron along with the muscle fibres connected to it constitute a motor unit.

The junction between a motor neuron and the sarcolemma of the muscle fibre is called the neuromuscular junction or motor-end plate.

Q 61. *Planaria* possess high capacity of:

Option A Regeneration
Option B Alternation of generation
Option C Bioluminescence
Option D Metamorphosis

Correct Option A

Solution: *Planaria* is a flatworm which possess high capacity of regeneration.

Q 62. Placenta and pericarp are both edible portions in:

Option A Banana
Option B Tomato
Option C Potato
Option D Apple

Correct Option B

Solution: The edible parts of tomato are the placenta and pericarp. Placenta is the connecting tissue which supplies nutrition to the embryo and pericarp is the remains of the ovular wall.

Q 63. Deficiency symptoms of nitrogen and potassium are visible first in:

Option A Young leaves
Option B Roots
Option C Buds
Option D Senescent leaves

Correct Option D

Solution: The deficiency symptoms of nitrogen, potassium and magnesium are visible first in the senescent leaves.

Q 64. Geitonogamy involves:

Option A Fertilisation of a flower by the pollen from the same flower.
Option B Fertilisation of a flower by the pollen from a flower of another plant in the same population.
Option C Fertilisation of a flower by the pollen from another flower of plant belonging to a distant population.
Option D Fertilisation of a flower by the pollen from another flower of the same plant.

Correct Option D

Solution: Geitonogamy is a type of pollination in which pollen grains of one flower are transferred to the stigma of another flower belonging to either the same plant or genetically similar plant.

Q 65. Viruses have:

Option A Prokaryotic nucleus
Option B Single chromosome
Option C Both DNA and RNA
Option D DNA enclosed in a protein coat

Correct Option D

Solution: In addition to proteins, viruses also contain genetic material that could be either RNA or DNA.

Q 66. How do parasympathetic neural signals affect the working of the heart?

Option A Heart rate is increased without affecting the cardiac output.

Option B Both heart rate and cardiac output increase.

Option C Heart rate decreases but cardiac output increases.

Option D Reduces both heart rate and cardiac output.

Correct Option D

Solution: Post-ganglionic fibers of parasympathetic nervous system secrete acetylcholine which decrease heart rate and cardiac output.

Q 67. A marine cartilaginous fish that can produce electric current is

Option A Torpedo

Option B Trygon

Option C Scoliodon

Option D Pristis

Correct Option A

Solution: Torpedo also called electric ray can produce electric current.

Q 68. An analysis of chromosomal DNA using the southern hybridisation technique does not use:

Option A Blotting

Option B Autoradiography

Option C PCR

Option D Electrophoresis

Correct Option C

Solution: Southern hybridisation technique is a method of hybridisation of DNA with probes and reveals information about DNA identity, size, and abundance. However, PCR is a method used for amplification of DNA sample.

Q 69. Archaebacteria differ from eubacteria in:

Option A Mode of nutrition

Option B Cell shape

Option C Mode of reproduction

Option D Cell membrane structure

Correct Option D

Solution: Cell membrane of archaebacteria possesses branched chain lipids which help it to survive in extreme conditions. Eubacteria have lipid membrane of ester bonds with fatty acids.

Q 70. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?
Plant → mice → snake → peacock

Option A 0.002 J
Option B 0.2 J
Option C 0.0002 J
Option D 0.02 J

Correct Option D

Solution: Energy trapped at producer level, plant = 20 J
Energy trapped by mice = 20 x 10% = 2 J
Energy trapped by snake = 2 x 10% = 0.2 J
Energy trapped by peacock = 0.2 x 10% = 0.02 J

Q 71. Which one of the following are analogous structures?

Option A Gills of prawn and lungs of man
Option B Thorns of *Bougainvillea* and tendrils of *Cucurbita*
Option C Flippers of dolphin and legs of horse
Option D Wings of bat and wings of pigeon

Correct Option A

Solution: Gills of prawn and lungs of man are analogous structures as their basic structure is different but their function is same.

Q 72. Dr.F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly cut coleoptile stumps. Of what significance is this experiment?

Option A It is the basis for quantitative determination of small amounts of growth promoting substances.
Option B It supports the hypothesis that IAA is auxin.
Option C It demonstrated polar movement of auxins.
Option D It made possible the isolation and exact identification of auxin.

Correct Option A

Solution: It is the basis for quantitative determination of small amounts of growth promoting substances.

Q 73. Non-albuminous seed is produced in:

Option A Castor
Option B Wheat
Option C Pea
Option D Maize

Correct Option C

Solution: Non-albuminous seeds are seeds which have no residual endosperm as it is completely consumed during embryo development. Non-albuminous seed is produced in pea.

Q 74. During which phase(s) of cell cycle, amount of DNA in a cell remains at 4C level if the initial amount is denoted as 2C?

Option A G_1 and S
Option B Only G_2
Option C G_2 and M
Option D G_0 and G_1

Correct Option C

Solution: In G_1 phase, the initial amount of DNA was 2C. In S phase, DNA replicates and the amount of DNA doubles. So the amount of DNA becomes 4C. In G_2 phase, there will be no change in the amount of DNA, so it remains 4C.

In M phase, cell division occurs. Before dividing into two daughter cells, the amount of DNA was 4C. After cytokinesis, each daughter cell will have 2C amount of DNA. Thus, in S phase, 2C becomes 4C and at the end of the M phase, 4C becomes 2C. Hence, the amount of DNA remains at 4C during G_2 to M phase of the cell cycle.

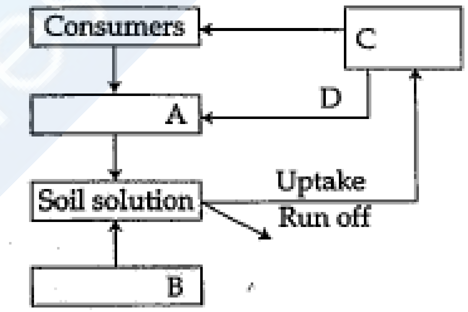
Q 75. Transformation was discovered by:

Option A Hershey and Chase
Option B Griffith
Option C Watson and Crick
Option D Meselson and Stahl

Correct Option B

Solution: Transformation was discovered by Griffith by performing experiment on *Diplococcus pneumoniae*.

Q 76. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D). Identify the blanks.



	A	B	C	D
Option A	Litter fall	producers	Rock minerals	Detritus
Option B	Detritus	Rock minerals	Producers	Litter fall
Option C	producers	Litter fall	Rock minerals	Detritus
Option D	Rock minerals	Detritus	Litter fall	Producers

Correct Option B

Solution: The correct sequence of options are given below:
A. – Detritus
B. – Rock minerals
C. – Producers
D. – Litter fall

Q 77. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is:
Option A 0.5
Option B 0.6
Option C 0.7
Option D 0.4
Correct Option B
Solution:
The total number of individuals = 1000
Genotype frequency of AA = 360÷1000 = 0.36
Genotype frequency of aa = 160÷1000 = 0.16
Genotype frequency of Aa = 2(240)÷1000 = 0.48
Now, according to the Hardy Weinberg equilibrium,
$(A+a)^2 = AA + 2Aa + aa = 1$
Thus, allele frequency of A = $\sqrt{0.36} = 0.6$
Allele frequency of a = $\sqrt{0.16} = 0.4$

Q 78. Tubectomy is a method of sterilisation in which:
Option A Ovaries are removed surgically.
Option B Small part of vas deferens is removed or tied up.
Option C Uterus is removed surgically.
Option D Small part of the fallopian tube is removed or tied up.
Correct Option D
Solution: Tubectomy is a method of sterilisation in which a small part of the fallopian tube is removed or tied up which prevents the movement of egg to reach the site of fertilisation.

Q 79. Which of the following is responsible for peat formation?
Option A *Riccia*
Option B *Funaria*
Option C *Sphagnum*
Option D *Marchantia*
Correct Option C
Solution: Species of *Sphagnum*, a moss, provide peat that have been used as fuel because of its water holding capacity.

Q 80. Which one of the following shows isogamy with non-flagellated gametes?
Option A *Ectocarpus*
Option B *Ulothrix*
Option C *Spirogyra*
Option D *Sargassum*
Correct Option C

Solution: In Spirogyra, sexual reproduction takes place through non-flagellated and similar sized gametes, and hence called isogamous.

Q 81. Which one of the following is wrongly matched?

Option A Translation – Using information in m-RNA to make protein.
Option B Repressor protein-Binds to operator to stop enzyme synthesis.
Option C Operon – Structural genes, operator and promoter.
Option D Transcription – Writing information from DNA to t-RNA

Correct Option D

Solution: Transcription is the process of formation of m-RNA from DNA during protein synthesis. It is not writing information from DNA to t-RNA.

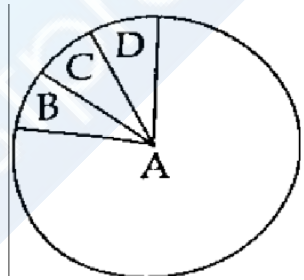
Q 82. Which of the following is a hormone releasing intra uterine device (IUD)?

Option A LNG – 20
Option B Cervical cap
Option C Vault
Option D Multiload 375

Correct Option A

Solution: LNG – 20 is a hormone releasing intra uterine device (IUD) which prevents implantation and make the cervix hostile to sperms.

Q 83. Given below is the representation of the extent of global diversity of invertebrates. What groups do the four portions (A-D) represent respectively?



	A	B	C	D
Option A	Crustaceans	Crustaceans	Molluscs	Other animal group
Option B	Molluscs	Other animal group	Crustaceans	Insects
Option C	Insects	Molluscs	Crustaceans	Other animal group
Option D	Insects	Crustaceans	Other animal group	molluscs

Correct Option C

Solution: Phylum-Arthropoda is the largest phylum of the animal kingdom with its largest group, i.e. Insecta (A). The second largest population is of phylum Mollusca (B). The third one is occupied by crustaceans (C). All other animals together indicate the (D) portion of the pie chart.

Q 84. Male gametophyte with least number of cells is present in:

Option A *Funaria*
Option B *Lilium*
Option C *Pinus*
Option D *Pteris*

Correct Option B

Solution: In angiosperms, male gametophyte is reduced to about 2-3 cells and is called pollen grain. *Lilium* is an angiosperm which possesses the male gametophyte with least number of cells.

Q 85. The shared terminal duct of the reproductive and urinary system in the human male is:

Option A Ureter
Option B Vas deferens
Option C Vasa efferentia
Option D Urethra

Correct Option D

Solution: In human male, urethra is urinogenital duct which carries both urine and sperm. Hence, it is a shared terminal duct of the reproductive and urinary system in the human male.

Q 86. Injury localised to the hypothalamus would most likely disrupt:

Option A Co-ordination during locomotion
Option B Executive functions such as decision making
Option C Regulation of body temperature
Option D Short term memory

Correct Option C

Solution: Hypothalamus regulates the body temperature, so injury localised to the hypothalamus would most likely disrupt regulation of body temperature.

Q 87. Select the correct option describing gonadotropin activity in a normal pregnant female:

Option A High level of FSH and LH facilitate implantation of the embryo.
Option B High level of hCG stimulates the synthesis of estrogen and progesterone.
Option C High level of hCG stimulates the thickening of endometrium.
Option D High level of FSH and LH stimulates the thickening of endometrium.

Correct Option B

Solution: During pregnancy, several hormones are secreted by the placenta including human chorionic gonadotropin (hCG) which stimulates the synthesis of estrogen and progesterone.

Q 88. The initial step in the digestion of milk in humans is carried out by?

Option A Trypsin
Option B Rennin
Option C Pepsin
Option D Lipase

Correct Option B

Solution: Rennin is a proteolytic enzyme found in the gastric juice of infants which helps in the digestion of milk proteins.

Q 89. The motile bacteria are able to move by:

Option A Flagella

Option B Cilia

Option C Pili

Option D Fimbriae

Correct Option A

Solution: The motile bacteria have thin filamentous extensions from their rigid cell wall called flagella which provide movement.

Q 90. Person with blood group AB is considered as universal recipient because he has:

Option A Both A and B antibodies in the plasma.

Option B No antigen on the RBC and no antibody in the plasma.

Option C Both A and B antigens in the plasma but no antibodies.

Option D Both A and B antigens on the RBC but no antibodies in the plasma.

Correct Option D

Solution: Person with blood group AB is considered as universal recipient as he has both A and B antigens on the RBC but does not have antibodies against A and B antigen cells.