AIPMT 2014

Section A: Physics

1. If force (F), velocity (V) and time (T) are taken as fundamental units, the dimensions of mass are
(1) $[FVT^{-1}]$ (2) $[FVT^{-2}]$
(3) $[FV^{-1}T^{-1}]$ (4) $[FV^{-1}T]$

Solution:
Force (F) = mass × acceleration

$$= \text{mass} \times \frac{\text{velocity}\,(V)}{\text{time}\,(T)}$$

Therefore,

$$\text{Mass} = \frac{F \times T}{V}$$

Units of mass = $[FV^{-1}T]$
Hence, the correct option is (4).

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 which is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is: (given, $g = 9.8\ ms^{-2}$)
(1) 3.5 (2) 5.9
(3)16.3 (4)110.8

Solution:
We know that

$$\text{Range} = \frac{u^2 \sin 2\theta}{g} \text{ so, } g \mu u^2$$

Therefore, $\frac{g_{planet}}{g} = \left(\frac{3}{5}\right)^2$

$$g_{planet} = \left(\frac{3}{5}\right)^2 \times 9.8\ ms^{-1}$$

$$= 3.528 \approx 3.5$$

Hence, the correct option is (1).

3. A particle is moving such that its position coordinates (*x*,*y*) are:
(2m, 3m) at time $t = 0$,
(6m,7m) at time $t = 2s$ and
(13m, 14m) at time $t = 5$ s,
Average velocity vector ($\vec{v}_{av}$) from $t = 0$ to $t = 5s$ is:

(1) $\frac{1}{5}(13\hat{i} + 14\hat{j})$ (2) $\frac{7}{3}(\hat{i} + \hat{j})$

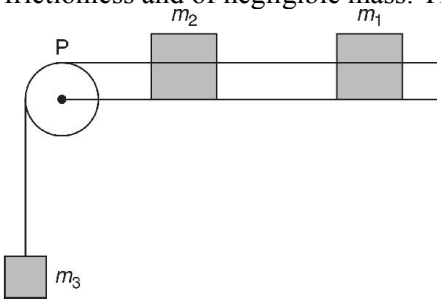
(3) $2(\hat{i} + \hat{j})$ (4) $\frac{11}{5}(\hat{i} + \hat{j})$

Solution:
We know that

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

Hence, the correct option is (4).

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 $m_1 = m_2 = m_3 = m$)



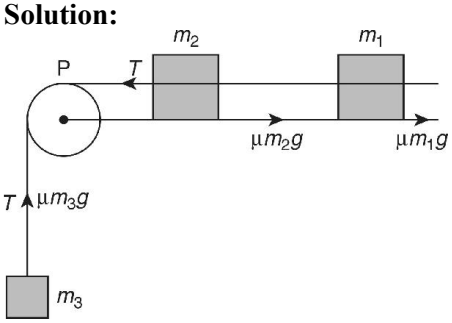
(1) $\frac{g(1-g\mu)}{g}$

(2) $\frac{2g\mu}{3}$

(3) $\frac{g(1-2\mu)}{3}$

(4) $\frac{g(1-2\mu)}{2}$

Solution:



$m_3g - T = m_3a$ …(1)

$\Rightarrow \quad T = m_3g - m_3a$ …(1)

$T - (\mu m_2g + \mu m_1g) = (m_1 + m_2)a$ …(2)

Putting (1) in (2)

$m_3g - m_3a - (\mu m_2g + \mu m_1g) = (m_1 + m_2)a$

$m_3g - (\mu m_2g + \mu m_1g) = (m_1 + m_2 + m_2)a$

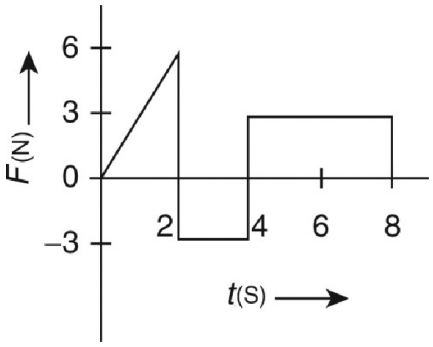
$m_3g - (\mu m_2g + \mu m_1g)/ (m_1 + m_2 + m_3) = a$

$$a = \frac{m\left[g - \frac{2mg}{3}\right]}{m\left[\frac{}{}\right]} \qquad (\text{as } m_1 = m_2 = m_3 = m)$$

$$a = \frac{g}{3}[1 - 2m]$$

Hence, the correct option is (3).

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 8s is:



(1) 24 Ns

(2) 20 Ns

(3) 12 Ns

(4) 6 Ns

Solution:

Change in momentum

$\Delta P = \int F dt$

= Area of F-t graph

$= \left(\frac{1}{2} \times 2 \times 6\right) + (4 \times 3)$

= 12 Ns

Hence, the correct option is (3).

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 is starts moving up with an acceleration 'a'?

(1) $\frac{2ma}{g+a}$

(2) $\frac{2ma}{g-a}$

(3) $\frac{ma}{g+a}$

(4) $\frac{ma}{g-a}$

Solution:

Let upthrust of air be F_a then

$mg - F_a = ma$ …(1)

For upward motion

$F_a - (m - \Delta m)g = (m - \Delta m)a$

$F_a - mg + \Delta mg = ma - \Delta ma$

$-ma + \Delta mg = ma - \Delta ma$

$\Delta m\,(a + g) = 2ma$

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

Hence, the correct option is (1).

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:

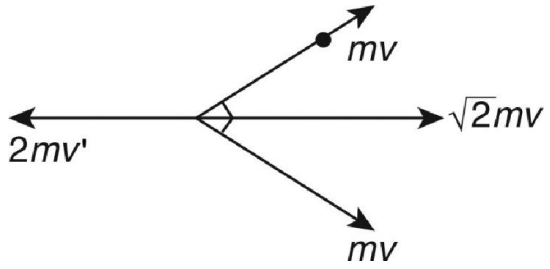
(1) mv^2

(2) $\frac{3}{2}mv^2$

(3) $2mv^2$

(4) $4mv^2$

Solution:



$2mv' = \sqrt{2}mv$

$v' = \frac{v}{\sqrt{2}}$ ....(1)

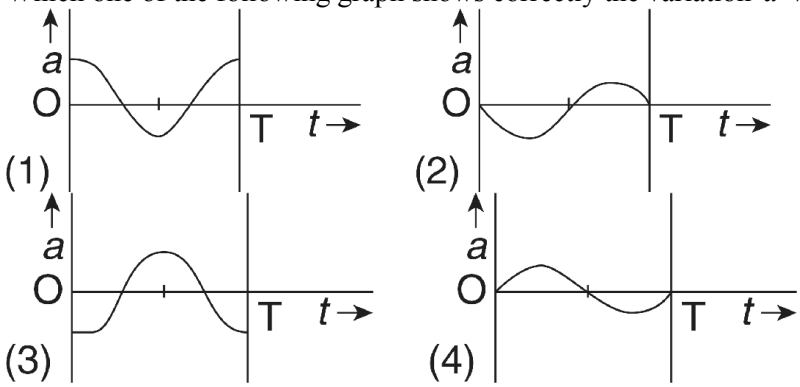
Total K.E. $= \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + \frac{1}{2}(2m)v'^2$

$= mv^2 + \frac{mv^2}{2}$ {On putting value of v' from (1)}

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

Hence, the correct option is (2).

8. The oscillation of a body on a smooth horizontal surface is represented by the equation,
$x = A \cos(\omega t)$
where x= displacement at time t
ω =frequency of oscillation
Which one of the following graph shows correctly the variation 'a' with 't'?



Solution:
$x = A \cos(\omega t)$

$v = \frac{dx}{dt} = -A \sin wt' w$

$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = -Aw^2 \cos wt$

Hence, the correct option is (3).

9. A solid cylinder of mass 50 kg and radius 0.5 m is free to rotate about horizontal axis. A 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}

(1) 25 N
(2) 50 N
(3) 78.5 N
(4) 157 N

Solution:
$Z = I\alpha$

$TR = I\alpha$

$\alpha = 2$ revolutions/s^2 $= 2 \times 2\pi$ rad/s^2

$= 4\pi$ rad/s^2

$T = I\alpha/R$

$$= \frac{1}{2}\frac{MR^2a}{R} = \frac{1}{2}MRa = \frac{1}{2}\times 50\times 0.5\times 4\times 3.14 = 157 \text{ N}$$

Hence, the correct option is (4).

10. The ratio of the acceleration 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:

(1) 5 : 7 (2) 2 : 3

(3) 2 : 5 (4) 7 : 5

Solution:

We know that,

For rolling motion without slipping on inclined plane,

$$a_1 = \frac{g\sin\theta}{1+\frac{k^2}{R^2}}$$

For slipping motion on inclined plane,

$a_2 = g\sin\theta$

$$\text{Ratio} = \frac{a_1}{a_2} = \frac{g\sin\theta \Big/ 1+\frac{k^2}{R^2}}{g\sin\theta} = \frac{1}{1+\frac{k^2}{R^2}} = \frac{1}{1+\frac{(2/5R)^2}{R^2}} = \frac{5}{7}$$

Hence, the correct option is (1).

11. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass= $5.98\times 1\ 0^{24}$ kg) have to be compressed to be a black hole?

(1) 10^{-9} m (2) 10^{-6} m

(3) 10^{-2} m (4) 100 m

Solution:

We know that

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

Here, R = Radius of earth

M = Mass of earth

G = Gravitational constant

Here, $v = c$

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

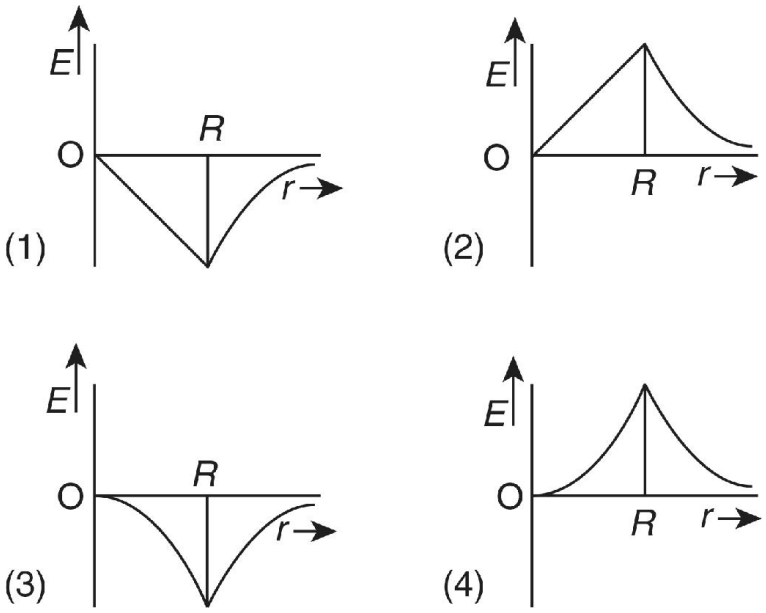
$RC^2 = 2GM$

$$R = \frac{2GM}{C^2}$$

$$= \frac{\left(2\times 6.6\times 10^{-11}\times 5.98\times 10^{24}\right)}{(3\times 10^8)^2} = 8.77\times 10^{-3} \text{ @} 10^{-2}$$

Hence, the correct option is (3).

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



Solution:

$E = -\frac{GM}{R^3} \times \vec{r}$ (if $r < R$)

$E = -\frac{GM}{r^3} \times \vec{r}$ (if $r \geq R$)

Hence, the correct option is (1).

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 graph is a straight line?

(1) Δl versus $1/l$ (2) Δl versus l^2

(3) Δl versus $1/l^2$ (4) Δl versus l

Solution:

$Y = \frac{F/A}{\Delta l/l} \Rightarrow \Delta l = \frac{Fl}{AY}$

But, $V = Al$, so $A = V/l$

$\Delta l = \frac{Fl^2}{VY}$

$\Delta l \propto l^2$

Hence, the correct option is (2).

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:

(1) Energy = $4VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is released. (2) Energy = $3VT\left(\frac{1}{r} + \frac{1}{R}\right)$ is released.

(3) Energy = $3VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is released. (4) Energy is neither released nor absorbed.

Solution:

$\Delta U = (ST)(\Delta A)$ …(1)

$A_{\text{initial}} = (4\pi r^2)n$

$A_{\text{final}} = 4\pi R^2$

$\Delta A = (4\pi r^2)n - 4\pi R^2$

$\left(\frac{4}{3}\pi r^3\right)n = \frac{4}{3}\pi R^3$

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

$\Delta A = 4\pi\left[\frac{R^3}{r^3}.r^2 - R^2\right] = 4\pi\left[\frac{R^3}{r} - \frac{R^3}{R}\right] = 4\pi R^3\left[\frac{1}{r} - \frac{1}{R}\right]$

$\Delta A = \left(\frac{4\pi R^3}{3}\right)3\left[\frac{1}{r} - \frac{1}{R}\right] = 3V\left[\frac{1}{r} - \frac{1}{R}\right]$

$\Delta U = 3VT\left[\frac{1}{r} - \frac{1}{R}\right]$ Putting in (1)

Hence, the correct option is (3).

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}]

(1) 24 g (2) 31.5 g

(3) 42.5 g (4) 22.5 g

Solution:

Heat lost = Heat gained

$mL + mS_w\Delta\theta = m_w S_w\Delta\theta$

Given

$L = 540$ cal/g

$S_w = 1$ cal/g/°C

$\Delta\theta = 100 - 80 = 20°C$

$m_w = 20$g

In order to determine 'm'

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

$\Rightarrow \quad m = 2.5$g

Total mass of water = (20 + 2.5)g = 22.5g

Hence, the correct option is (4).

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:

(1) 45°C (2) 20°C

(3) 42 °C (4) 10°C

Solution:

By Newton's law of cooling, we know that

$\frac{q_1 - q_2}{t} = k\left[\frac{q_1 + q_2}{2} - q_0\right]$

$\Rightarrow \quad \frac{60 - 70}{5} = k\left[\frac{70 + 60}{2} - q_0\right]$

$\Rightarrow \quad -2 = k\left[65 - \theta_0\right]$ …(1)

Also, $\frac{54-60}{5}=k\left[\frac{60+54}{2}-q_0\right]$

$-\frac{6}{5}=k[57-q_0]$ ...(2)

On dividing (1) by (2) we get:

$\frac{10}{6}=\frac{k[65-q_0]}{k[57-q_0]}$

$570-10\theta_0=390-6\theta_0$

$570-390=4\theta_0$

$\frac{180}{4}=q_0$

$\theta_0=45°C$

Hence, the correct option is (1).

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 $\gamma = 5/3$)

(1) $64P$ (2) $32P$

(3) $P/64$ (4) $16P$

Solution:

For isothermal expansion, $P_1V_1 = P_2V_2$ [$\because$ T = constant]

$\Rightarrow$ $PV = P_2(2V)$

$\Rightarrow$ $P_2 = P/2$

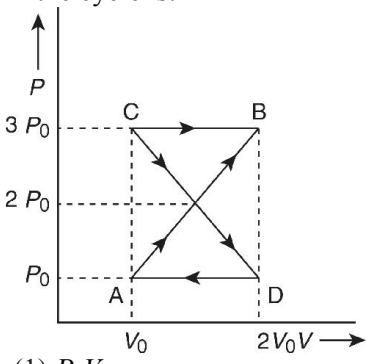
For adiabatic process $P_2V_2^{g} = P_3V_3^{g}$

$\Rightarrow$ $\left(\frac{P}{2}\right)(2V)^{g} = P_3(16)^{g}$

$\Rightarrow$ $P_3=\frac{3}{2}\left(\frac{1}{8}\right)^{5/3}=\frac{P}{64}$

Hence, the correct option is (3).

18. A thermodynamics system undergoes cyclic process ABCDA as shown in Fig. The work done by the system in the cycle is:



(1) P_0V_0 (2) $2P_0V_0$

(3) $P_0V_0/2$ (4) Zero

Solution:

Work done under cyclic process ABCDA = Area of the graph

We know that

If $V_2 > V_1$ then $W > 0$ (When clock wise, Work done > 0) …(1)

If $V_2 < V_1$ then $W < 0$ (When anticlockwise, Work done < 0) …(2)

From the figure, by using (1) and (2)

$$= \frac{1}{2}(V_0 - 2V_0)(2P_0 - P_0) + \frac{1}{2}(V_0 - 2V_0)(3P_0 - 2P_0)$$

$$= -\frac{1}{2}P_0V_0 + \frac{1}{2}P_0V_0$$

$= 0$

Hence, the correct option is (4).

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

(1) r^3 (2) r^2

(3) r (4) $\sqrt{r}$

Solution:

We know that

Mean free path, $l_m = \frac{1}{\sqrt{2}p\,d^2 n}$

$$d = 2r$$

$$l_m = \frac{1}{\sqrt{2}p\,4r^2 m}$$

$$l_m \mu \frac{1}{r^2}$$

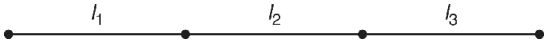
Hence, the correct option is (2).

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:

(1) $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$ (2) $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}} + \frac{1}{\sqrt{n_3}}$

(3) $\sqrt{n} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3}$ (4) $n = n_1 + n_2 + n_3$

Solution



$$n_1 = \frac{1}{2l_1}\sqrt{\frac{T}{\mu}}$$

$$n_2 = \frac{1}{2l_2}\sqrt{\frac{T}{\mu}}$$

$$n_3 = \frac{1}{2l_3}\sqrt{\frac{T}{\mu}}$$

$$l = l_1 + l_2 + l_3$$

Thus, $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$

Hence, the correct option is (1).

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

(1) 4 (2) 5

(3) 7 (4) 6

Solution:

The fundamental frequency of a closed organ pipe is $f = \frac{V}{4l} = \frac{340}{4 \times 0.85} = 100\text{Hz}$

The natural frequencies of the organ pipe will be f = 100Hz, 300 Hz, 500 Hz, 700 Hz, 900 Hz and 1100Hz. Thus, there are 6 possible natural oscillations which are below 1250 Hz.

Hence, the correct option is (4).

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 speed of sound is 343 m/s, the frequency of the honk as heard by him will be:

(1) 1332 Hz (2) 1372 Hz

(3) 1412 Hz (4) 1454 Hz

Solution:

Both source and observer are moving in the same direction

$$f = f_0 \left[\frac{v + v_0}{v + v_s}\right]$$

Here v_s = 18 km/hr

v_0 = 36 km/hr

f_0 = 1392 Hz

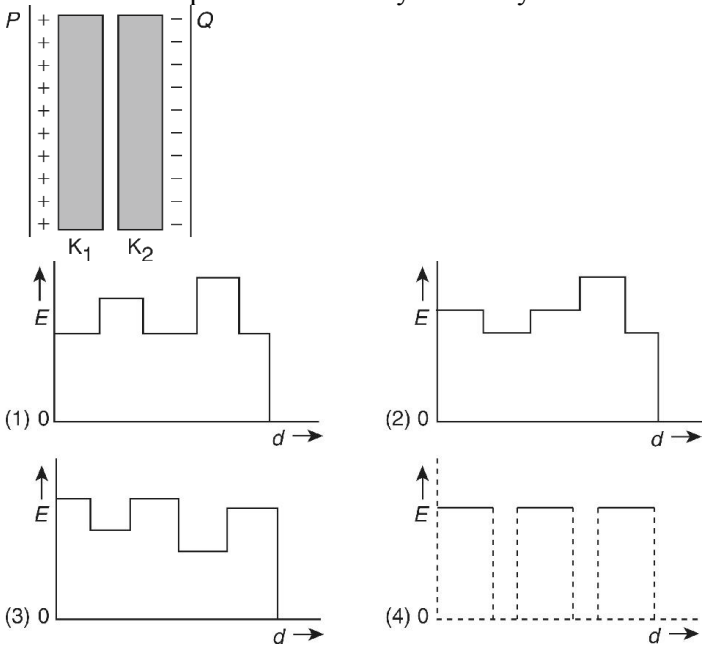
$$f = 1392 \left[\frac{343 + 10}{343 + 5}\right]$$

$$= 1392 \times \frac{353}{348}$$

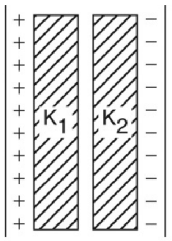
= 1412 Hz

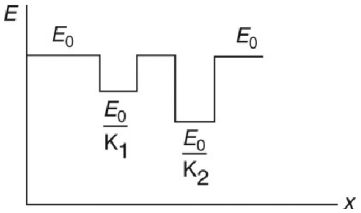
Hence, the correct option is (3).

23. Two thin dielectric slabs of dielectric constants K_1 and K_2 ($K_1 < K_2$) are inserted 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:



Solution:





Hence, the correct option is (3).

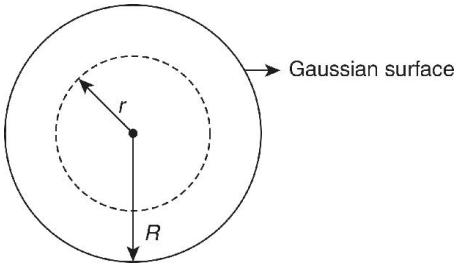
24. A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the center of the sphere respectively are:

(1) Zero and $\frac{Q}{4\pi\varepsilon_0 R^2}$ (2) $\frac{Q}{4\pi\varepsilon_0 R}$ and zero

(3) $\frac{Q}{4\pi\varepsilon_0 R}$ and $\frac{Q}{4\pi\varepsilon_0 R^2}$ (4) Both are zero

Solution:

Electric field inside the shell (or conducting sphere)



According to Gauss Law:

$\oint E.ds = \frac{q_{in}}{e_0}$

$E\oint ds = \frac{q_{in}}{e_0}$

$E(4p r^2) = \frac{0}{e_0}$ [$\because$ Charge enclosed by the Gaussian surface will be zero].

$E = 0$

So, electric field inside the conducting sphere will be zero.

Potential inside the shell

Using $dV = \vec{E}.d\vec{r}$, we have

$dV = 0 \Rightarrow V =$ constant [$\because E = 0$ inside the shell]

Thus, the potential at any point inside the uniformly charged shell is same. This will be equal to potential of surface. So, $V = \frac{q}{4pe_0 R}$

Hence, the correct option is (2).

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:

(1) $6\sqrt{5}$ N (2) 30 N

(3) 24 N (4) $4\sqrt{35}$ N

Solution:

$V(x, y, z) = 6x - 8xy - 8y + 6xyz$

We know that

$$E_x = -\frac{\partial V}{\partial x}, E_y = -\frac{\partial V}{\partial y} \text{ and } E_z = -\frac{\partial V}{\partial z},$$

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

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

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

$\therefore \quad \vec{E} = \sqrt{2^2 + 10^2 + 6^2} = \sqrt{140} = 2\sqrt{35}$

$q = 2$ coulomb

$F = qE$

$= 2 \times 2\sqrt{35} = 4\sqrt{35}$ N

Hence, the correct option is (4).

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 wire is:

(1) 19.2 W (2) 19.2 kW

(3) 19.2 J (4) 12.2 kW

Solution:

For 1 km,

$P = VI$

$$P = \frac{V^2}{R} = \frac{8 \times 8}{0.5}$$

For 150 km,

$$P = \frac{100 \times 8 \times 8}{0.5} = \frac{150 \times 640}{5}$$

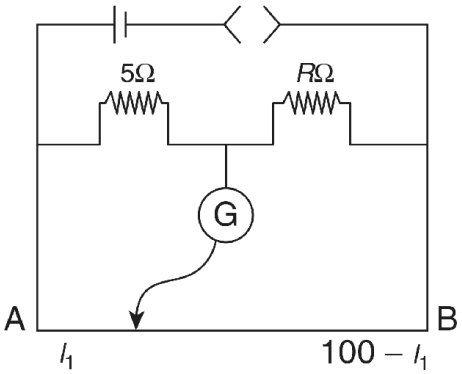
$= 30 \times 640$

$= 19200$ W

$= 19.2$ kW

Hence, the correct option is (2).

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:



(1) 10 Ω (2) 15 Ω
(3) 20 Ω (4) 25 Ω

Solution:

Before applying shunt resistance

$$\frac{5}{R}=\frac{l_1}{100-l_1} \Rightarrow R=\frac{5(100-l_1)}{l_1} \quad \ldots(1)$$

After applying shunt resistance in R of equal value:

$$\frac{5}{R/2}=\frac{1.6l_1}{100-1.6l_1} \Rightarrow R=\frac{10(100-1.6l_1)}{1.6l_1} \quad \ldots(2)$$

From (1) by (2) we get:

$$\frac{5(100-l_1)}{l_1}=\frac{10(100-1.6l_1)}{1.6l_1}$$

$$8(100-l_1)=10(100-1.6l_1)$$

$800 - 8l_1 = 1000 - 16l_0$

$8l_1 = 200$

$l_1 = 25$

Putting l_1 in (1) we get:

$R = 15\ \Omega$

Hence, the correct option is (2).

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 4 m long. When the resistance R is 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:

(1) 0.25 Ω (2) 0.95 Ω
(3) 0.5 Ω (4) 0.75 Ω

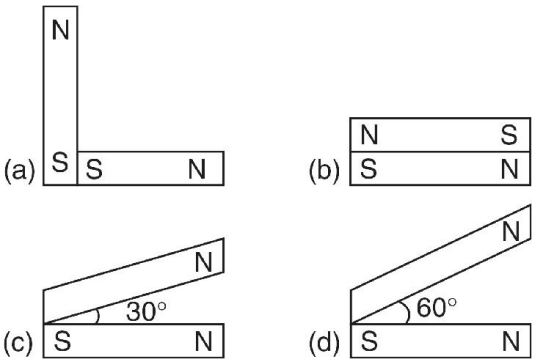
Solution:

For determination of internal resistance of a cell:

$$r=R\left(\frac{l_1}{l_2}-1\right)=9.5\left(\frac{3}{2.85}-1\right)=0.5\,\Omega$$

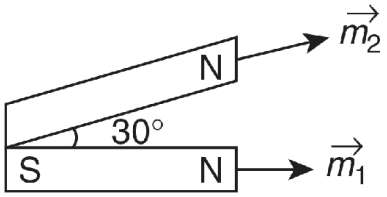
Hence, the correct option is (3).

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



(1) a
(2) b
(3) c
(4) d

Solution:
$m = IA\cos\theta$



$\vec{m}_{\text{net}} = \sqrt{m_1^2 + m_2^2 + 2m_1 m_2 \cos\theta}$

But $\vec{m}_1 = \vec{m}_2 = m$

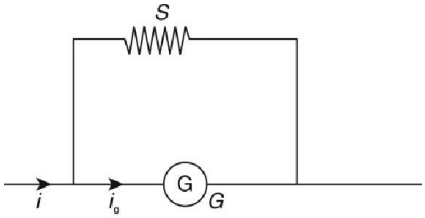
$\vec{m}_{\text{net}} = \sqrt{2m^2 + 2m^2 \cos q} = \sqrt{2m^2(1+\cos\theta)} = \sqrt{2m^2{}' \; 2\cos\theta/2} = 2M\cos\theta/2$

The value of m is maximum for $\theta = 30°$.
Hence, the correct option is (3).

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

(1) $\frac{1}{499}G$
(2) $\frac{499}{500}G$
(3) $\frac{1}{500}G$
(4) $\frac{500}{499}G$

Solution:
We know that for ammeter



$i_g = \frac{i's}{G+S}$ .....(1)

Given $i_g = \frac{0.2}{100}i$. Putting its value in (1)

$$\frac{0.2}{100} i = \frac{i's}{G+S}$$

$\Rightarrow \quad 2G + 2S = 1000\, S$

$\Rightarrow \quad S = \frac{1}{499} G$

Total Resistance $= \frac{SG}{S+G} = \frac{\frac{1}{499}G^2}{\frac{1}{499}G+G} = \frac{\frac{1}{499}}{\frac{900}{499}} G = \frac{1}{500} G$

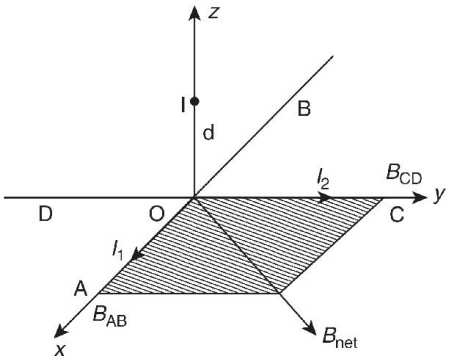
Hence, the correct option is (3).

31. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point 'I' 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:

(1) $\frac{m_0}{2\pi d} \frac{I_1}{I_2}$ (2) $\frac{m_0}{2\pi d}(I_1 + I_2)$

(3) $\frac{m_0}{2\pi d}(I_1^2 - I_2^2)$ (4) $\frac{m_0}{2\pi d}\sqrt{I_1^2 + I_2^2}$

Solution:



$$B_{AB} = \frac{m_0 I_1}{2\pi d}$$

$$B_{CD} = \frac{m_0 I_2}{2\pi d}$$

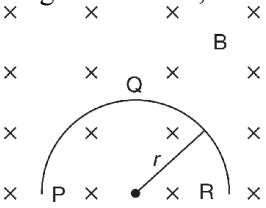
Net magnetic field $B_{net} = \sqrt{B_1^2 + B_2^2}$

$$= \sqrt{\left(\frac{m_0 I_1}{2\pi d}\right)^2 + \left(\frac{m_0 I_2}{2\pi d}\right)^2}$$

Net magnetic field $= \frac{m_0}{2\pi d}\sqrt{I_1^2 + I_2^2}$

Hence, the correct option is (4).

32. A thin semicircular conducting the 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:



(1) Zero
(2) $Bv\pi r^2/2$ and P is at higher potential
(3) $Bv\pi r/2$ and R is at higher potential
(4) $2Bvr$ and R is at higher potential

Solution:
For motion of conductor in magnetic field,
$E = B\, l_{\text{eff}}\, v$
$\because\ l_{\text{eff}} = 2r$
$\therefore\ E = B(2r)v = 2Brv$
R is at higher potential and P is at lower potential.
Hence, the correct option is (4).

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:
(1) 300V, 15A
(2) 450V, 15A
(3) 450V, 13.5A
(4) 600V, 15A

Solution:

$$\text{Efficiency} = \frac{\text{Power output}}{\text{Power input}} = \frac{V_s I_s}{V_P I_p}$$

$$\frac{90}{100} = \frac{V_S \times 6}{3 \times 10^3}$$

$$V_S = \frac{0.9 \times 3 \times 10^3}{6} = 0.45 \times 10^3 = 450\text{V}$$

$P_{\text{in}} = V_P I_P$
$3000 = 200 \times I_P$
$I_P = 15\text{A}$
Hence, the correct option is (2).

34. Light with an energy flux of 25×10^4 Wm^{-2} falls on a perfectly reflecting surface at normal incidence. If the surface area is 15 cm^2, the average force exerted on the surface is:
(1) 1.25×10^{-6} N
(2) 2.50×10^{-6} N
(3) 1.20×10^{-6} N
(4) 3.0×10^{-6} N

Solution:
For complete reflection
$\Delta p = 2h/\lambda$ ….(1)
\ Momentum transfer per unit time i.e. force (F) exerted on the surface,
$F = n\Delta p$ (where n is no. of photons per second)

$$F = \frac{2nh}{l} = \frac{2IA}{c}$$ {Putting value of Δp from (1)}

$$F_{\text{av}} = \frac{2IA}{c} = \frac{2 \times 25 \times 10^4 \times 15 \times 10^{-4}}{3 \times 10^8} = 2.5 \times 10^{-6}\ \text{N}$$

Hence, the correct option is (2).

35. A beam of light of λ = 600 nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2m away. The distance between first dark fringes on either side of the central bright fringe is:
(1) 1.2 cm
(2) 1.2 mm
(3) 2.4 cm
(4) 2.4 mm

Solution:

Width of central bright fringe $= \frac{2lD}{d} = \frac{2 \times 600 \times 10^{-6} \times 2}{10^{-3}} = 2.4 \times 10^{-3}$ m = 2.4 mm

Hence, the correct option is (4).

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 wavelength of light used). The intensity at a point where the path difference is $\lambda/4$ will be:

(1) K (2) K/4

(3) K/2 (4) Zero

Solution:

We know that

$$I = I_0 \cos^2 \frac{f}{2} \quad \text{.....(1)}$$

Given, I_0 = K,

$f = \frac{2p}{l} \times$ Path difference

When path difference = λ

$f = \frac{2p}{l} \times l = 2\pi$

On putting these values in (1)

$$I = \mathrm{K} \cos^2 \frac{2\pi}{2} = \mathrm{K} \cos^2 \pi = \mathrm{K}$$

When path difference = $\lambda/4$

$f = \frac{2p}{l} \times \frac{l}{4} = \frac{\pi}{2}$

On putting these values in (1)

$$I = \mathrm{K} \cos^2 \left(\frac{\pi}{4}\right) = \mathrm{K} \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{\mathrm{K}}{2}$$

Hence, the correct option is (3).

37. If the focal length of objective lens is increased, then magnifying power of:

(1) microscope will increase but that of telescope decrease.

(2) microscope and telescope both will increase.

(3) microscope and telescope both will decrease.

(4) microscope will decrease but that of telescope will increase.

Solution:

Magnifying power of microscope $= \frac{LD}{f_0 f_e}$

Thus, magnifying power of microscope $\mu \frac{1}{f_0}$

Magnifying power of telescope $= \frac{-f_0}{f_e}$

Thus, magnifying power of telescope μf_0

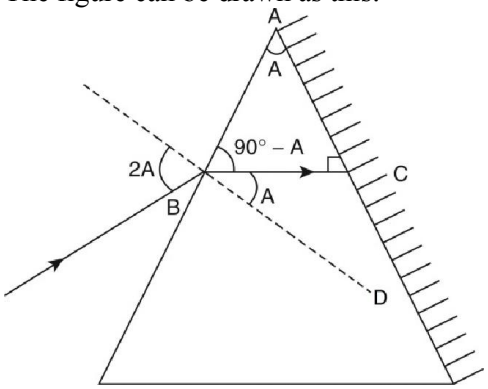
Hence, the correct option is (4).

38. The angle of a prism is 'A'. One of its refracting surfaces is silvered. Light rays falling at an angle of incidence 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:

(1) 2 sinA (2) 2 cosA

(3) $\frac{1}{2}\cos A$ (4) tanA

Solution:
The figure can be drawn as this:



In ΔABC
ĐA +ĐB +ĐC =180°
ĐA +ĐB +90° =180°
ĐB = 90° - ĐA
ĐABD = 90°
ĐABC +ĐCBD = 90°
(90° - ĐA) +ĐCBD = 90°
ĐCBD =ĐA
By Snell's law
sin 2A = μ sinA
μ = 2 cosA
Hence, the correct option is (2).

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 emitted 0.5 eV to 0.8eV. The work function of the metal is
(1) 0.65 eV (2) 1.0 eV
(3) 1.3 eV (4) 1.5 eV

Solution:
According to Einstein's photoelectric equation:
$h\nu = f_0 + K_{max}$
When K.E. = 0.5 eV
$h\nu = f_0 + 0.5$ …(1)
When K.E. = 0.8 eV
Then, frequency is increased by 20% Þ $\nu' = \nu + \frac{20}{100}\nu = \frac{6}{5}\nu = 1.2\nu$
$1.2h\nu = f_0 + 0.8$ …(2)
On dividing (1) by (2) we get:
$\frac{h\nu}{1.2\,h\nu} = \frac{f_0 + 0.5}{f_0 + 0.8}$
$f_0 + 0.8 = 1.2f_0 + 0.5 \times 1.2$
$0.8 - 0.6 = 0.2f_0$
$f_0 = 1$
Hence, the correct option is (2).

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:

(1) 25 (2) 75

(3) 60 (4) 50

Solution:

$$l = \frac{h}{mv} = \frac{h}{\sqrt{\frac{1}{2} \times 2mv \times mv}} = \frac{h}{\sqrt{\frac{1}{2} mv^2 \times 2m}} = \frac{h}{\sqrt{2m\,\mathrm{KE}}}$$

$$\frac{l_1}{l_2} = \sqrt{\frac{\mathrm{KE}_2}{\mathrm{KE}_1}}$$

Given, $\mathrm{KE}_2 = 16\mathrm{KE}_1$

$$\frac{l_1}{l_2} = \sqrt{\frac{16\,\mathrm{KE}_1}{\mathrm{KE}_1}}$$

$$\frac{l_1}{l_2} = 4$$

$$-\frac{l_2}{l_1} = \frac{-1}{4}$$

$$1 - \frac{l_2}{l_1} = 1 - \frac{1}{4}$$

$$\frac{l_1 - l_2}{l_1} = \frac{3}{4}$$

$$\frac{l_1 - l_2}{l_1} \times 100 = \frac{3}{4} \times 100 = 75\%$$

Hence, the correct option is (2).

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

(1) 3 (2) 2

(3) 6 (4) 10

Solution:

Energy of the photons, $E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{975 \times 10^{-10}} = 2.03 \times 10^{-16}\,\mathrm{J} = 12.75\ \mathrm{eV}$

This energy equals the energy gap between n = 1 (-13.6) and n = 4(-0.85). Thus, by the gain of this energy, the electron will excite from n = 1 to n = 4.

When the electron will fall back to its original state,

Numbers of spectral lines emitted = $\frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$

Hence, the correct option is (3).

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

(1) 19.6 MeV (2) -2.4 MeV

(3) 8.4 MeV (4) 17.3 MeV

Solution:

Binding energy per nucleon of $^{7}_{3}\mathrm{Li} = 5.60$ MeV

Total binding energy of $^{7}_{3}\mathrm{Li} = 7 \times 5.6 = 39.2$ MeV

Binding energy per nucleon of $^{4}_{2}\mathrm{He} = 7.06$

Total binding energy of $^{4}_{2}\mathrm{He} = 4 \times 7.06 = 28.24$ MeV

$^{7}_{3}\mathrm{Li} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{4}_{2}\mathrm{He} + Q$

39.20 $\quad$ 28.24×2

$Q = 56.48 - 39.20 = 17.28$ MeV

Hence, the correct option is (4).

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:

(1) 1.96×10^{9} years (2) 3.92×10^{9} years

(3) 4.20×10^{9} years (4) 8.40×10^{9} years

Solution:

We know that

$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{n}$ and $t = \mathrm{n}\, t_{1/2}$

$\frac{N_X}{N_Y} = \frac{1}{7} \Rightarrow \frac{N_Y}{N_X} = 7$

$\frac{N_Y}{N_X} + 1 = 8$

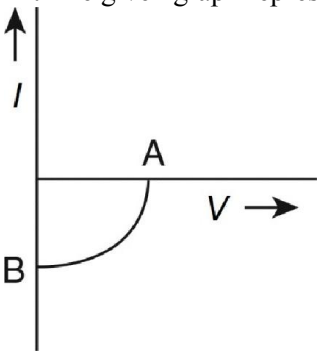
$\frac{N_X}{N_X + N_Y} = \frac{1}{8} = \left(\frac{1}{2}\right)^{3}$

n = 3

$t = 3 \times 1.4 \times 10^{8}$ yrs. $= 4.2 \times 10^{9}$ yrs.

Hence, the correct option is (3).

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



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

(2) It is for a solar cell and points A and B represent open circuit voltage and current, respectively.

(3) It is for a photodiode and points A and B represent open circuit voltage and current respectively.

(4) It is for a LED and points A and B represent open circuit voltage and short circuit current, respectively.

Solution:

It is *V- I* characteristic curve for a solar cell, where A represent open circuit voltage of solar cell and B represent short circuit current.

Hence, the correct option is (1).

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?
(1) (a) and (b) only
(2) (b) only
(3) (b) and (c) only
(4) (a), (b) and (c)

Solution:
The barrier potential depends on type of semiconductor (for Si $V_b = 0.7$ volt and for Ge $V_b = 0.3$ volt), amount of doping and also on the temperature.
Hence, the correct option is (4).

Section B: Chemistry

46. What is the maximum number of orbitals that can be identified with the following quantum numbers?
$n = 3, l = 1, m = 0$
(1) 1
(2) 2
(3) 3
(4) 4

Solution:
$3p$ has m = 0, so only one orbital is possible i.e. $3p_z$.
Hence, the correct option is (1).

47. Calculate the energy in 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})
(1) 1
(2) 2
(3) 3
(4) 4

Solution:
Using Planck's quantum theory:

$$E = \frac{hc}{\lambda} = \frac{6.634 \times 10^{-34} \times 3 \times 10^8}{45 \times 10^{-9}} = 4.4 \times 10^{-18} \text{J}$$

Hence, the correct option is (4).

48. 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
(1) 8 : 16 : 1
(2) 16 : 8 : 1
(3) 16 : 1 : 2
(4) 8 : 1 : 2

Solution:
Using mole concept
$x/2 : x/32 : x/16 = 16 : 1 : 2$
Hence, the correct option is (3).

49. 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
(1) $\frac{2}{\sqrt{3}}a$
(2) $\frac{4}{\sqrt{3}}a$

(3) $\frac{\sqrt{3}}{4}a$ (4) $\frac{\sqrt{3}}{2}a$

Solution:
For bcc arrangement,

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

And $d = 2r$ where r is the radius of the sphere and d is the distance between the body centered atom and corner atom.

So, $d = \frac{\sqrt{3}}{2}a$

Hence, the correct option is (4).

50. Which property of colloids is not dependent on the charge on colloidal particles?
(1) Coagulation (2) Electrophoresis
(3)Electro-osmosis (4) Tyndall effect

Solution:
Tyndall effect is due to scattering of light by colloidal particles.
Hence, the correct option is (4).

51. Which of the following salts will give highest pH in water?
(1) KCl (2) NaCl
(3) Na_2CO_3 (4) $CuSO_4$

Solution:
Na_2CO_3 is a salt of strong base and weak acid.
Hence, the correct option is (3).

52. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression?
(1) KCl (2) $C_6H_{12}O_6$
(3) $Al_2(SO_4)_3$ (4) K_2SO_4

Solution:
$Al_2(SO_4)_3 \rightarrow 2Al^{3+} + 3SO_4^{2-}$
Here, $i = 5$
$\Delta T_f = iK_f m$
Hence, the correct option is (3).

53. When 22.4 litres of H_2 (g) is mixed with 11.2 1itres of Cl_2 (g), each at STP, the moles of HCl (g) formed is equal to
(1) 1 mol of HCl (g) (2) 2 mol of HCl (g)
(3) 0.5 mol of HCl (g) (4) 1.5 mol of HCl (g)

Solution:
1 mol of H_2 needs 1 mole of Cl_2
22.4 L needs 22.4 L of Cl_2
Available volume of Cl_2 = 11.2 L

So, Cl_2 is the limiting reagent here.
Thus, 1 mol of Cl_2 will give 1 mol of HCl.
Hence, the correct option is (1).

54. When 0.1 mol MnO_4^{2-} is oxidized the quantity of electricity required to completely covert MnO_4^{2-} to MnO_4^- is
(1) 96500 C
(2) 2 × 96500 C
(3) 9650 C
(4) 96.50 C

Solution:
$MnO_4^{2-} \rightarrow MnO_4^- + e^-$
1 mole of MnO_4^{2-} requires 1F conversion to MnO_4^-
1 F = 96500 C
Thus, 0.1 mole requires 0.1 × 96500 C = 9650 C
Hence, the correct option is (3).

55. Using the Gibbs change, $\Delta G°$ = + 63.3 kJ, for the following reaction, $Ag_2CO_3(g) \rightarrow 2Ag^+(aq) + CO_3^{2-}(aq)$, the K_{sp} of Ag_2CO_3(s) in water at 25°C is (R = 8.314 JK^{-1} mol^{-1})
(1) 3.2×10^{-26}
(2) 8.0×10^{-12}
(3) 2.9×10^{-3}
(4) 7.9×10^{-2}

Solution:
$\Delta G^o = -2.303RT \log K_{sp}$
$63.3 \times 10^3 = -2.303 \times 8.314 \times 298 \times \log K_{sp}$
$-11.09 = \log K_{sp}$
$K_{sp} = 8 \times 10^{-12}$
Hence, the correct option is (2).

56. The weight of silver (At.Wt. = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be
(1) 5.4 g
(2) 10.8 g
(3) 54.0 g
(4) 108.0 g

Solution:
According to Faraday's law of electrolysis
$$W_{Ag} \times \frac{1}{108} = W_{O_2} \times \frac{4}{M_{O_2}}$$
Given, $\frac{W_{O_2}}{M_{O_2}} = n_{O_2} = \frac{5600}{22400} = \frac{1}{4}$
$$\therefore W_{Ag} \times \frac{1}{108} = \frac{1}{4} \times 4 \Rightarrow W_{Ag} = 108$$
Hence, the correct option is (4).

57. Which of the following statements is correct for the spontaneous adsorption of a gas?
(1) ΔS is negative and therefore, ΔH should be highly positive.
(2) ΔS is negative and therefore, ΔH should be highly negative.
(3) ΔS is positive and therefore, ΔH should be negative.
(4) ΔS is positive and therefore, ΔH should also be highly positive.

Solution:
For a spontaneous process, ΔG should be negative
$\Delta G = \Delta H - T\Delta S$
Thus, ΔG will be negative when) ΔS is negative and therefore, ΔH is highly negative.
Hence, the correct option is (2).

58. For the reversible reaction:
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH3(g) + \text{Heat}$
The equilibrium shifts in forward direction-
(1) by increasing the concentration of NH_3 (g)
(2) by decreasing the pressure
(3) by decreasing the concentrations of N_2 (g) and H_2 (g)
(4) by increasing pressure and decreasing temperature

Solution:
According to Le-Chatliers principle,
On increasing the pressure, the equilibrium shifts in the direction in which there is decrease in the number of moles.
For an exothermic reaction like this, on increasing the temperature the equilibrium will shift in the backward direction, so temperature should be kept low for facilitating forward direction.
Hence, the correct option is (4).

59. For the reaction: $X_2O_4(l) \rightarrow 2XO_2(g)$
$\Delta U = 2.1$ k cal, $\Delta S = 20$ cal K^{-1} at 300 K.
Hence, ΔG is
(1) 2.7 kcal (2) –2.7 kcal
(3) 9.3 kcal (4) –9.3 kcal

Solution:

$$\Delta H = \Delta U + \Delta n_g RT = 2.1 + 2 \times \frac{2}{1000} \times 300 = 3.3 \text{ k cal}$$

$$\Delta G = \Delta H - T\Delta S = 3.3 - 300 \times \frac{26}{1000} = -2.7 \text{ kcal}$$

Hence, the correct option is (2).

60. For a given exothermic reaction, K_P and K_P' are the equilibrium constants at temperatures T_1 and T_2 respectively. Assuming that heat of reaction is constant in temperatures range between T_1 and T_2, it is readily observation that
(1) $K_P > K_P'$ (2) $K_P < K_P'$
(3) $K_P = K_P'$ (4) $K_P = 1/K_P'$

Solution:
Using Arrhenius equation:

$$\log \frac{K_P'}{K_P} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

If $T_1 > T_2$, then $K_P >> K_P'$
Hence, the correct option is (1).

61. Which of the following orders of ionic radii is correctly represented?
(1) $H^- > H^+ > H$ (2) $Na^+ > F^- > O^{2-}$
(3) $F^- > O^{2-} > Na^+$ (4) $Al^{3+} > Mg^{2+} > N^{3-}$

Solution:
The order should be $O^{2-} > F^{-} > Na^{+}$
Hence, the correct option is none.

62. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reaction is left in excess and how much?
(At. Wt. Mg = 24; 0 = 16)
(1)Mg, 0.16 g (2) O_2, 0.16 g
(3) Mg, 0.44 g (4) O_2, 0.28 g

Solution:
$Mg + ½O_2 \rightarrow MgO$
According to the reaction,
1 mol of Mg requires 0.5 mol of O_2
So, 0.04 mol requires $0.04 \times 0.5 = 0.02$ moles of O_2
But O_2 available is 0.0175 mol
So, here O_2 is the limiting reagent and Mg is the excess reagent.
Excess of Mg = 0.15/12 – 0.07/2 = 0.0067 mol
Mass of Mg = $0.0067 \times 24 = 0.16$ g
Hence, the correct option is (1).

63. The pair of compounds that can exist together is:
(1) $FeCl_3, SnCl_2$ (2) $HgCl_2, SnCl_2$
(3) $FeCl_2, SnCl_2$ (4) $FeCl_3, KI$

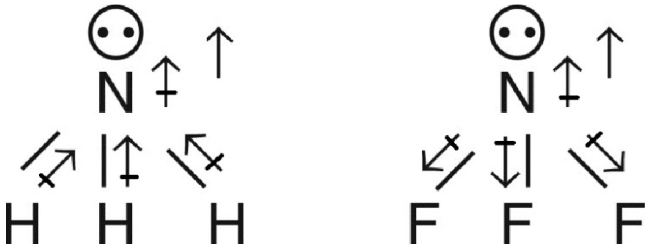
Solution:
Fe^{2+} and Sn^{2+}, both are reducing in nature.
Hence, the correct option is (3).

64. Be^{2+} is isoelectronic with which of the following ions?
(1) H^{+} (2) Li^{+}
(3) Na^{+} (4) Mg^{2+}

Solution
$Be^{2+} = 1s^2 = Li^{+}$
Hence, the correct option is (2).

65. Which of the following molecules has the maximum dipole moment?
(1) CO_2 (2) CH_4
(3)NH_3 (4) NF_3

Solution:



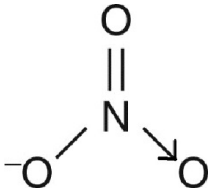
Hence, the correct option is (3).

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

(1) N_3 (2) NO_3^-

(3)NO_2 (4) CO_2

Solution:



Hence, the correct option is (2).

67. Acidity of diprotic acids in aqueous solutions increases in the order:

(1) $H_2S < H_2Se < H_2Te$ (2) $H_2Se < H_2S < H_2Te$

(3) $H_2Te < H_2S < H_2Se$ (4) $H_2Se < H_2Te < H_2S$

Solution:

Because, bond dissociation enthalpy decreases down the group.

Hence, the correct option is (1).

68. (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:

(1) oxidizing in (a) and reducing in (b)

(2) reducing in (a) and oxidizing in (b)

(3) reducing in (a) and (b)

(4) oxidizing in (a) and (b)

Solution:

There is decrease in oxidation number of oxygen from 0 to -2 and +1 to 0.

Hence, the correct option is (3).

69. Artificial sweetener which is stable under cold conditions only is:

(1) Saccharine (2) Sucralose

(3)Aspartame (4) Alitame

Solution:

Aspartame is unstable at cooking temperature.

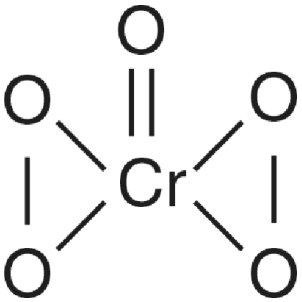
Hence, the correct option is (3).

70. 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:

(1) + 5 (2) + 3

(3) + 6 (4) - 10

Solution:



$x + 4(-1)(O-O) + 1(-2)(O=O) = 0$

$x = +6$

Hence, the correct option is (3).

71. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives:

(1) Mn^{4+} and O_2 (2) Mn^{2+} and O_2

(3) Mn^{2+} and O_3 (4) Mn^{4+} and MnO_2

Solution:

$3H_2SO_4 + 2KMnO_4 + 5H_2O_2 \rightarrow 5O_2 + 2MnSO_4 + 8H_2O + K_2SO_4$

Hence, the correct option is (2).

72. Among the following complexes the one which shows Zero crystal field stabilizations energy (CFSE) is

(1) $[Mn(H_2O)_6]^{3+}$ (2) $[Fe(H_2O)_6]^{3+}$

(3) $[Co(H_2O)_6]^{2+}$ (4) $[Co(H_2O)_6]^{3+}$

Solution:

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

$Fe^{2+} = 3d^5$ $(t_{2g}^3\ e_g^1)$

$CFSE = [-0.4 \times 3 + 0.6 \times 2]\Delta_0 = 0$

Hence, the correct option is (2).

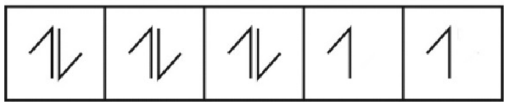
73. Magnetic moment 2.83 BM is given by which of the following ions? (At. No.s Ti = 22,Cr = 24, Mn = 25, Ni = 28)

(1) Ti^{3+} (2) Ni^{2+}

(3) Cr^{3+} (4) Mn^{2+}

Solution:

Ni^{2+}



$n = 2$

Dipole moment $= \mu = \sqrt{n(n+2)} = 2\sqrt{2}$ 2.82

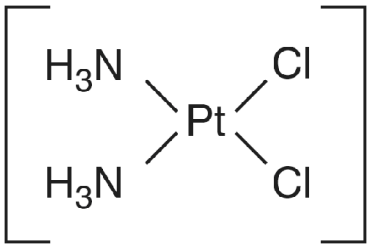
Hence, the correct option is (2).

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

(1) *mer*-$[Co(NH_3)_3Cl]$ (2) *cis*-$[Pt.Cl_2(NH_3)_2]$

(3) *cis*-$K_2[PtCl_2Br_2]$ (4) Na_2CoCl_4

Solution:

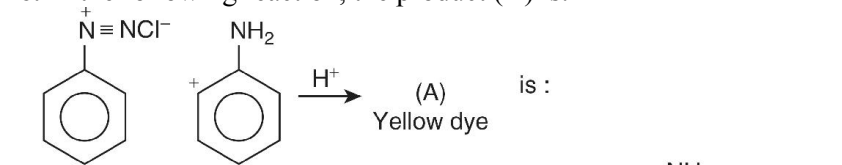


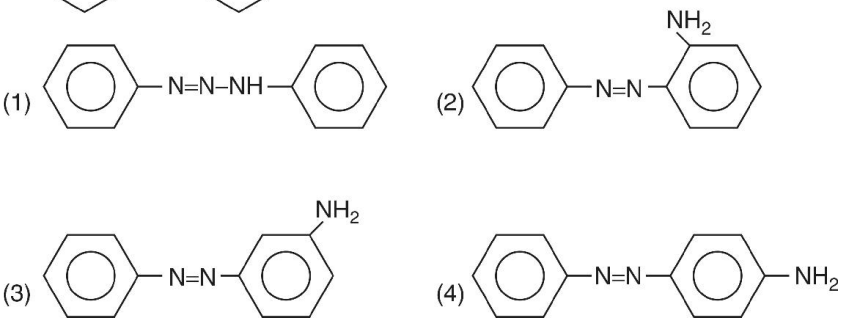
cis-platin is used as an anticancer agent.
Hence, the correct option is (2).

75. Reason of lanthanide contraction is:
(1) Negligible screening effect of '*f*' orbitals (2) Decreasing nuclear charge
(3) Decreasing nuclear charge (4) Decreasing screening effect

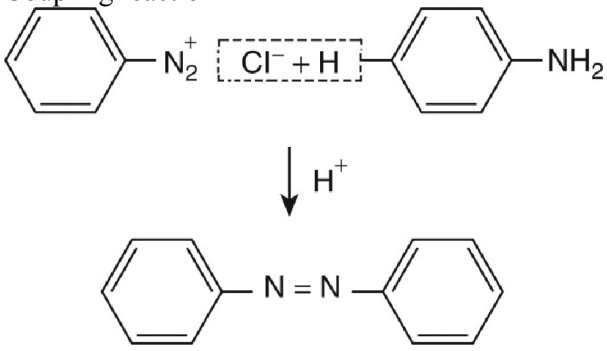
Solution:
Poor shielding of *f*-orbital due to which the radii of members of third transition series is very similar to that of second transition series.
Hence, the correct option is (1).

76. In the following reaction, the product (A) is:





Solution:
Coupling reaction



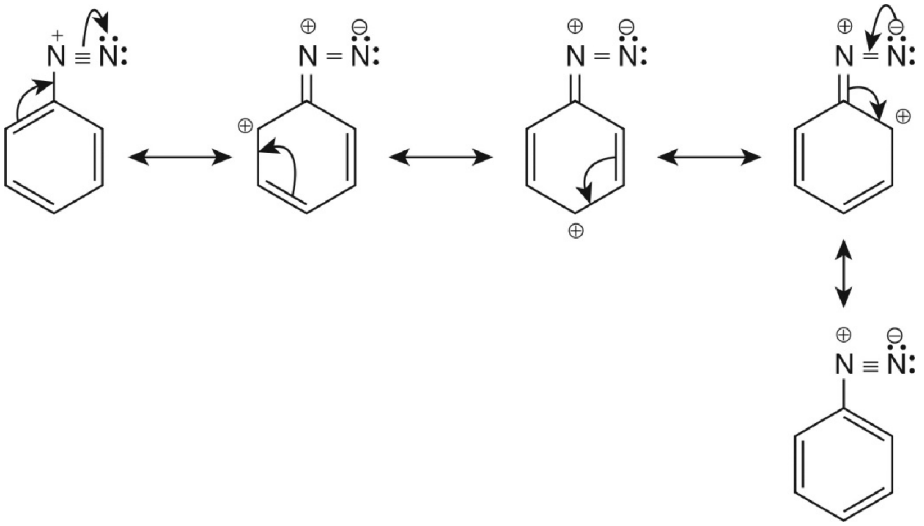
Hence, the correct option is (4).

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

(1) $CH_3N_2^+X^-$ (2) $C_6H_5N_2^+X^-$

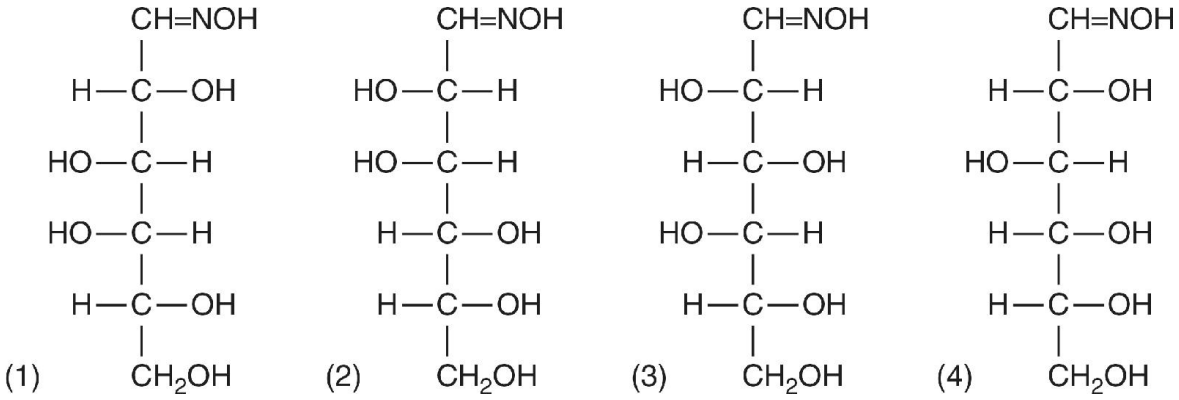
(3) $CH_3CH_2N_2^+X^-$ (4) $C_6H_5CH_2N_2^+X^-$

Solution:
Due to resonance stabilization as shown:

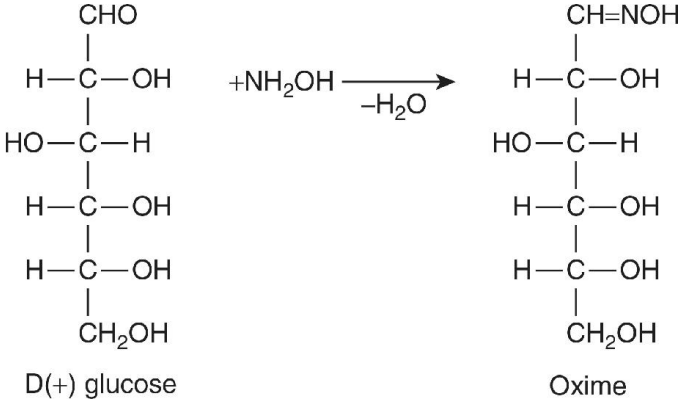


Hence, the correct option is (2).

78. D (+) glucose reacts with hydroxyl amine and yield an oxime. The structure of the oxime would be:



Solution:



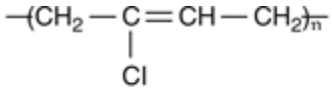
Hence, the correct option is (2).

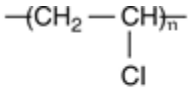
79. Which of the following hormones is produced under the condition of stress which stimulates glycogenolysis in the liver of human being?

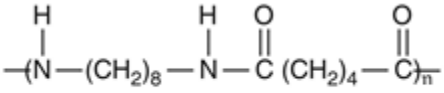
(1) Thyroxin
(2) Insulin
(3)Adrenaline
(4) Estradiol

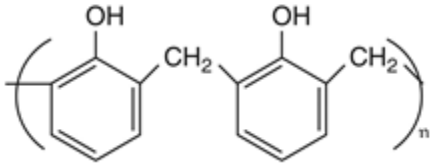
Solution:
Adrenaline gland is secreted under stressful situations.
Hence, the correct option is (3).

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

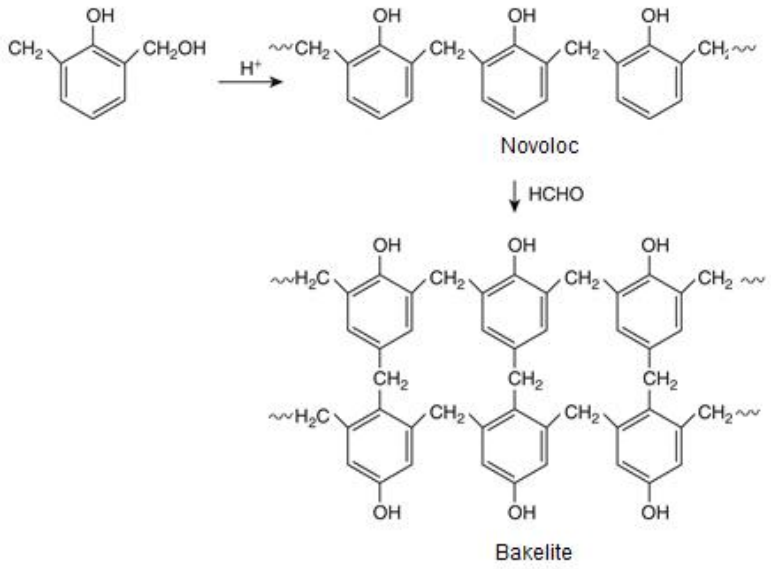
(1) 

(2) 

(3) 

(4) 

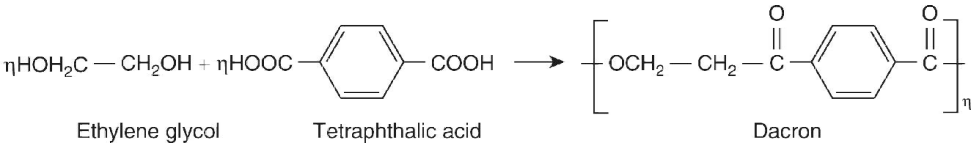
Solution:
Bakelite is a thermosetting polymer.



Hence, the correct option is (4).

81. Which of the following organic compounds polymerizes to form the polyester Dacron?
(1) Propylene and para $HO-\left(C_6H_4\right)-OH$
(2) Benzolic acid and ethanol
(3) Terepthalic acid and ethylene glycol
(4) Benzoic acid and para $HO-\left(C_6H_4\right)-OH$

Solution:



Hence, the correct option is (3).

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

(1) Ozone (2) Acrolein

(3) Peroxyacetyl nitrate (4) Chloroflurocarbons

Solution:

Chlorofluorocarbons are responsible for depletion of ozone layer rest all of them are components of photochemical smog.

Hence, the correct option is (4).

83. In the Kjedahl's method for estimation of nitrogen present in soil sample, ammonia evolved from 0.75g of sample neutralized 10 mL. of 1M H_2SO_4. The percentage of nitrogen in the soil is:

(1) 37.33 (2) 45.33

(3) 35.33 (4) 43.33

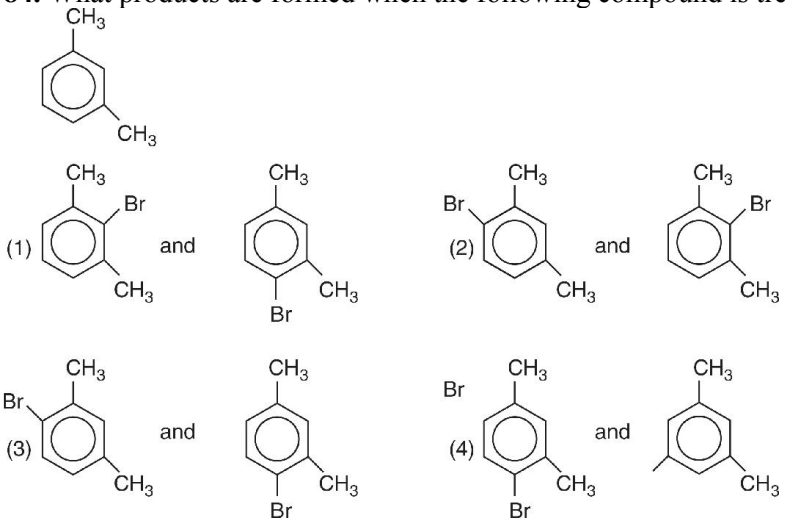
Solution:

$$\text{Percentage of nitrogen} = 1.4 \times \text{Molarity of acid} \times \text{Basicity of acid} \times \frac{\text{Volume of acid used}}{\text{Mass of substance taken}}$$

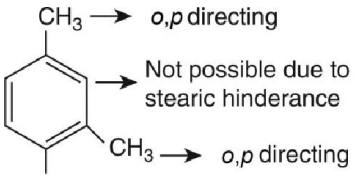
$$= 1.4 \times 1 \times 2 \times \frac{10}{0.75} = 37.33\%$$

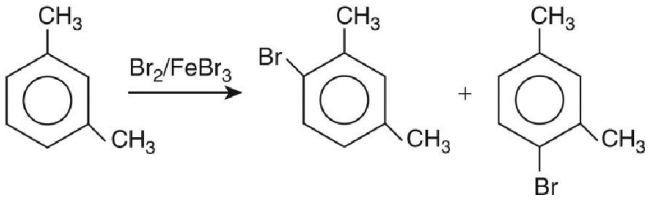
Hence, the correct option is (1).

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



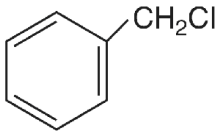
Solution:

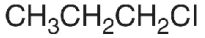


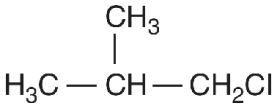


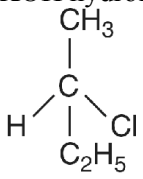
Hence, the correct option is (3).

85. Which of the following compounds will undergo racemisation when solution of KOH hydrolysis?

(i) 

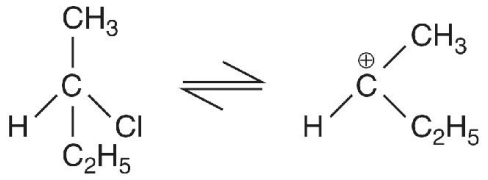
(ii) 

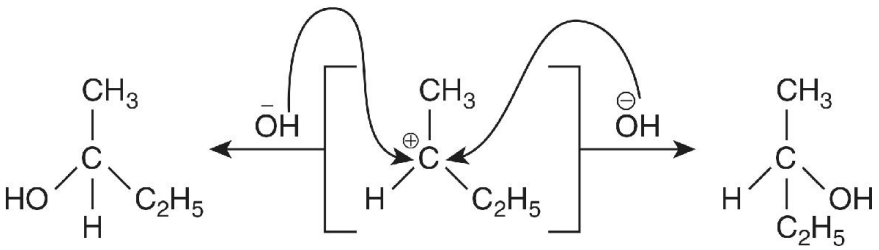
(iii) 

(iv) 

(1) (i) and (ii)
(2) (ii) and (iv)
(3) (iii) and (iv)
(4) (i) and (iv)

Solution:





Inversion Retention

Hence, the correct option is none.

86. Among the following sets of reaction which one produces anisole?

(1) CH_3CHO; RMgX
(2) C_6H_5OH; NaOH; CH_3I
(3) C_6H_5OH; neutral $FeCl_3$
(4) C_6H_5-CH_3; CH_3COCl:$AlCl_3$

Solution:

Williamson's synthesis

$$C_6H_5OH + NaOH \rightarrow C_6H_5ONa + CH_3I \rightarrow C_6H_5OCH_3 + NaI$$

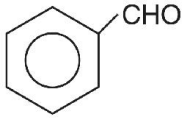
Hence, the correct option is (2).

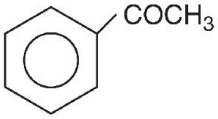
87. Which of the following will not be soluble in sodium hydrogen carbonate?

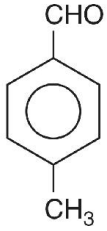
(1) 2, 4, 6- trinitrophenol
(2) Benzoic acid
(3) *o*- nitro phenol
(4) Benzenesulphonic acid

Solution:
It is a stronger acid due to the presence of electron withdrawing group i.e., NO_2.
Hence, the correct option is (3).

88. Which one is most reactive towards Nucleophilic addition reaction?

(1) 

(2) 

(3) 

(4) 

Solution:
It is due to the presence of two electron withdrawing groups (NO_2) which increases the polarity of the bond and hence, facilitates the release of proton.
Hence, the correct option is (4).

89. Identify Z in the sequence of reactions:

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

(1) $CH_3-(CH_2)_3-O-CH_2CH_3$
(2) $(CH_3)_2CH_2-O-CH_2CH_3$
(3) $CH_3(CH_2)_4-O-CH_3$
(4) $CH_3CH_2-CH(CH_3)-O-CH_2CH_3$

Solution:

$$CH_3CH_2CH=CH_2 \xrightarrow{HBr,H_2O_2} CH_3CH_2CH_2CH_2Br \xrightarrow{C_2H_5ONa} CH_3-CH_2-CH_2-CH_2-O-C_2H_5$$

Hence, the correct option is (1).

90. Which of the following organic compounds has same hybridization as its combustion product -(CO)?
(1) Ethane
(2) Ethyne
(3) Ethene
(4) Ethanol

Solution:
The hybridisation of both CO_2 and ethyne is *sp*.
Hence, the correct option is (2).

Section C: Biology

91. Which one of the following shows isogamy with non-flagellated gametes?
(1) *Sargassum*
(2) Ectocarpus
(3) *Ulothrix*
(4) *Spirogyra*

Solution:
Syngamy is isogamy when gametes are similar. Out of the given options, only *Spirogyra* shows isogamy with the non-flagellated gametes.
Hence, the correct option is (4).

92. Five kingdom system of classification suggested by R.H. Whittaker is not based on:
(1) Presence or absence of a well-defined nucleus
(2) Mode of reproduction
(3) Mode of nutrition.
(4) Complexity of body organization

Solution:
Five kingdom classification was given by R.H. Whittaker. He used taxonomic features such as cell type, biochemical profile of cell wall, presence or absence of nuclear membrane, level of structural organization, for example, cell-tissue-organ-organ system grade and mechanism of obtaining food to classify organisms.
Hence, the correct option is (1).

93. Which one of the following fungi contains hallucinogens?
(1) *Morchella esculenta* (2) *Amanita muscaria*
(3) *Neurospora sp.* (4) *Ustilago sp.*

Solution:
Amanita muscaria is a mushroom. It is commonly known as the fly agaric or fly amanita. It is poisonous. It is noted for its hallucinogenic properties. Its main psychoactive constituent is the compound muscimol. It is a depressant that cause dissociative changes in perception.
Hence, the correct option is (2).

94. Archaebacteria differs from eubacteria in:
(1) Cell membrane structure (2) Mode of nutrition
(3) Cell shape (4) Mode of reproduction

Solution:
Archaebacteria have several features that differentiate these bacteria from other bacteria:
- Archaeans do not cause common diseases like bacteria do.
- They differ chemically from bacteria in their cell walls, cell membranes and ribosomal RNA and RNA polymerase. Their cell wall is made up of proteins and polysaccharides. Peptidoglycan is absent. This is the reason why they are able to survive in harsh environments where bacteria cannot.
- They are different in their physiological processes.

Hence, the correct option is (1).

95. Which one of the following is wrong about *Chara*?
(1) Upper oogonium and lower round antheridium
(2) Globule and nucule present on the same plant
(3) Upper antheridium and lower oogonium
(4) Globule is male reproductive structure

Solution:
Chara reproduces both vegetatively and sexually. Vegetative reproduction takes place by tubers and secondary protonema. The fructifications for sexual reproduction are male globule or antheridium and female nucule or archegonium. Ooogium is the upper part and antheridium is the lower part.
Hence, the correct option is (3).

96. Which of the following is responsible for peat formation?
(1) *Marchantia* (2) *Riccia*
(3) *Funaria* (4) *Sphagnum*

Solution:
Sphagnum is commonly known as peat moss. *Sphagnum* amass to store water. It is because both living and dead plants present in it has large water holding capacities in their cells. The vacant cells can hold water under drier conditions. Therefore, as sphagnum moss grows, it slowly extents into drier conditions, thus forming bigger peatlands. These peat buildups provide habitat for a wide array of peatland plants.
Hence, the correct option is (4).

97. Placenta and pericarp are both edible portions in:

(1) Apple (2) Banana
(3) Tomato (4) Potato

Solution:
The fruit of tomato is smooth or grooved, like a true berry. It is formed from a bicarpellary, syncarpous, bilocular or tetralocular ovary with swollen placenta. All parts of the fruit except the small seeds are edible. The membranous skin is represented by epicarp, while mesocarp is the middle fleshy part. The endocarp, septa and placentae are all pulpy.
Hence, the correct option is (3).

98. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as:
(1) Vexillary (2) Imbricate
(3) Twisted (4) Valvate

Solution:
Aestivation is said to be imbricate when irregular overlapping of appendages by one another occurs. Some of the five sepals are external, while some are internal. It is seen in *Cassia*, gulmohar, etc.
In vexillary, out of five petals, the largest posterior or standard petal is the outermost with both margins outside and overlapping two lateral petals (wings or alae) and in the two smallest anterior petals (keel), both margins are inside. In twisted, one margin of a sepal or petal overlaps the margin of the next one while the other margin is overlapped by the preceding one, thereby giving a twisted appearance. In valvate, Margins of adjacent petals or sepals touch each other without overlapping.
Hence, the correct option is (2).

99. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will your use to distinguish between the two?
(1) Secondary xylem (2) Secondary phloem
(3) Protoxylem (4) Cortical cells

Solution:
Developmentally, the earlier formed part of the primary xylem is protoxylem. On the basis of the position of Protoxylem, roots can be differentiated from shoots. In roots, xylem is exarch i.e. protoxylem is towards periphery and metaxylem lies towards the centre, while in shoots xylem is endarch i.e. protoxylem is towards centre and the metaxylem lies towards the periphery.
Hence, the correct option is (3).

100. Which one of the following statements is correct?
(1) The seed in grasses is not endospermic.
(2) Mango is a parthenocarpic fruit
(3) A proteinaceous aleurone layer is present in maize grain.
(4) A sterile pistil is called a staminode

Solution:
In the seed of maize grain, the endosperm is surrounded by a layer of cells called aleurone which separates the embryo from the endosperm. The cells of aleurone layer consist of numerous protein bodies that are sources of enzymes required for mobilizing food reserves during germination
The seed in grasses is endospermic.
Mango is a true fruit, it is one-seeded fruit formed from monocarpellary superior ovaries.
A stamen which is sterile is called a staminode.
Hence, the correct option is (3).

101. Tracheids differ from the tracheary elements in:
(1) Having casparian strips

(2) Being imperforate
(3) Lacking nucleus
(4) Being lignified

Solution:
The difference between tracheids and vessels lies in the fact that tracheids are imperforate cells and have pit-pairs on the common walls. In vessels, perforations are present in areas which lack both primary and secondary walls through which vessel elements are interconnected.
Hence, the correct option is (2).

102. An example of edible underground stem is:
(1) Carrot (2) Groundnut
(3) Sweet potato (4) Potato

Solution:
Potatoes are stem tubers that are underground swollen tips of the underground branches. Since the branch growth is retarded so food accumulates and the tips become swollen. They help in food storage.
Carrot, groundnut and sweet potato are root modifications. They are roots which have been modified for storing food materials.
Hence, the correct option is (4).

103. Which structures perform the function of mitochondria in bacteria?
(1) Nucleoid (2) Ribosomes
(3) Cell wall (4) Mesosomes

Solution:
Electron micrographs of bacterial cells often show large infoldings of the cell membrane called mesosomes which are structurally similar to the mitochondria. These are formed by the invaginations of the cell membrane. They help in the synthesis of the cell wall, replication of DNA, equal distribution of chromosomes in the daughter cells, increase the surface area of plasma membrane for effective absorption and also increase the enzyme content.
Hence, the correct option is (4).

104. The solid linear cytoskeletal elements having a diameter of 6 nm and made up of a single type of monomer are known as:
(1) Microtubules (2) Microfilaments
(3) Intermediate filaments (4) Lamins

Solution:
Microfilaments are approximately 6-8 nm in diameter. The actin monomers that form microfilaments, polymerize in the presence of ATP and form a flexible, helical filament. The subunit organization in microfilaments is two-stranded structure with two helical grooves running along its length.
Hence, the correct option is (2).

105. The osmotic expansion of a cell kept in water is chiefly regulated by:
(1) Mitochondria (2) Vacuoles
(3) Plastids (4) Ribosomes

Solution:
The vacuolar membrane, called the tonoplast, like the lysosomal membrane, also contains many protein pumps which lead to active transport of ions into the vacuolar compartment. This results in a much higher concentration of these ions in the vacuole as compared to the cytoplasm or the extracellular fluid. This in turn helps in osmotic entry of water into the vacuole and forms the basis of mechanical support for the soft tissues of a plant and also helps stretch the cell wall during cell growth.
Hence, the correct option is (2).

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

(1) G_0 and G_1 (2) G_1 and S

(3) Only G_2 (4) G_2 and M

Solution:

During the G_2 stage of interphase, the time gap between the end of DNA replication and the beginning of cell division, the supercoils of DNA condense into tightly compacted bodies that become visible as chromosomes during mitosis. Each chromosome contains two copies of hereditary information (the original and its replica synthesized during the S phase), which can be seen as two strands of chromosomal material held together at a single point. The strands are called sister chromatids.

Hence, the correct option is (3).

107. Match the following and select the correct answer:

(a) Centriole (i) lnfoldings in mitochondria

(b) Chlorophyll (ii) Thylakoids

(c) Cristae (iii) Nucleic acids

(d) Ribozymes (iv) Basal body cilia or flagella

	(a)	(b)	(c)	(d)
(1)	(iv)	(ii)	(i)	(iii)
(2)	(i)	(ii)	(iv)	(iii)
(3)	(i)	(iii)	(ii)	(iv)
(4)	(iv)	(iii)	(i)	(ii)

Solution:

(a) Centriole (iv) Basal body cilia or flagella

(b) Chlorophyll (iii) Nucleic acid

(c) Cristae (i) Infoldings in mitochondria

(d) Ribozyme (ii) Thylakoids

Hence, the correct option is (4).

108. 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?

(1) It made possible the isolation and exact identification of auxin.

(2) It is the basis for quantitative determination of small amounts of growth- promoting substances.

(3) It supports the hypothesis that IAA is auxin.

(4) It demonstrated polar movements of auxins

Solution:

This curvature was due to differential cell elongation and was proportional to the amount of substance present in the agar. The significant conclusions from Went's experiments were:

(a) Presence of regulatory substance, auxin in the apex of the coleoptile was confirmed.

(b) A method for isolation and quantitative analysis of auxin was devised

Hence, the correct option is (1).

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

(1) Senescent leaves (2) Young leaves

(3) Roots (4) Buds

Solution:

As nitrogen travels in the form of soluble amines and amides from the older to the younger leaves, the symptoms of nitrogen deficiency generally appear first in the older leaves and occur in the younger leaves only when the deficiency becomes severe.
The deficiency symptoms of potassium first appear in older leaves, which characteristically develop mottling or chlorosis, followed by necrotic lesions.
Hence, the correct option is (1).

110. In which one of the following processes CO_2 is not released?
(1) Aerobic respiration in plants (2) Aerobic respiration in animals
(3) Alcoholic fermentation (4) Lactate fermentation

Solution:
Under anaerobic conditions in some bacteria or in muscles of animals, pyruvate is reduced to lactate to regenerate NAD^+. It is also known as homolactic fermentation.
In all other processes, CO_2 is the end product.
Hence, the correct option is (4).

111. Anoxygenic photosynthesis is characteristic of:
(1) *Rhodospirillum* (2) *Spirogyra*
(3) *Chlamydomonas* (4) *Ulva*

Solution:
Chromatium and *Rhodospirillum* are anoxygenic nitrogen fixing photosynthetic bacteria. Photosynthetic *Rhodospirillaceae* are obligate anaerobes that is, they die in the presence of oxygen.
Hence, the correct option is (1).

112. A few normal seedling of tomato were kept in a dark room.After few days they were found to have become white- coloured like albions , Which of the following terms will you use to describe them?
(1) Mutated (2) Embolised
(3) Etiolated (4) Defoliated

Solution:
Etiolation is characterized by increased stem elongation, reduced leaf development, and lack of chlorophyll in seedlings grown in darkness or low light conditions.
Hence, the correct option is (3).

113. Which one of the following growth regulators is known as stress hormone?
(1) Abscissic acid (2) Ethylene
(3) GA3 (4) Indole acetic acid

Solution:
Abscisic acid is synthesized in mesophyll cells, guard cells and vascular tissue mainly from mevalonic acid or xanthophyll. It is highly mobile and rapidly moves out of the leaves to other parts of the plant body, specially sink tissues through diffusion, as well as through xylem and phloem transport. It serves to increase plant tolerance to several stresses, such as drought, waterlogging, etc., hence, it is also known as stress hormone.
Hence, the correct option is (1).

114. Geitonogamy involves
(1) Fertilization of a flower by the pollen from another flower of the same plant
(2) Fertilization of a flower by the pollen from another same flower.
(3) Fertilization of a flower by the pollen from a flower of another plant in the same population
(4) Fertilization of a flower by the pollen from a flower of another plant belonging to a distant population

Solution:

Transfer of pollen grains from the anther of the flower of one plant to the stigma of another flower of the same plant is known as geitonogamy. It involves two flowers and requires a pollinating agent. Hence, functionally, it is cross-pollination. However, genetically, it is self-pollination because both the flowers belong to the same plant.
Hence, the correct option is (1).

115. Male gametophyte with least number of cells is present in:
(1) *Pteris* (2) *Funaria*
(3) *Lilium* (4) *Pinus*

Solution:
Most reduced male gametophyte or minimum number of cells in the male gametophyte is present in angiosperms. They have three celled male gametophyte. *Lilium* is an angiosperm, while *Funaria* is a bryophyte, *Pinus* is a gymnosperm and *Pteris* is a Pteridophyte.
Hence, the correct option is (3).

116. An aggregate fruit is one which devloped from
(1) Multicarpellary syncarppous gynoecium
(2) Multicarpellary apocarups gynoecium
(3) Complete inflorescence
(4) Multicarpellary superior ovary

Solution:
If the number of carpels of gynoecium is more than one then the fruit formed is aggregate. In apocarous condition, the carpels of the gynoecium must be free, while the carpels of styles and stigma may be fused. Thus, fruit formed is aggregate. For example, rose, lotus, Ranunculus, etc.
Hence, the correct option is (2).

117. Pollen tablets are available in the market for:
(1) *In vitro* fertilization (2) Breeding programmes
(3) Supplementing food (4) *Ex situ* conservation

Solution:
Since pollen grains are rich in nutrients (proteins, carbohydrates and fats), they are taken as food supplements to increase stamina in athletes and race horses. They are used as pollen tablets or syrups. Pollen grains are also used to produce variety of products such as cosmetics, syrups, energy drinks, etc.
Hence, the correct option is (3).

118. Function of filiform apparutus is to:
(1) Recognize the suitable pollen at stigma (2) Stimulate division of generative cell
(3) Producer nectar (4) Guide the entry of pollen tube

Solution:
The three cells at the micropylar end form the egg apparatus. They consist of two synergids (or help cells) and one egg cell (ovum). The synergids have a filiform apparatus (finger-like cellular thickenings at the micropylar tip) attached to their upper wall that functions to attract and guide the pollen tube into the synergid. The egg cell has a large vacuole at its upper end and a nucleus at its lower end.
Hence, the correct option is (4).

119. Non-albuminous seed is produced in:
(1) Maize (2) Castor
(3) Wheat (4) Pea

Solution:

Endosperm is a nutritive tissue and plays an important role in development and germination of seed. The developing embryo can consume it or it may remain persistent in the mature seed. In the former case, the seed is called albuminous, while in the latter case, the seed is called ex-albuminous. Ex-albuminous seeds do not contain endosperm. Their cotyledons carry food and are thick and fleshy. For example, peas, beans, groundnut, gram, etc.
Hence, the correct option is (4).

120. Which of the following shows coiled RNA strand and capsomeres?
(1) Polio virus (2) Tobacco mosaic virus
(3) Measles virus (4) Retrovirus

Solution:
Tobacco mosaic virus has a single stranded coiled RNA and a protein capsid coat known as capsomere. Its infection causes mosaic -like mottling and discoloration of the leaves of tobacco plant.
Hence, the correct option is (2).

121. Which one of the following is wrongly matched?
(1) Transcription- Writing information from DNA to- RNA
(2) Transcription- Using information in m- RNA to make protein
(3) Repressor protein - Binds to a operator to stop enzyme synthesis
(4) Operon- Structural genes, operator and promoter

Solution:
(i) Transcription is the transfer of the genetic information from DNA to RNA (mRNA)
(ii) Translation: It is the transfer of information from RNA (mRNA) to protein.
(iii) Repressor protein is encoded by regulator gene. It binds to operator to stop the synthesis of enzyme.
(iv) A typical operon consists of structural genes, a promoter region (binding site of RNA polymerase) and an operator region (binding site of the repressor, a regulatory protein).
Hence, the correct option is (2).

122. Transformation was discovered by:
(1) Meseson and stahl (2) Hershey and chase
(3) Griffith (4) Waston and crick

Solution:
Transformation is the change in an organism's characteristics because of the transfer of genetic information. Frederick Griffith, an English military physician, while studying pneumococcal infections in mice discovered bacterial transformation in 1928. Hence, it is also called Griffith effect.
Hence, the correct option is (3).

123. Fruit colour in squash is an example of:
(1) Recessive epistasis (2) Dominant epistasis
(3) Complementary genes (4) Inhibitory genes

Solution:
There are three fruit colors observed in Curcubita pepo—yellow, green and white. There are two genes involved to produce the color, one gene has alleles Y and y, while the other has alleles W and w. The genotypes W– produces white color; wwY– produces yellow color; wwyy gives green color. The outcome of a cross between plants heterozygous for both of the fruit-color determining genes results in phenotype ratio 12 (white): 3 (yellow): 1 (green). Therefore, we can see that allele W in one gene is dominant over all the alleles (Y and y) of the other gene, and thus epistatic over the other gene. This is a case of dominant epistasis.
Hence, the correct option is (2).

124. Viruses have:
(1) DNA enclosed in a protein coat (2) Prokaryotic nucleus

(3) Single Chromosome (4) Both DNA and RNA

Solution:
A virus is a small infectious agent that replicates only inside the living cells of other organisms. Virus particles contain three parts: i) the genetic material made from either DNA or RNA, long molecules that carry genetic information; ii) a protein coat that protects these genes; and in some cases iii) an envelope of lipids that surrounds the protein coat.

125. The first human hormone produced by recombinant DNA technology is:
(1) Insulin (2) Estrogen
(3) Thyroxin (4) Progesterone

Solution:
Insulin is synthesized by the beta cells of the islets of Langerhans in the pancreas and controls blood sugar (glucose) levels. Its deficiency results in diabetes mellitus. In 1983, Eli Lily, an American company, prepared two DNA sequences corresponding to A and B chains of human insulin. Thus, it was the first hormone to be produced using recombinant DNA technology.
Hence, the correct option is (1).

126. An analysis of chromosomal DNA using the Southern hybridization technique does not use:
(1) Electrophoresis (2) Blotting
(3) Autoradiography (4) PCR

Solution:
Southern blot hybridization was developed by M. Southern in 1975 in which the locations of genes and other DNA sequences can be identified on restriction fragments separated by gel electrophoresis. The DNA molecules that have been separated by gel electrophoresis are transferred onto nitrocellulose or nylon membranes. A radioactively labeled VNTR DNA probe containing the sequence of interest is then hybridized with the immobilized DNA on the membrane and detected by autoradiography.
Hence, the correct option is (4).

127. In vitro clonal propagation in plants in characterized by:
(1) PCR and RAPD (2) Northern blotting
(3) Electrophoresis and HPLC (4) Microscopy

Solution:
Clonal propagation or Somaclonal propagation refers to the multiplication of genetically identical copies of a plant by micropropagation. They are often used to develop new plant varieties. Meristems are regions of active cell division in plants. The meristems found at the shoot and root tips are called apical meristems while those that form in the axils of leaf primordia, giving rise to branches and flowers are called axillary meristems. They are selected by by using microscopy and cultured on a suitable medium where multiplication takes place.
Hence, the correct option is (4).

128. An alga which can be employed as food for human beings:
(1) *Ulothrix* (2) *Chiarella*
(3) *Spirogyra* (4) *Polysiphonia*

Solution:
Some algae such as Scenedesmus and Chlorella are used as food. The cyanobacterium Spirulina is consumed as food. They are rich source of protein.
Hence, the correct option is (2).

129. Which vector can clone only a small fragment of DNA?
(1) Bacterial artificial chromosome (2) Yeast artificial chromosome

(3) Plasmid (4) Cosmid

Solution:
(i) Bacterial Artificial Chromosomes (BAC) vectors are vectors which are based on fertility plasmid of bacteria. These are used for mapping of large eukaryotic genome. They can accommodate large DNA fragments of size 300–350 kb.
(ii) Yeast Artificial Chromosomes (YAC) vectors resembles a natural chromosome. They have telomere at each end, autonomously replicating sequence (origin of replication) and a centromere. These are used for the cloning of DNA fragments of size more than 106 bp in size.
(iii) Plasmids are circular molecules of DNA that lead an independent existence in a bacterial cell. The size of the plasmid should be relatively small since large molecules tend to break down
during purification and are also difficult to manipulate.
(iv) Cosmid vectors are hybrid vectors constructed by inserting "cos" site of phage Lambda into plasmid DNA. Cosmid is inserted into lambda protein heads. They infect bacteria and replicate like plasmids. They can clone DNA fragments up to 45 kb of length.
Hence, the correct option is (3).

130. An example of ex situ conservation is:
(1) National Park (2) Seed Bank
(3) Wildlife sanctuary (4) Sacred Grove

Solution:
Ex situ conservation involves the conservation of genetic resources of species away from their area of origin or development. This includes off site collection and gene banks. This strategy is aimed to conserve more genetic material in less area.
Hence, the correct option is (2).

131. A location with luxuriant growth of lichens on the trees indicates that the :
(1) Trees are very healthy (2) Trees are heavily infested
(3) Location is highly polluted (4) Location is not polluted

Solution:
Lichens are bio-monitors. They are indicators of air pollution or in other words are very sensitive to changes in the environment. Lichens not grow in polluted habitat. They are sensitive to oxides of Sulphur. The absence of lichens means air pollution in the area and hence luxuriant growth of lichens indicates that the location is not polluted.
Hence, the correct option is (4).

132. 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)
(1)	(i)	(ii)	(iii)	(iv)
(2)	(iv)	(i)	(iii)	(ii)
(3)	(iii)	(ii)	(iv)	(i)
(4)	(ii)	(i)	(iv)	(iii)

Solution:
(i) The pioneer species are generally small hardy species that spread into un-colonized areas generally algae and lichens. They are perennial species that spread quickly and produce large amount of seeds for the next season. The appearance of these species modifies the microenvironment of the ecosystem and generates changes in its abiotic

and biotic factors. Therefore, they open the way to other species to establish in the place by the creation of new potential ecological niches.
(ii) Detritivore, also known as detritus feeders, or saprophages, are heterotrophs. They obtain their nutrients by consuming decomposing plant and animal parts as well as feces. Earthworm is a detritivore.
(iii) Natality is the number of young individuals produced in a unit time in a population in the given area and is added to the density.
(iv) The process of the transfer of pollen grains from the anthers of a flower to the stigma of the same flower or of another flower is known as pollination.
Hence, the correct option is (4).

133. A species facing extremely high risk of extinction in the immediate future is called:
(1) Vulnerable (2) Endemic
(3) Critically Endangered (4) Extinct

Solution:
Species are classified into nine groups on the criteria such as population size, rate of decline, area of geographic distribution, etc. According to IUCN, a taxon is considered critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future. For example, pygmy hog (Sus salvanius).
Hence, the correct option is (3).

134. The zone of atmosphere in which the ozone layer is:
(1) Ionosphere (2) Mesosphere
(3) Stratosphere (4) Troposphere

Solution:
Ozone is formed as a natural layer high in the atmosphere (stratosphere) by the effect of sunlight on normal oxygen. It is an allotropic form of oxygen in which three atoms of oxygen occur together rather than the normal two. It is relatively unstable and releases its third oxygen atom readily, so it oxidizes or burns things more readily and at much lower concentrations than normal oxygen. It is very active chemically, and has a short average lifetime in the air.
Hence, the correct option is (3).

135. The organization which published the Red List of species is :
(1) ICFRE (2) IUCN
(3) UNEP (4)WWF

Solution:
Founded in 1948, IUCN or World Conservation Union encourages the preservation of natural environment and wildlife. The IUCN Red List or Red Data List, was created in 1963. It is the world's most comprehensive inventory of global conservation status of biological species and has many uses in conservation including
Hence, the correct option is (2).

136. Select the Taxon mentioned that represents both marine and fresh water species:
(1) Echionoderms (2) Ctenophroa
(3) Cephalocoradata (4) Cnidaria

Solution:
The phylum Coelenterata, sometimes called Cnidaria, includes about 9000 species of jellyfish, hydras, sea anemones, sea fans and corals. There are thousands of cnidarian species, and most are marine except a few, example, *Hydra* are fresh water cnidarian.
All species belonging to Echinodermata are marine animals that live on the sea floor. Ctenophores commonly known as sea walnuts or comb jellies are gelatinous marine animals. Cephalochordata are exclusively marine and are considered to be primitive and are also known as protochordates.
Hence, the correct option is (4).

137. Which one of the following living organisms completely lacks a cell wall?
(1) *Cyanobacteria* (2) Sea- fan (*Gorgonia*)
(3) *Saccharomyces* (4) Blue- green algae

Solution:
Sea fan (*Gorgonia*) is an animal belonging to the phylum Coelnterata. The cells of this animal lack cellulosic cell wall unlike other animal of this phylum.
Cynobacteria, *Saccharomyces* (fungus) and blue-green algae have cell wall.
Hence, the correct option is (2).

138. *Planaria* possesses high capacity of:
(1) metamorphosis (2) regeneration
(3) alternation of generation (4) bioluminescence

Solution:
If an individual is divided into two or more parts, each part can regenerate into a new individual. This type of asexual reproduction is called regeneration. It is commonly observed in some flatworms like *Planaria*, sponges and in Cnidarians.
Hence, the correct option is (2).

139. A marine cartilaginous fish that can produce electric current is:
(1) *Pristis* (2) *Torpedo*
(3) *Trygon* (4) *Scoliodon*

Solution:
Torpedo is a marine, cartilaginous fish. It has an electric organ between the eyes and pectoral fins. This electric organ can give electric shocks. Hence, this fish is called an electric ray.
Hence, the correct option is (2).

140. Choose the correctly matched pair:
(1) Tendon-Specialized connective tissue
(2) Adipose tissue-Dense connective tissue
(3) Areolar tissue- Loose connective tissue
(4) Cartilage-Loose connective tissue

Solution:
The cells and fibers of loose connective tissues are loosely arranged in a ground substance which is semi-fluid. The types of loose connective tissues are areolar connective tissue, adipose tissue and reticular connective tissue.
Dense connective tissues contain more fibres and fibroblasts, which are thicker and more densely packed. There are two types: dense regular connective tissue (white fibrous and yellow elastic connective tissues) and dense irregular connective tissue. The three specialized connective tissues are cartilage, bone and blood.
Hence, the correct option is (3).

141. Choose the correctly matched pair:
(1) Inner lining of salivary ducts- Ciliated epithelium
(2) Moist surface of buccal cavity- Glandular epithelium
(3) Tubular parts of nephrons- Cuboidal epithelium
(4) Inner surface of bronchioles- Squamous epithelium

Solution:
Tubular parts of nephrons in kidneys and inner lining of smaller ducts of many glands like salivary are lined by simple cuboidal epithelium. Buccal cavity is lined by stratified squamous epithelium. Bronchioles (small tubes) of respiratory tract are lined by simple ciliated epithelium.

Hence, the correct option is (3).

142. In 'S' phase of the cell cycle:
(1) amount of DNA doubles in each cell. (2) amount of DNA remains same in each cell.
(3) chromosome number is increased (4) amount of DNA is reduced to half in each cell

Solution:
During the S stage of interphase, the DNA of the cell is replicated in the nucleus in preparation for cell division and its amount doubles. The chromosome number, however, remains the same. The cell synthesizes the additional histones that will be needed as the cell doubles the number of nucleosomes (repeating subunits of DNA and histones) in its chromosomes. The centriole present in the cytoplasm also duplicates.
Hence, the correct option is (1).

143. The motile bacteria are able to move by:
(1) fimbriae (2) flagella
(3) cilia (4) pili

Solution:
One of the appendages used by bacteria for movement is the flagella (singular: flagellum, means whip in Latin). These are long, thin, helical appendages, which could be single or multiple in number. Hence, bacteria are motile or non-motile depending upon the presence or absence of flagella.
Hence, the correct option is (2).

144. Select the option which is not correct with respect to enzyme action:
(1) Substrate binds with enzyme at its active site.
(2) Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate
(3) A non- competitive inhibitor binds the enzyme at a site distinct from that which binds the substrate
(4) Malonate is a competitive inhibitor of succinic dehydrogenase

Solution:
Enzymes are highly specific. Each particular enzyme binds only to specific substrates at its active site.
Non-competitive inhibitors do not compete with the substrate for the same binding site of the enzyme; rather, the inhibitor binds to a site other than the enzyme's active site.
Malonate is a competitive inhibitor of succinate dehydrogenase, an enzyme that converts succinate to fumarate. Malonate structurally resembles succinate but cannot be dehydrogenated. Such inhibition is overcome by addition of lot of succinate.
Hence, the correct option is (2).

145. Which one of the following is a non-reducing carbohydrate?
(1) Maltose (2) Sucrose
(3) Lactose (4) Ribose 5-phosphate

Solution:
Sucrose is commonly known as table sugar. It is a non-reducing sugar made up of glucose and fructose. The formula for sucrose is $C_{12}H_{22}O_{11}$, not $C_{12}H_{24}O_{12}$, because a molecule of water is removed as the two monosaccharides are joined. It is found in free-state in many fruits.
Hence, the correct option is (2).

146. The enzyme recombinase is required at which stage of meiosis:
(1) Pachytene (2) Zygotene
(3) Diplotene (4) Diakinesis

Solution:

With the end of synapsis, the zygotene phase ends and the next stage of prophase I, called pachytene begins. This stage is characterized by a fully formed synaptonemal complex. During pachytene, the homologues are held closely together along their length by the SC. The DNA of sister chromatids is extended into parallel loops. Under the electron microscope, within the center of the SC, a number of electron-dense bodies about 100 nm in diameter are seen. These structures are called recombination nodules because they correspond to the sites where crossing over is taking place between non-sister chromatids of the homologous chromosomes. Recombination nodules contain the enzyme recombinase that facilitates genetic recombination.
Hence, the correct option is (1).

147. The initial step in the digestion of milk in human is carried out by?
(1) Lipase (2) Trypsin
(3) Rennin (4) Pepsin

Solution:
In stomach, prorennin gets activated to rennin in the presence of HCl and hydrolyses the soluble milk protein calcium casein as insoluble milk protein calcium paracasienate, forming soluble curd or coagulated milk. This is the first step in the digestion of milk.
Hence, the correct option is (3).

148. Fructose is absorbed into the blood through mucosa cells of intestine by the process called:
(1) active transport (2) facilitated transport
(3) simple diffusion (4) co-transport mechanism

Solution:
Monosaccharides pass from the lumen through the apical membrane via facilitated transport which occurs against the concentration gradient. Fructose, a monosaccharide found in fruits, is transported via facilitated transport. Its transport involves a carrier protein and carries fructose without utilization of ATP.
Hence, the correct option is (2).

149. Approximately seventy percent of carbon-dioxide absorbed by the blood will be transported to the lungs:
(1) as bicarbonate ions (2) in the form of dissolved gas molecules
(3) by binding to R.B.C. (4) as carbamino-haemoglobin
Solution:
The greatest percentage of CO_2—about 70 per cent—is transported in blood plasma as bicarbonate ions (HCO_3^-). As CO_2 diffuses into systemic capillaries and enters red blood cells, it reacts with water in the presence of the enzyme carbonic anhydrase (CA) to form carbonic acid, which dissociates into H^+ and HCO_3^-.
Hence, the correct option is (1).

150. Person with blood group AB is considered as universal recipient because he has:
(1) both A and B antigens on RBC but no antibodies in the plasma.
(2) both A and B antibodies in the plasma.
(3) no antigen on RBC and no antibody in the plasma
(4) both A and B antigens in the plasma but no antibodies

Solution:
People with type AB blood do not have anti-A or anti-B antibodies in their blood plasma and have no antigen on the red blood cells. Thus, they are sometimes called as universal recipients because theoretically they can receive blood from donors of all four blood types A, B, O or AB. People with blood group O are considered universal donors.
Hence, the correct option is (3).

151. How do parasympathetic neural signals affect the working of the heart?
(1) Reduce both heart rate and cardiac output
(2) Heart rate is increased without affecting the cardiac output.

(3) Both heart rate and cardiac output increase
(4) Heart rate decreases but cardiac output increases.

Solution:
Neural system regulation of the heart rate originates in the cardiovascular center in the medulla oblongata. This region of the brain stem receives input from a variety of sensory receptors and from higher brain centers, such as the limbic system and cerebral cortex. The cardiovascular center then directs appropriate output by increasing or decreasing the frequency of nerve impulses in both the sympathetic and parasympathetic branches of the autonomic neural system Parasympathetic nerve impulses reach the heart via the right and left vagus nerves. They release acetylcholine, which decreases heart rate by slowing the rate of spontaneous depolarization in autorhythmic fibers.
Hence, the correct option is (1).

152. Which of the following causes an increase in sodium reabsorption in distal convoluted tubule?
(1) Increase in aldosterone levels
(2) Decrease in antidiuretic hormone levels
(3) Decrease in aldosterone levels
(4) Decrease in antidiuretic hormone levels

Solution:
When glomerular blood flow, glomerular blood pressure or GFR decrease, the walls of the afferent arterioles are stretched less and the juxta glomerular (JG) cells secrete the enzyme renin. Renin converts angiotensinogen to angiotensin I; angiotensin-converting enzyme (ACE) further converts angiotensin I to angiotensin II. It stimulates the adrenal cortex to release aldosterone. It in turn stimulates the principal cells in the collecting ducts to reabsorb more Na^+ and Cl^- and secrete more K^+. The osmotic consequence of reabsorbing more Na^+ and Cl^- is that more water is reabsorbed, which causes an increase in blood volume, blood pressure and GFR. This mechanism is called renin– angiotensin mechanism.
Hence, the correct option is (1).

153. Select the correct matching of the types of the joint with the example in human skeletal system:

	Types of joints	**Examples**
(1)	Cartilaginous joint	between frontal and parietal
(2)	Pivot joint	between third and fourth cervical vertebrae
(3)	Hinge joint	between humerus and pectoral girdle
(4)	Gliding joint	between carpals

Solution:
The articulating surfaces of bones in a gliding joint are flat or slightly curved. They primarily permit back-and-forth and side-to-side movements between the flat surfaces of bones, but they may also rotate against one another. For example, the inter-carpal joints, inter-tarsal joints, sterno-clavicular joints and acromio-clavicular joints.
A cartilaginous joint lacks a synovial cavity and allows little or no movement, for example, the epiphyseal plate and the pubic symphysis.
In a pivot joint, the rounded or pointed surface of one bone articulates with a ring formed partly by another bone and partly by a ligament, for example, the atlanto-axial joint and the radio-ulnar joint.
In a hinge joint, the convex surface of one bone fits into the concave surface of another bone, for example, knee, elbow, ankle and interphalangeal joints.
Hence, the correct option is (4).

154. Stimulation of a muscle fiber by a motor neuron occurs at:
(1) the neuromuscular junction
(2) the transverse tubules
(3) the myofibril
(4) the sacroplasmic reticulum

Solution:
The site of communication between two neurons or between a neuron and an effector cell is called a synapse. The tips of some axon terminals swell into bulb-shaped structures called synaptic end bulbs or synaptic knobs. The synaptic end bulbs contain many tiny membrane-enclosed sacs called synaptic vesicles that store a chemical

called a neurotransmitter. The nerve impulses are transmitted away from the cell body to a synapse or a neuromuscular junction by the axon. The region of the sarcolemma opposite the synaptic end bulbs, called the motor end plate containing millions of acetylcholine (a neurotransmitter) receptors.
Hence, the correct option is (1).

155. Injury localized to the hypothalamus would most likely disrupt:
(1) short- term memory (2) coordination during locomotion
(3) executive functions, such as decision making. (4) regulation of body temperature

Solution:
Hypothalamus regulates autonomic nervous system, production of hormones, emotional and behavioral patterns, drinking and eating of food, body temperature and circadian rhythms and states of consciousness.
Short term memory and decision making is regulated by cerebrum. Cerebellum regulates posture and balances the body during locomotion.
Hence, the correct option is (4).

156. Which one of the following statements is not correct?
(1) Retinal is the light absorbing portion of visual photo pigments.
(2) In retina the rods have the photopigments rhodopsin while cones have three different photopigments.
(3) Retinal is a derivative of Vitamin C.
(4) Rhodopsin is the purplish red protein present in rods only.

Solution:
Retinal is a derivative of vitamin A called retinal. Vitamin A derivatives are formed from carotene, the plant pigment that gives carrots their orange color. Good vision depends on adequate dietary intake of carotene-rich vegetables such as carrots, spinach, broccoli or foods that contain vitamin A, such as liver.
Hence, the correct option is (3).

157. Identify the hormone with its correct matching of source and function:
(1) Oxytocin- posterior pituitary, growth and maintenance of mammary glands.
(2) Melatonin- pineal gland, regulates the normal rhythm of sleepwake cycle.
(3) Progesterone- corpus-luteum, stimulation of growth and activities offemale secondary sex organs.
(4) atrial natriuretic factor- ventricular wall increases the blood pressure

Solution:
The pineal gland secretes melatonin, an amine hormone derived from tryptophan. Melatonin appears to contribute to the setting of the body's biological clock, which is controlled by the suprachiasmatic nucleus of the hypothalamus. It also helps maintain body temperature and sleep–wake cycle.
Oxytocin is released by posterior pituitary gland. After delivery, it stimulates milk ejection from the mammary glands in response to the mechanical stimulus.
Progesterone, secreted mainly by cells of the corpus luteum, cooperates with estrogens to prepare and maintain the endometrium for implantation of a fertilized ovum and to prepare the mammary glands for milk secretion by stimulating the formation of alveoli.
Atrial natriuretic factor (ANF) is a peptide hormone released by cells of the atria and heart on receiving signals as a result of high blood pressure.
Hence, the correct option is (2).

158. Fight- or- flight reaction cause activation of:
(1) the parathyroid glands, leading to increased metabolic rate.
(2) the kidney, leading to suppression of renin angiotensin-aldosterone pathway.
(3) the adrenal medulla, leading to increased secretion of epinephrine and norepinephrene
(4) the pancreas leading to a reduction in the blood sugar levels.

Solution:

Sympatheticoadrenal system is formed by the sympathetic neural system and adrenal medulla which work together as an integrated system, in close association with each other to provide more energy for the body during times of stress. The sympathetic nerves stimulate the adrenal medulla to secrete hormones. Adrenal medulla releases emergency hormones or "Flight or Fight hormones" (catecholamines) in response to stress. Catecholamines [e.g. epinephrine (adrenalin) and norepinephrine (noradrenalin)] so released, function to enhance heart beat and rate of respiration rate, glycogen breakdown to release more glucose and thus, energy.
Hence, the correct option is (3).

159. The shared terminal duct of the reproductive and urinary system in the human male is:
(1) Urethra (2) Ureter
(3) Vas deferens (4) Vasa efferentia

Solution:
In males, the urethra is the shared terminal duct of the reproductive and excretory systems. The ejaculatory duct opens into the urethra, it serves as a passageway for both semen and urine.
Hence, the correct option is (1).

160. The main function of mammalian corpus luteum is to produce:
(1) estrogen only (2) progesterone
(3) human chorionic gonadotropin (4) relaxin only

Solution:
A corpus luteum (yellow body) contains the remnants of a mature follicle after ovulation (i.e., luteum cells, fibrin and blood clot). The corpus luteum produces progesterone, estrogens, relaxin and inhibin until it degenerates into fibrous scar tissue called the corpus albicans (white body).
Hence, the correct option is (2).

161. Select the correct option describing gonadotropin activity in a normal pregnant female:
(1) High level of FSH and LH stimulates the thickening of endometrium
(2) High level of FSH and LH facilitate implantation of the embryo.
(3) high level of hCG stimulates the synthesize of estrogen and progesterone
(4) High level of hCG stimulates the thickening of endometrium

Solution:
The chorion secretes human chorionic gonadotropin (hCG) into the blood. In turn, hCG stimulates the corpus luteum to continue production of progesterone and estrogens—an activity required to prevent menstruation and for the continued attachment of the embryo and foetus to the lining of the uterus. By the eighth day after fertilization, hCG can be detected in the blood and urine of a pregnant woman. Peak secretion of hCG occurs at about the ninth week of pregnancy.
Hence, the correct option is (3).

162. Tubectomy is method of sterilization in which:
(1) small part of the fallopian tube is removed or tied up.
(2) ovaries are removed surgically
(3) small part of vas deferens is removed or tied up.
(4) uterus is removed surgically

Solution:
Sterilization in females most often is achieved by performing a tubal ligation, in which both fallopian tubes are tied closed and then cut. This process is called tubectomy. This can be achieved in a few different ways. "Clips" or "clamps" can be placed on the fallopian tubes, the tubes can be tied and/or cut, and sometimes they are cauterized (sealed by burning or freezing).
Hence, the correct option is (1).

163. Which of the following is a hormone releasing intra Uterine Device (IUD)?
(1) Multiload 375 (2) LNG- 20
(3) Cervical cap (4) Vault

Solution:
Intra uterine device (IUD) are small objects made of plastic, copper, or stainless steel inserted into the cavity of the uterus through vagina to prevent sperm from entering the fallopian tubes and enhance phagocytosis of the sperms. The IUDs can be non-medicated such as Lippes loop, copper-releasing such as CuT, Cu7, Multiload 375 and hormone releasing such as Progestasert, LNG-20, etc.
Hence, the correct option is (2).

164. Assisted reproductive technology, IVF involves transfer of:
(1) Ovum into the fallopian tube.
(2) Zygote into the fallopian tube.
(3) Zygote into the uterus
(4) Embryo with 16 blastomeres into the fallopian tube

Solution:
In vitro fertilization (IVF) means fertilization outside of the body of woman in which similar conditions as that of the body are provided. This technique is also known as test tube baby programme. It is followed by embryo transfer (ET) in the fallopian tube. It is the most common form of assisted reproductive technology.
Hence, the correct option is (2).

165. A man whose father was colour blind marries a woman who had a colour blind mother and normal father. What percentage of male children of this couple will be colour blind?
(1) 25% (2) 0%
(3) 50% (4) 75%

Solution:
The man's father was colourblind, and he has got normal vision as he has got y chromosome from his father and X from his mother. His wife's mother was colourblind and father was normal. She must be carrier of the trait. Their cross will produce:

X^cX — Female (Normal & Carrier)

XY — Male (Normal eyed)

♀ \ ♂	X	Y
X^c	X^cX	X^cY
X	X^cX	XY

Thus, 50% of their male children will be colorblind of this couple.
Hence, the correct option is (3).

166. 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:
(1) 0.4 (2) 0.5
(3) 0.6 (4) 0.7

Solution:
In a population of 1000:
AA: 260

Aa: 480
Aa: 160

$$\text{Frequency of allele } a = \frac{480+160}{1000} = \frac{640}{1000}$$
$$= 0.64$$

Hence, the correct option is (3).

167. A human female with Turner's syndrome:
(1) has 45 chromosomes with XO
(2) has one additional X chromosome.
(3) exhibits male characters
(4) is able to produce children with normal husband

Solution:
Monosomy occurs when one chromosome is missing in an otherwise diploid individual. In human beings, there is only one viable monosomic, the 45, X karyotype. If an O gamete (no X) from the mother fuses with a Y gamete, the resulting OY zygote is nonviable and fails to develop further. If, on the other hand, an O gamete from either the mother or the father fuses with an X gamete to form an XO zygote, the resulting zygote has only one X chromosome and no second sex chromosome (denoted as XO) develops into a female with Turner syndrome.
Hence, the correct option is (1).

168. Select the correct option:

	Direction of RNA synthesis	Direction of reading of the template DNA strand
(1)	5'-3'	3'-5'
(2)	3'-5'	5'-3'
(3)	5'-3'	5'-3'
(4)	3'-5'	3'-5'

Solution:
The process by which RNA is synthesized from its DNA template is known as transcription. The template DNA strand has polarity $3' \rightarrow 5'$. It serves as a template for the synthesis of RNA. RNA polymerase synthesizes RNA only in $5' \rightarrow 3'$ direction.
Hence, the correct option is (1).

169. Commonly used vectors for human genome sequencing are:
(1) T- DNA (2) BAC and YAC
(3) Expression Vectors (4) T/A Cloning Vectors

Solution:
Bacterial Artificial Chromosomes (BAC) vectors are vectors which are based on fertility plasmid of bacteria. These are used for mapping of large eukaryotic genome. They can accommodate large DNA fragments of size 300–350 kb.
Yeast Artificial Chromosomes (YAC) vectors resembles a natural chromosome. They have telomere at each end, autonomously replicating sequence (origin of replication) and a centromere. These are used for the cloning of DNA fragments of size more than 106 bp in size.
Hence, the correct option is (2).

170. Forelimbs of cat, lizard used in walking; forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of:
(1) Analogous organs (2) Adaptive radiation
(3) Homologous organs (4) Convergent evolution

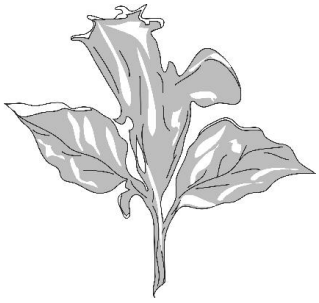
Solution:

Homologous structures are those which have the same basic structure and developmental origin, but different functions and appearance. The various classes of organisms, such as birds, mammals and amphibians, exhibit similar basic anatomical plan of bones (and also brain, heart, nerves, etc.) although these bones function differently among the classes. For example, the forelimbs of cat, lizard used in walking, forelimbs of whale used in swimming and forelimb of bats used in flying are made up of similar bones.
Hence, the correct option is (3).

171. Which one of the following are analogous structures?
(1) Wings of Bat and Wings of Pigeon
(2) Gills of Prawn and Lungs of Man
(3) Thorns of Bougainvillea and Tendrils of Cucurbita
(4) Flippers of Dolphin and legs of Horse

Solution:
If the structures in organisms are similar and carry out similar functions but do not have same embryological origin or similar anatomy, they are known as analogous structures. For example, the wings of bats and pigeon are analogous structures. Though they perform similar function, they have different structures.
Hence, the correct option is (1).

172. Which is the particular type of drug that is obtained from the plants whose one flowering branch is shown below?



(1) Hallucinogen
(2) Depressant
(3) Stimulant
(4) Pain- Killer

Solution:
The branch of the plant given above is of Datura. It is a source of psychoactive compound which causes hallocinations. It acts by altering the way users perceive time, movement, colors and sound. It also disrupts the thinking ability, leading to abnormal behavior.
Hence, the correct option is (1).

173. At which stage of HIV infection does one usually show symptoms of AIDS?
(1) Within 15 days of sexual contact with an infected person.
(2) When the infected retrovirus enters host cells.
(3) When HIV damages large number of helper T- Lymphocytes.
(4) When the viral DNA is produced by reverse transcriptase

Solution:
After a period of 2 to 10 years, HIV destroys enough helper T cells that most infected people begin to experience symptoms of immunodeficiency. AIDS related complex (ARC) refers to the initial form of AIDS. The infected people commonly have enlarged lymph nodes and experience persistent fatigue, involuntary weight loss, night sweats, skin rashes, diarrhoea and various lesions of the mouth and gums. Besides, the virus can also infect neurons in the brain, affecting the person's memory and vision.
Hence, the correct option is (3).

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

(1)Apical meristem only (2) Palisade parenchyma

(3) Both apical and axillary meristems (4) Epidermis only

Solution:

Meristems are regions of active cell division in plants. The meristems found at the shoot and root tips are called apical meristems while those that form in the axils of leaf primordia, giving rise to branches and flowers are called axillary meristems. They are selected by by using microscopy and cultured on a suitable medium to obtain diseases free plant.

Hence, the correct option is (3).

175. What gases are produced in anaerobic sludge digesters?

(1) Methane and CO_2

(2) Methane, Hydrogen Sulphide and CO_2

(3) Methane, Hydrogen Sulphide and CO_2

(4) Hydrogen Sulphide and CO

Solution:

The effluent from primary treatment is constantly agitated, aerated and added to solid material remaining from earlier water treatment. This is known as sludge. The sludge so formed is then pumped into sludge digesters where anaerobic bacteria partially digest the sludge to simple organic molecules and the gases carbon dioxide, hydrogen sulphide and methane. These gases produce biogas which can be used as a source of energy to run the sludge digester.

Hence, the correct option is (2).

176. 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:

(1) Western Ghat (2) Meghalaya

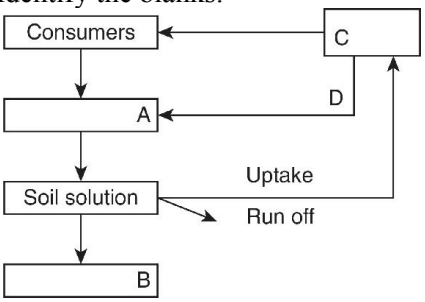
(3) Corbett National Park (4) Keoladeo National Park

Solution:

Organisms can move away temporarily from the stressful habitat to a favorable habitat and return with the onset of favorable conditions in their original habitat. The migration of animals to places of optimum temperature range to escape from the extremes of temperature is called thermal migration. Siberian birds migrate from Siberia during winter to Keoladeo National Park located in Bharatpur, Rajasthan, India. This is a mechanism of escape in space.

Hence, the correct option is (4).

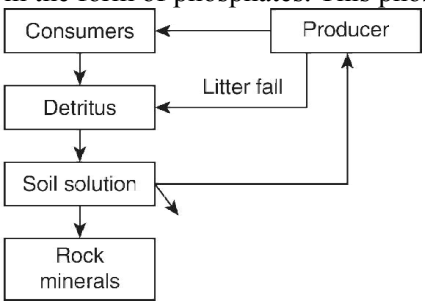
177. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D). Identify the blanks.



	A	B	C	D
(1)	Rock minerals	Detritus	Litter fall	Producers
(2)	Litter fall	Producers	Rock minerals	Detritus
(3)	Detritus	Rock minerals	Producers	Litter fall

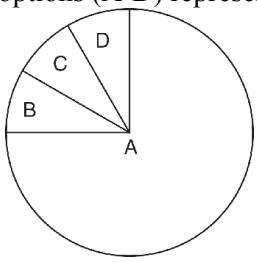
(4) Producers Litter fall Rock minerals Detritus

Solution:
Phosphorus cycle is also called imperfect cycle because phosphorus remains in the relatively inactive and immobile state in the Earth's crust and any disturbance can disturb it. Phosphorus that enters the nutrient cycles in ecosystems has to come from rocks. Plants absorb phosphorus from the soil in the form of hydrogenated phosphates. Herbivorous animals derive phosphorus from plants. Carnivores, however, obtain phosphorus from the animals that they feed on. Decomposers such as phosphate solubilizing bacteria return phosphorus to the soil in the form of phosphates. This phosphate is released from molecules such as DNA, RNA, ATP, etc.



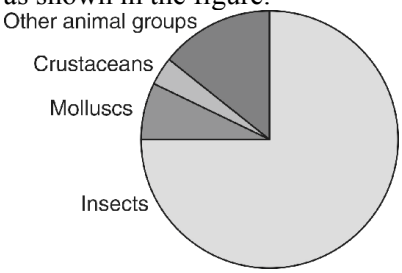
Hence, the correct option is (3).

178. Given below is the representation of the extent of global diversity of invertebrates. What groups the four options (A-D) represent respectively?



	A	B	C	D
(1)	Insects	Crustaceans	Other animals group	Molluscs
(2)	Crustaceans	Insects	Molluscs	Other animals group
(3)	Molluscs	Other animals group	Crustaceans	Litter fall
(4)	Insects	Molluscs	Crustaceans	Other animals group

Solution:
In invertebrates, 70% of the population is of insects, and the rest contains molluscs, crustaceans and other animals as shown in the figure.



Hence, the correct option is (4).

179. A scrubber in the exhaust of a chemical industrial plant removes:
(1) Gases like sulphur dioxide

(2) Particulate matter of the size 5 micrometer or above
(3) Gases like ozone and methane
(4) Particulate matter of the size 2.5 micrometer or less

Solution:
Scrubbers are air pollution control devices that use liquid to remove particulate matter or gases from an industrial exhaust or flue gas stream. Through scrubbers, the combustible gases like ammonia, sulphur dioxide and particulate matter released from high temperature exhaust fumes are trapped, cooled and release into the atmosphere.
Hence, the correct option is (1).

180. 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 $\rightarrow$ Mice $\rightarrow$ Snake $\rightarrow$ Peacock
(1) 0.02 J (2) 0.002 J
(3) 0.2 J (4) 0.0002 J

Solution:
The 10% law proposed by Lindeman in 1942 describes the flow of energy between different trophic levels. According to this law, 10% of the productivity of the gross productivity of the producers is used up by primary consumers (herbivores) for building up their biomass. Similarly, primary carnivores that feed on herbivores use only 10% of herbivore productivity to produce biomass; the remaining energy is consumed in ingestion, respiration, maintenance of body heat and related activities. Thus,
Hence, the correct option is (1).