Previous Year Question Paper

of

AIIMS

MBBS Entrance Examination

AIIMS: 2018

(Original Question Paper with Answer Key)

All India Institute of Medical Sciences, New Delhi

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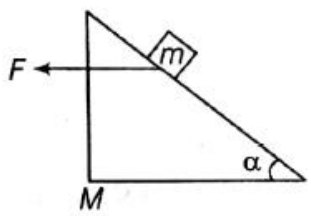
Physics

Single correct answer type:

1. A wooden wedge of mass M and inclination angle (α) rest on a smooth floor. A block of mass m is kept on wedge. A force F is applied on the wedge as shown in the figure such that block remains stationary with respect to wedge. So, magnitude of force F is



(A) $(M+m)g\tan\alpha$

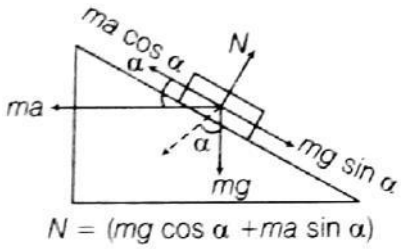
(B) $g\tan\alpha$

(C) $mg\cos\alpha$

(D) $(M+m)g\,\mathrm{cosec}\,\alpha$

Solution: (A)

Since, $F=(M+m)a$ ...(i)



So, apply pseudo force on the block by observing, it from the wedge.

Now, as in free body diagram of block, we get

$ma\cos\alpha = mg\sin\alpha$

$\Rightarrow a = g\frac{\sin\alpha}{\cos\alpha} \Rightarrow a = g\tan\alpha$ ...(ii)

Now, from equations (i) and (ii), we get

$F = (M + m)g\tan\alpha$

2. A piece of ice slides down a rough inclined plane at 45° inclination in twice the time that it takes to slide down an identical but frictionless inclined plane. What is the coefficient of friction between ice and incline?

(A) $\frac{3}{7\cot\theta}$

(B) $\frac{4}{7\cot\theta}$

(C) $\frac{3}{4\cot\theta}$

(D) $\frac{7}{9\cot\theta}$

Solution: (C)

Given, $\theta = 45^o, s_1 = s_2, u = 0$

On the rough incline, $a_1 = g(\sin\theta - \mu\cos\theta)$

$t_1 =$ time taken

On the frictionless incline, $a_2 = g\sin\theta$

$t_2 =$ time taken, $t_1 = 2t_2$

$$s = ut + \frac{1}{2}at^2$$

$$s_1 = 0 + \frac{1}{2}g(\sin\theta - \mu\cos\theta)t_1^2$$

$$s_2 = 0 + \frac{1}{2}g\sin\theta t_2^2$$

As $s_1 = s_2$,

$$\frac{1}{2}g(\sin\theta - \mu\cos\theta)t_1^2 = \frac{1}{2}g\sin\theta t_2^2$$

$$\frac{\sin\theta - \mu\cos\theta}{\sin\theta} = \frac{t_2^2}{t_1^2}$$

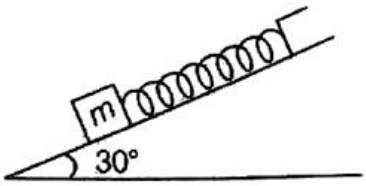
$$\Rightarrow 1 - \mu\cot\theta = \frac{t_2^2}{(2t_2)^2}$$

$$\Rightarrow 1 - \mu\cot\theta = \frac{1}{4}$$

$$\Rightarrow \mu\cot\theta = 1 - \frac{1}{4} = \frac{3}{4}$$

$$\therefore \mu = \frac{3}{4\cot\theta}$$

3. A body of mass 5 kg is suspended by a spring balance on an inclined plane as shown in figure.



So, force applied on spring balance is

(A) $50\ N$

(B) $25\ N$

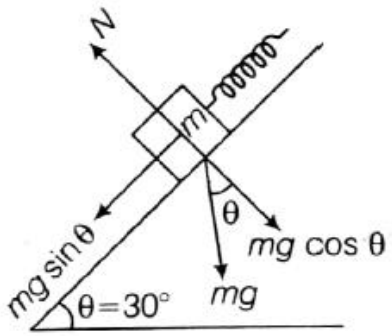
(C) $500\ N$

(D) $10\ N$

Solution: (B)

Acceleration of the body down the rough inclined plane $= g\sin\theta$

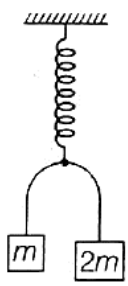
$\therefore$ Force applied on spring balance



$= mg \sin\theta = 5 \times 10 \times \sin 30^o$

$= 5 \times 10 \times \frac{1}{2} = 25\ N$

4. In the figure, blocks A and B of masses $2m$ and m are connected with a string and system is hanged vertically with the help of a spring. Spring has negligible mass. Find out magnitude of acceleration of masses $2m$ and m just after the instant when the string is cut



(A) g, g

(B) $g, \frac{g}{2}$

(C) $\frac{g}{2}, g$

(D) $\frac{g}{2}, \frac{g}{2}$

Solution: (C)

When the system is in equilibrium, then the spring force is $3\ mg$. When the string is cut, then net force on block A

$= 3\ mg - 2\ mg = mg$

Hence, acceleration of block A at that instant

$$a = \frac{\text{force on block } A}{\text{mass of block } A} = \frac{mg}{2\,m} = \frac{g}{2}$$

When string is cut, then block B falls freely with an acceleration equal to g.

5. If the formula, $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction. The dimensions of Y in $MKSQ$ system are

(A) $[M^{-3}L^{-2}T^4Q^4]$

(B) $[ML^2T^8Q^4]$

(C) $[M^{-2}L^{-3}T^2Q^4]$

(D) $[M^{-2}L^{-2}TQ^2]$

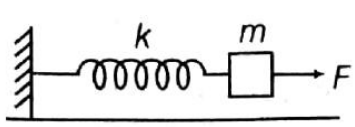
Solution: (A)

According to question, $[X] = [C] = [M^{-1}L^{-2}T^2Q^2]$ and $[Z] = [B] = [MT^{-1}Q^{-1}]$

$$\therefore [Y] = \frac{[X]}{[Z^2]}$$

$$[Y] = \frac{[M^{-1}L^{-2}T^2Q^2]}{[M^2T^{-2}Q^{-2}]} = [M^{-3}L^{-2}T^4Q^4]$$

6. The figure shows a mass m on a frictionless surface. It is connected to rigid wall by the mean of a massless spring of its constant k. Initially, the spring is at its natural position. If a force of constant magnitude starts acting on the block towards right, then the speed of the block when the deformation in spring is x, will be



(A) $\sqrt{\frac{2F_x - kx^2}{m}}$

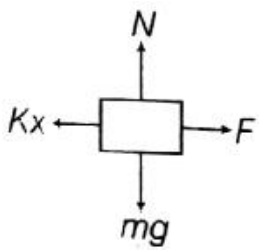
(B) $\sqrt{\frac{F_x - kx^2}{m}}$

(C) $\sqrt{\frac{x(F-k)}{m}}$

(D) $\sqrt{\frac{F_x - kx^2}{2m}}$

Solution: (A)

Free body diagram of block is shown below.



Now, from the energy conservation,

$w = \Delta K$

$w_F + w_{sp} \ = \frac{1}{2}mv^2 - 0$

$\Rightarrow F_x - \frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$\therefore v = \sqrt{\frac{2F_x - kx^2}{m}}$

7. Body of mass M is much heavier than the other body of mass m. The heavier body with speed v collides with the lighter body which was at rest initially elastically. The speed of lighter body after collision is

(A) $2v$

(B) $3v$

(C) v

(D) $\frac{v}{2}$

Solution: (A)

From conservation of momentum,

$Mv + m \times 0 = Mv_1 + mv_2$

$\Rightarrow M(v - v_1) = mv_2$ ...(i)

Again, from the conservation of kinetic energy (as collision is of elastic nature)

$$\frac{1}{2}Mv^2 + \frac{1}{2}m \times 0 = \frac{1}{2}Mv_1^2 + \frac{1}{2}mv_2^2$$

$\Rightarrow M(v^2 - v_1^2) = mv_2^2$ ...(ii)

On solving equations (i) and (ii), we get

$$\frac{M(v - v_1)}{M(v + v_1)(v - v_1)} = \frac{mv_2}{mv_2^2}$$

$v_2 = v + v_1$ ...(iii)

Now, solving equations (i) and (iii), we get

$v_1 = \frac{(M-m)v}{(M+m)}$ and $v_2 = \frac{2Mv}{(M+m)}$

As $M \gg m$

So, $v_1 = v \Rightarrow v_2 = v + v = 2v$

8. A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc

(A) Continuously decreases

(B) Continuously increases

(C) First increases and then decreases

(D) Remains unchanged

Solution: (C)

Moment of inertia of the insect disc system,

$$MI = \frac{1}{2}MR^2 + mx^2$$

where, m = mass of insect

and x = distance of insect from centre.

Clearly, as the insect moves along the diameter of the disc. Moment of inertia first decreases and then increases.

By conservation of angular momentum, angular speed first increases and then decreases.

9. Three bodies having masses $5\ kg, 4\ kg$ and $2\ kg$ is moving at the speed of $5\ m/s, 4\ m/s$ and $2\ m/s$ respectively along X-axis. The magnitude of velocity of centre of mass is

(A) $1.0\ m/s$

(B) $4\ m/s$

(C) $0.9\ m/s$

(D) $1.3\ m/s$

Solution: (B)

As, $v_{CM} = \frac{m_1v_1+m_2v_2+m_3v_3}{m_1+m_2+m_3}$

$$= \frac{5 \times 5 + 4 \times 4 + 2 \times 2}{5 + 4 + 2}$$

$$= \frac{25 + 16 + 4}{11}$$

$$\therefore v_{CM} = \frac{45}{11} - 4.09 \approx 4\ m/s$$

10. Two satellites A and B revolve round the same planet in coplanar circular orbits lying in the same plane. Their periods of revolutions are $1\ h$ and $8\ h$, respectively. The radius of the orbit of A is $10^4\ km$. The speed of B is relative to A. When they are closed in km/h is

(A) $3\pi \times 10^4$

(B) Zero

(C) $2\pi \times 10^4$

(D) $\pi \times 10^4$

Solution: (D)

From Kepler's law,

$$\frac{T_A^2}{T_B^2} = \frac{r_A^3}{r_B^3} \Longrightarrow \frac{1^2}{8^2} = \frac{(10^4)^3}{r_B^3}$$

$\Rightarrow r_B^3 = 64 \times (10^4)^3$

$\therefore r_B = 4 \times 10^4 km$

Speed of satellite $A, v_A = \frac{2\pi T_A}{T_A} = \frac{2\pi \times 10^4}{1}$

$= 2\pi \times 10^4 \ km/h$

Speed of satellite $B, v_B = \frac{2\pi r_B}{T_B}$

$$\frac{2\pi \times 4 \times 10^4}{8}$$

$= \pi \times 10^4 \ km/h$

The speed of B relative to A when they are closed.

$v_{BA} = v_A - v_B$

$= 2\pi \times 10^4 - \pi \times 10^4$

$= \pi \times 10^4 \ km/h$

11. A planet is revolving around the sun in a circular orbit with a radius r. The time period is T. If the force between the planet and star is proportional to $r^{-3/2}$, then the square of time period is proportional to

(A) $r^{3/2}$

(B) r^2

(C) r

(D) $r^{5/2}$

Solution: (D)

As, force $= \frac{GMm}{r^{3/2}} = m\omega^2 r$

$$= \frac{GMm}{r^{3/2}} = \frac{4\pi^2 mr}{T^2}\left[\because T = \frac{2\pi}{\omega}\right]$$

$$\Rightarrow T^2 = \left(\frac{\Delta\pi^2}{GM}\right).r^{5/2}$$

$$\Rightarrow T^2 \propto r^{5/2}$$

12. The weight of a body on the surface of the earth is $63\ N$. What is the gravitational force on it due to the earth at a height equal to half the radius of the earth?

(A) $35\ N$

(B) $28\ N$

(C) $18N$

(D) $40\ N$

Solution: (B)

Given, $h = \frac{R_e}{2}$

Acceleration due to gravity at altitude h is given by

$$g' = \frac{g}{\left(1 + \frac{h}{R_e}\right)^2} = \frac{g}{\left(1 + \frac{R_e/2}{R_e}\right)^2}$$

$$= \frac{g}{\left(1+\frac{1}{2}\right)^2} = \frac{g}{\left(\frac{3}{2}\right)^2} = \frac{4g}{9} \text{ ...(i)}$$

Weight of the body at the earth's surface,

$w = mg = 63\ N$ ...(ii)

Weight of the body at altitude, $h = \frac{R_e}{2}$

$w' = mg' = \frac{4}{9}mg$...(iii)

Using equation (ii), we get

$w' = \frac{4}{9} \times 63 = 28\ N$

13. A block of rectangular size of mass m and area of cross-section A, floats in a liquid of density ρ. If we give a small vertical displacement from equilibrium, it undergoes SHM with time period T, then

(A) $T^2 \propto \frac{1}{\rho}$

(B) $T^2 \propto \rho$

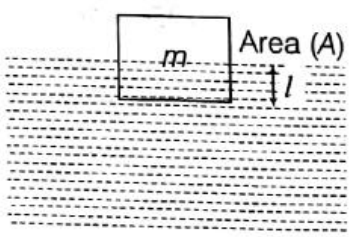
(C) $T^2 \propto m^{-1}$

(D) $T^2 \propto \frac{1}{A^{-2}}$

Solution: (A)

At equilibrium,

$Mg = Al\rho g \Longrightarrow m = A\rho l$



Where, $l =$ length of part immersed in liquid.

When it is given in downward displacement y, restoring force (upward direction) on block is

$F = -[A(l+y)\rho g - mg]$

$= -[A(l+y)\rho g - Al\rho g]$

$= -A\rho g y$

i.e. $F \propto -y$ or $a \propto -\gamma$, so it execute SHM (inertia factor). Mass of block $= m$

Spring factor $= A\rho g$

Time period $= 2\pi\sqrt{\frac{\text{Inertia factor}}{\text{Spring factor}}}$

$$T = 2\pi\sqrt{\frac{m}{A\rho g}}$$

$\Longrightarrow T^2 \propto \frac{m}{A\rho}$

14. A steel rod $100\ cm$ long is damped at into middle. The fundamental frequency of longitudinal vibrations of the rod are given to be $2.53\ kHz$. What is the speed of sound in sound is steel?

(A) $6.2\ km/s$

(B) $5.06\ km/s$

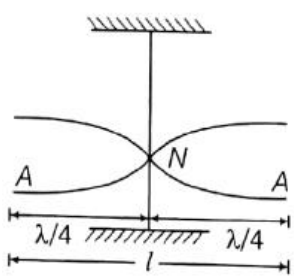
(C) $7.23\ km/s$

(D) $7.45\ km/s$

Solution: (B)

In fundamental mode, $l = 2\left(\frac{\lambda}{4}\right) = \frac{\lambda}{2}$

$\Longrightarrow \lambda = 2l$ ...(i)



Given, $l = 100\ cm, v = 2.53\ kHz = 2.53 \times 10^3 Hz$

We know that,

$v = v\lambda$

$= v \times 2l$ [from equation (i)]

$= 2.53 \times 10^3 \times 2 \times 100 \times 10^{-2}$

$= 5.06 \times 10^3\ m/s$

$= 5.06\ km/s$

15. A pipe of length $85\ cm$ is closed from one end. Find the number of possible natural oscillations of air column in the pipe whose frequencies lie below $1250\ Hz$. The velocity of sound in air is $340\ m/s$

(A) 12

(B) 8

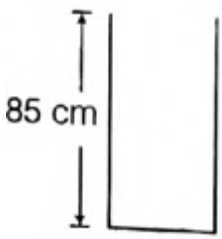
(C) 6

(D) 4

Solution: (C)

For closed organ pipe,

$f = \frac{(2n+1)v}{4l}$(where, $n = 0, 1, 1,....$)



According to question,

$$\frac{(2n+1)v}{4l} < 1250$$

$$2n + 1 < \frac{1250 \times 4l}{v}$$

$$2n + 1 < \frac{1250 \times 4 \times 0.85}{340}$$

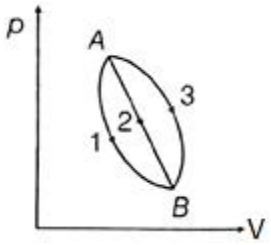
$\Rightarrow 2n < 11.5$

$n < 5.75$

So $n = 0, 1,2,3, \ldots 5.$

So, we have 6 possibilities.

16. An ideal gas of mass m in a state A goes to another state B via three different processes as shown in figure. If Q_1, Q_2 and Q_3 denote the heat absorbed by the gas along the three paths, then



(A) $Q_1 < Q_2 < Q_3$

(B) $Q_1 < Q_2 = Q_3$

(C) $Q_1 = Q_2 > Q_3$

(D) $Q_1 > Q_2 > Q_3$

Solution: (A)

Initial and final states are same in all the process.

Hence, $\Delta U = O$ is same for each case.

$\therefore \Delta Q = \Delta W$

Area enclosed by curve with volume.

$\because (\text{Area})_1 < (\text{Area})_2 < (\text{Area})_3$

$\therefore Q_1 < Q_2 < Q_3$

17. A metal wire has a resistance of 35 Ω. If its length is increased to double by drawing it, then its new resistance will be

(A) 70 Ω

(B) 140 Ω

(C) 105 Ω

(D) 35 Ω

Solution: (B)

Given, $R_1 = 35\Omega, l_2 = 2l_1$

On increasing the length,

$m_1 = m_2$

$\therefore \rho A_1 l_1 = \rho A_2 l_2$

$\pi r_1^2 l_1 = \pi r_2^2 l_2$

$\frac{r_1^2}{r_2^2} = \frac{l_2}{l_1}$

$\frac{r_1^2}{r_2^2} = \frac{2l_1}{l_1}$

$\frac{r_1^2}{r_2^2} = 2$ ...(i)

$\frac{R_1}{R_2} = \frac{\rho.\frac{l_1}{\pi r_1^2}}{\rho.\frac{l_2}{\pi r_2^2}}$

$= \frac{l_1}{l_2}.\frac{r_2^2}{r_1^2} = \frac{l_1}{2l_1}.\frac{1}{2}$

$\frac{R_1}{R_2} = \frac{1}{4}$

$R_2 = 4R_1 = 4 \times 35 = 140\Omega$

18. A half ring of radius R has a charge of λ per unit length. The electric force on 1 C charged placed at the centre is

(A) Zero

(B) $\frac{k\lambda}{R}$

(C) $\frac{2k\lambda}{R}$

(D) $\frac{k\pi\lambda}{R}$

Solution: (C)

As, R be the radius of the ring. Consider a small strip of length dl having charge dq lying at an angle θ.

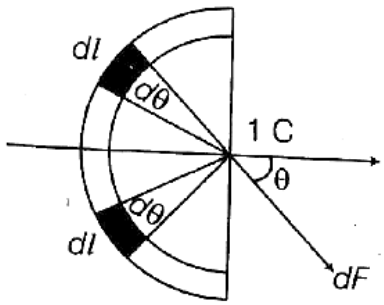
$dl = Rd\theta$

Charge on $dl = \lambda Rd\theta$

Force at 1 C due to dl

$= \frac{k\lambda R d\theta}{R^2} = \frac{k\lambda}{R} d\theta = dF$

We need to consider only the component $dF \cos\theta$, as the component $dF \sin\theta$ will cancel out because of the symmetrical element dl.



The total force on 1 C is

$$F = \int_{-\pi/2}^{\pi/2} dF \cos\theta$$

$$= \frac{k\lambda}{R} \int_{-\pi/2}^{\pi/2} \cos\theta \, d\theta$$

$$= \frac{k\lambda}{R} \times 2 = \frac{2k\lambda}{R}$$

19. Positive charge Q is distributed uniformly over a circular ring of radius R. A point particle having a mass (m) and a negative charge $-q$ is placed on its axis at a distance x from the centre. Assuming $x < R$, find the time period of oscillation of the particle, if it is released from there [neglect gravity].

(A) $\left[\frac{16\pi^3 \varepsilon_0 R^3 m}{Qq}\right]^{1/2}$

(B) $\left[\frac{8\pi^2 \varepsilon_0 R^3}{q}\right]^{1/2}$

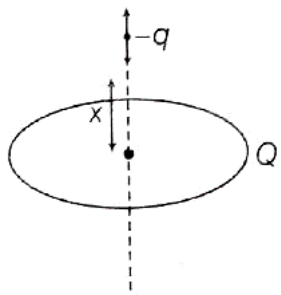
(C) $\left[\frac{2\pi^3 \varepsilon_0 R^3}{3q}\right]^{1/2}$

(D) None of these

Solution: (A)

When the negative charge is shifted at a distance x from the centre of the ring along its axis, then

force acting on the point charge due to the ring.



$F = qE$ (towards centre)

$$= q.\frac{kQx}{(R^2+x^2)^{3/2}}$$

If $R \gg x$, then $R^2 + x^2 \simeq R^2$

and $F = \frac{1}{4\pi\varepsilon_0}.\frac{Qqx}{R^3}$ (towards centre)

$$\Longrightarrow a = \frac{F}{m} = \frac{1}{4\pi\varepsilon_0}.\frac{Qqx}{mR^3}$$

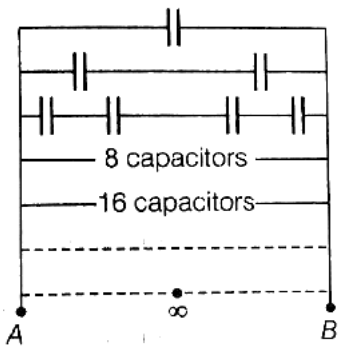
Since, restoring force $F_E \propto x$, therefore motion of charge particle will be SHM.

Time period of SHM,

$$T = \frac{2\pi}{\omega} = \left[\frac{16\pi^3\varepsilon_0 R^3 m}{Qq}\right]^{1/2} \left[\because \omega^2 = \frac{Qq}{4\pi\varepsilon_0 R^3}\right]$$

20. An infinite number of identical capacitors each of capacitance $1\ \mu F$ are connected as shown in the

figure. Then, the equivalent capacitance between A and B is



(A) $1\ \mu F$

(B) $2\ \mu F$

(C) $\frac{1}{2}\ \mu F$

(D) ∞

Solution: (B)

This combination forms a GP,

$$s = 1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots$$

Sun of infinite GP,

$$s = \frac{a}{1 - r}$$

$$s = \frac{1}{1 - \frac{1}{2}}$$

$$s = \frac{1}{\frac{1}{2}}$$

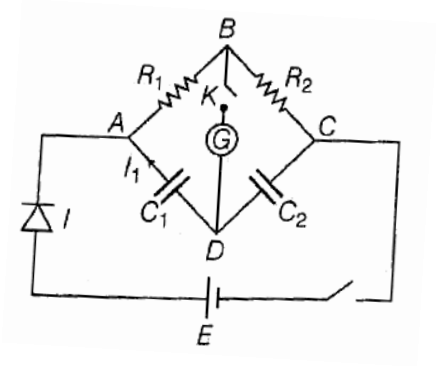
$$\therefore s = 2$$

Hence, capacitance of the combination

$$C_\infty = 2 \times 1\mu F = 2\mu F$$

21. In the circuit in the figure, if no current flows through the galvanometer when the key K is closed,

the bridge is balanced. The balancing condition for bridge is



(A) $\frac{C_1}{C_2} = \frac{R_1}{R_2}$

(B) $\frac{C_1}{C_2} = \frac{R_2}{R_1}$

(C) $\frac{C_1^2}{C_2^2} = \frac{R_1^2}{R_2^2}$

(D) $\frac{C_1^2}{C_2^2} = \frac{R_2}{R_1}$

Solution: (B)

In the steady state, no current is passing through capacitor. Let the charge on each capacitor be q. Since, the current through galvanometer is zero.

$\therefore I_1 = I_2$

The potential difference between ends of galvanometer will be zero.

$\therefore V_A - V_B = V_A - V_D$

$\therefore I_1 R_1 = \frac{q}{C_1}$ ...(i)

Similarly, $V_B - V_C = V_D - V_C$

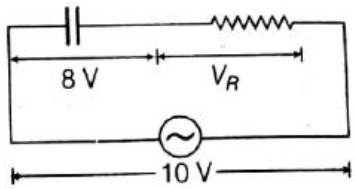
$I_2 R_2 = \frac{q}{C_2}$ ...(ii)

On dividing equation (i) by equation (ii), we get

$$\frac{I_1 R_1}{I_2 R_2} = \frac{q/C_1}{q/C_2} = \frac{C_2}{C_1}$$

$$\therefore \frac{C_1}{C_2} = \frac{R_2}{R_1}$$

22. In a series R-C circuit shown in figure, the applied voltage is $10\ V$ and the voltage across capacitor is found to be $8V$. Then, the voltage across R and the phase difference between current and the applied voltage will respectively be



(A) $6V, \tan^{-1}\left(\frac{4}{3}\right)$

(B) $3V, \tan^{-1}\left(\frac{3}{4}\right)$

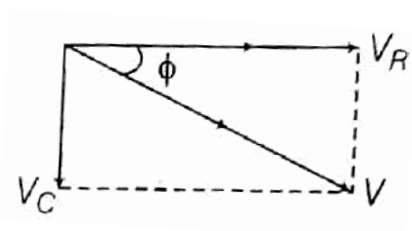
(C) $6V, \tan^{-1}\left(\frac{5}{3}\right)$

(D) None of these

Solution: (A)

We know that, for series R-C circuit

$V^2 = V_C^2 + V_R^2$



$100 = 64 + V_R^2$

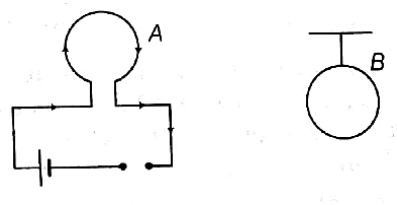
$\Rightarrow V_R^2 = 36 \Rightarrow V_R = \sqrt{36} = 6\ V$

Also, $\tan\phi = \frac{V_C}{V_R} \Rightarrow \tan\phi = \frac{8}{6}$

$\tan\phi = \frac{4}{3}$

$\therefore \phi = \tan^{-1}\left(\frac{4}{3}\right)$

23. A system S consists of two coils A and B. The coil A carries a steady current I. While the coil B is suspended nearby as shown in figure. Now, if the system is heated, so as to raise the temperature of two coils steadily, then



(A) The two coils shows attraction

(B) The two coils shows repulsion

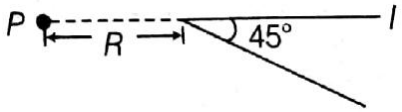
(C) There is no change in the position of the two coils

(D) Induced current are not possible in coil B

Solution: (A)

Coil A carries a steady current with Increase in temperature, its resistance increases and so current is decreasing at a constant rate, this induces an emf in B which opposes this change i.e., current in coil B is in same direction of A, therefore they attract to each other.

24. A long straight wire, carrying current I is bent at its mid-point to form an angle of 45°. Induction of magnetic field (in tesla) at point P, distant R from point of bending is equal to



(A) $\frac{(\sqrt{2}-1)\mu_0 I}{4\pi R}$

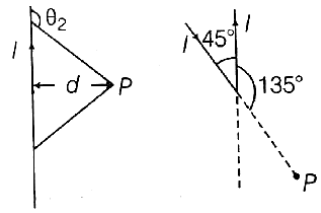
(B) $\frac{(\sqrt{2}+1)\mu_0 I}{4\pi R}$

(C) $\frac{(\sqrt{2}-1)\mu_0 I}{4\sqrt{2}\pi R}$

(D) $\frac{(\sqrt{2}+1)\mu_0 I}{4\sqrt{2}\pi R}$

Solution: (A)

$$\therefore B(\text{at } P) = \frac{\mu_0 I}{4\pi d}(\cos\theta_1 - \cos\theta_2)$$



In given case,

$$d = R\sin 45^o = \frac{R}{\sqrt{2}}$$

$$\theta_1 = 135^o, \theta_2 = 180^o$$

$$\therefore B(\text{at } P) = \frac{\mu_0 I}{4\pi\left(\frac{R}{\sqrt{2}}\right)}[\cos 135^o - \cos 180^o]$$

$$= \frac{\mu_0 I}{4\pi R}\sqrt{2}\left(\frac{-1}{\sqrt{2}} - (-1)\right)$$

$$= \frac{\mu_0 I}{4\pi R}\sqrt{2}\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)$$

or $B(\text{at } P) = \frac{\mu_0 I}{4\pi R}(\sqrt{2}-1)T$

25. An element $dl = dx\hat{\imath}$ (where, $dx = 1\ cm$) is placed at the origin and carries a large current $i = 10\ A$. What is the magnetic field on the Y-axis at a distance of $0.5\ m$?

(A) $2 \times 10^{-8}\hat{k}T$

(B) $4 \times 10^{-8}\hat{k}T$

(C) $-2 \times 10^{-8}\hat{k}T$

(D) $-4 \times 10^{-8}\hat{k}T$

Solution: (B)

Here, $dl = dx = 1\ cm = 10^{-2}m$,

$i = 10A, r = 0.5m$

$\therefore dB = \frac{\mu_0}{4\pi}.\frac{i(dl \times r)}{r^3}$

$= \frac{\mu_0}{4\pi}.\frac{idl}{r^2}(\hat{\imath} \times \hat{\jmath}) = \frac{\mu_0}{4\pi}.\frac{idl}{r^2}\hat{k}$

$= \frac{10^{-7} \times 10 \times 10^{-2} \sin 90^o}{(0.5)^2}\hat{k}$

$= 4 \times 10^{-8}\hat{k}T$

26. The horizontal component of the earth's magnetic field at any place is $0.36 \times 10^{-4}\, Wb/m^2$. If the angle of dip at that place is 60°, then the value of vertical component of the earth's magnetic field will be (in Wb/m^2)

(A) 0.12×10^{-4}

(B) 0.40×10^{-4}

(C) 0.24×10^{-4}

(D) 0.622×10^{-4}

Solution: (D)

Vertical component of earth's magnetic field,

$B_V = B_H \tan\delta$

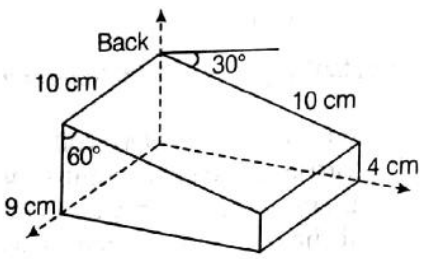
$= 0.36 \times 10^{-4} \times \tan 60^o$

$= 0.36 \times 10^{-4} \times \sqrt{3}$

$= 0.622 \times 10^{-4}T$

$= 0.622 \times 10^{-4}\, Wb/m^2$

27. Consider the following figure, a uniform magnetic field of $0.2\ T$ is directed along the positive X-axis. The magnetic flux through top surface of the figure.



(A) Zero

(B) $0.8\ m\text{-}Wb$

(C) $1.0\ m\text{-}Wb$

(D) $-1.8\ m\text{-}Wb$

Solution: (C)

$\therefore$ Magnetic flux, $\phi = BA\cos\theta$

For the top surface, the angle between normal to the surface and the X-axis is $\theta = 60^o$.

$\therefore \phi = 0.2 \times (10 \times 10 \times 10^{-4}) \times \cos 60^o$

$= 10^{-3} Wb = 1\ m\text{-}Wb$

28. An ideal coil of $10\ H$ is connected in series with a resistance of 5Ω and a battery of $5\ V$. After $2\ s$, after the connection is made, the current flowing (in ampere) in the circuit is.

(A) $(1 - e)$

(B) e

(C) e^{-1}

(D) $(1 - e^{-1})$

Solution: (D)

Rise of current in L-R circuit is given by

$I = I_0\left(1 - e^{-t/\tau}\right)$

where, $I_0 = \frac{E}{R} = \frac{5}{5} = 1A$

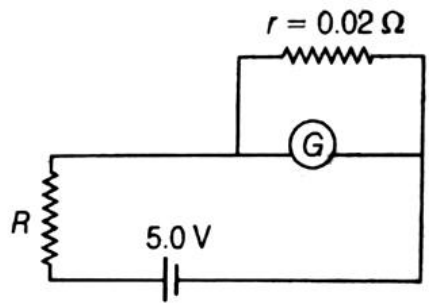
Now, $\tau = \frac{L}{R} = \frac{10}{5} = 2s$

After $2\ s$, i.e. at $t = 2\ s$

Rise of current, $I = (1 - e^{-1})A$

29. In the circuit, shown the galvanometer G of resistance 60Ω is shunted by a resistance $r = 0.02\ \Omega$.

The current through R (in ohm) is nearly $1\ A$. The value of resistance R (in ohm) is nearly



(A) 1.00Ω

(B) 5.00Ω

(C) 11.0Ω

(D) 6.0Ω

Solution: (B)

Here, resistance of the galvanometer

$R_G = 60\Omega$

When the galvanometer is shunted by a resistance r, its effective resistance

$$R_P = \frac{R_G r}{R_G + r} = \frac{60 \times 0.02}{60 + 0.02} \approx 0.02\Omega$$

Total resistance of the circuit $= R + R_P = R + 0.02$

Current, $I = \frac{5}{R+0.02} \Longrightarrow 1 = \frac{5}{R+0.02}$

$R + 0.02 = 5 \Rightarrow R = 5 - 0.02 = 4.98 \approx 5\Omega$

30. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is

(A) $\frac{1}{2\pi(2\pi fL+R)}$

(B) $\frac{1}{\pi f(2\pi fL+R)}$

(C) $\frac{1}{2\pi f(2\pi fL-R)}$

(D) $\frac{1}{\pi f(2\pi fL-R)}$

Solution: (C)

$$\therefore \tan\phi = \frac{\omega L - \frac{1}{\omega C}}{R}$$

ϕ being the and angle by which the current leads the voltage.

Given, $\phi = 45^o$

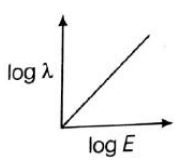
$$\therefore \tan 45^o = \frac{\omega L - \frac{1}{\omega C}}{R} \Longrightarrow 1 = \frac{\omega L - \frac{1}{\omega C}}{R}$$

$$R = \omega L - \frac{1}{\omega C} \Longrightarrow \omega C = \frac{1}{\omega L - R}$$

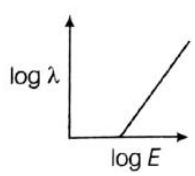
$$\Longrightarrow C = \frac{1}{\omega(\omega L - R)} = \frac{1}{2\pi f(2\pi fL - R)}$$

31. The graph between the energy $\log E$ of an electron and its de-Broglie wavelength $\log\lambda$ will be

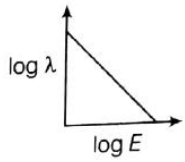
(A)



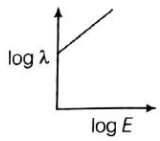
(B)



(C)



(D)



Solution: (C)

As we know that, wavelength of a particle

$$\lambda = \frac{h}{\sqrt{2mE}} = \frac{h}{\sqrt{2m}} \cdot \frac{1}{\sqrt{E}}$$

$$\Rightarrow \log \lambda = \log\left(\frac{h}{\sqrt{2m}} \cdot \frac{1}{E}\right)$$

$$\Rightarrow \log \lambda = \log \frac{h}{\sqrt{2m}} + \log \frac{1}{E^{1/2}}$$

$$\Rightarrow \log \lambda = \log\left(\frac{h}{\sqrt{2m}}\right) - \frac{1}{2} \log E$$

$$\Rightarrow \log \lambda = -\frac{1}{2} \log E + \log \frac{h}{\sqrt{2m}}$$

So, equation of straight line is $y = mx + c$.

This is equation of line with slope $-\frac{1}{2}$.

32. The half-life of a radioactive substance is $20\ min$. The approximate time interval $(t_2 - t_1)$ between the time t_2, when $\frac{2}{3}$ of it has decayed and time t_1, when $\frac{1}{3}$ of it had decayed is

(A) $14\ min$

(B) $20\ min$

(C) $28\ min$

(D) $7\ min$

Solution: (B)

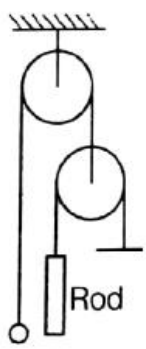
$\therefore N_1 = N_0 - \frac{1}{3}N_0 = \frac{2}{3}N_0$

and $N_2 = N_0 - \frac{2}{3}N_0 = \frac{1}{3}N_0$

$\therefore \frac{N_2}{N_1} = \left(\frac{1}{2}\right)^n \Rightarrow n = 1$

$\therefore t_2 = t_1 =$ one half-life $= 20\ min$

33. In the figure, mass of a ball is $\frac{9}{5}$ times mass of the rod. Length of rod is $1\ m$. The level of ball is same as rod level. Find out time taken by the ball to reach at upper end of rod.



(A) $1.4\ s$

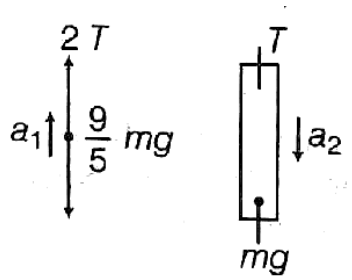
(B) $2.45\ s$

(C) $3.25\ s$

(D) $5\ s$

Solution: (A)

Let a_1 and a_2 be accelerations of a ball (upward) and rod (downward), respectively.



Clearly, from the diagram

$2a_1 - a_2$ ...(i)

Now, for the ball

$2T - \frac{9}{5}mg - \frac{9}{5}ma$ ...(ii)

and for the rod, $mg - T = ma_2$ ...(iii)

On solving equations (i) and (iii), we get

$a_1 = \frac{g}{29}\ m/s^2$ ↑(upward)

$a_2 = \frac{2g}{29}\ m/s^2$ ↓(upward)

So, acceleration of ball w.r.t rod $= a_1 + a_2 = \frac{3g}{29}$

Now, displacement of ball w.r.t. rod when it reaches the upper end of rod is $1m$.

Using equation of motion,

$$s = ut + \frac{1}{2}at^2$$

$$s = 0 + \frac{1}{2} \times \frac{3 \times 10}{29} t^2$$

$$t = \sqrt{\frac{58}{30}} = 1.4\ s\ (\text{approx})$$

34. The diode used at a constant potential drop of $0.5\ V$ at all currents and maximum power rating of $100\ mW$. What resistance must be connected in series diode, so that current in circuit is maximum?

(A) 200Ω

(B) 6.67Ω

(C) 5Ω

(D) 15Ω

Solution: (C)

Current passing in the circuit is

$$I = \frac{P}{V} = \frac{100 \times 10^{-3}}{0.5} 0.2\ A$$

Value of connected series resistance,

$$R = \frac{1.5 - 0.5}{0.2} \Rightarrow R = \frac{1}{0.2}$$

$\therefore R = 5\Omega$

35. An unpolarised beam of intensity $2a^2$ passes through a thin polaroid. Assuming zero absorption in the polaroid, the intensity of emergent plane polarised light is

(A) $2a^2$

(B) a^2

(C) $\sqrt{2}a^2$

(D) $\frac{a^2}{2}$

Solution: (B)

The intensity of plane polarized light $= 2a^2$.

$\therefore$ Intensity of polarized light from first nicol prism

$$= \frac{I_0}{2} = \frac{1}{2} \times 2a^2 = a^2$$

36. A gas consisting of a rigid diatomic molecules was initially under standard condition. Then, gas was compressed adiabatically to one-fifth of its initial volume. What will be the mean kinetic energy of a rotating molecule in the final state?

(A) $1.44\ J$

(B) $4.55\ J$

(C) $787.98 \times 10^{-23}\ J$

(D) $757.3 \times 10^{-23}\ J$

Solution: (C)

For diatomic gas, $\gamma = 1.4 = \frac{7}{5}$

For adiabatic process, $TV^{r-1} =$ constant

$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

$(300) V_1^{\frac{7}{5}-1} = T_2 \left(\frac{V_1}{5}\right)^{\frac{7}{5}-1}$

$\Rightarrow T_2 = \frac{300 \times V_1^{2/5}}{V_1^{\frac{2}{5}} \times \left(\frac{1}{5}\right)^{2/5}} = \frac{300}{5^{-\frac{2}{5}}} = 300 \times 5^{2/5}$

$= 300 \times 1.903 = 571$

Mean kinetic energy of rotating molecules

$= kT = 1.38 \times 10^{-23} \times 571 = 787.98 \times 10^{-23} J$

37. A diode detector is used to detect and amplitude modulated wave of 60% modulation by using a condenser of capacity $250\ pF$ in parallel with a load resistance $100\ k\Omega$. Find the maximum modulated frequency which could be detected by it,

(A) $10.62\ MHz$

(B) $10.61\ kHz$

(C) $5.31\ MHz$

(D) $5.31\ kHz$

Solution: (B)

$\therefore \tau = RC - 100 \times 10^3 \times 250 \times 10^{-12} s$

$= 2.5 \times 10^7 \times 10^{-12} s - 2.5 \times 10^{-5} s$

The higher frequency which can be detected with tolerable distortion is

$$f - \frac{1}{2\pi m_a RC} - \frac{1}{2\pi \times 0.6 \times 2.5 \times 10^{-5}} Hz$$

$$= \frac{100 \times 10^4}{25 \times 1.2\,\pi} Hz = \frac{4}{1.2\pi} \times 10^4 Hz$$

$$= 10.61\ kHz$$

This condition is obtained by applying the condition that rate of decay of capacitor voltage must be equal or less than the rate of decay modulated signal voltage for proper detection of modulated signal.

38. Red light of wavelength 5400 Å from a distant source falls on a slit $0.80\ mm$ wide. Calculate the distance between first two dark bands on each side of central bright band in the diffraction pattern observed on a screen place $1.4\ m$ from the slit.

(A) $1.89\ mm$

(B) $4\ mm$

(C) $1\ mm$

(D) $3\ mm$

Solution: (A)

Here wavelength $(\lambda) = 5400\text{Å} = 5.4 \times 10^{-7} m, a = 0.80\ mm = 8 \times 10^{-4} m, D = 1.4\ m$

∴ Distance between first two dark bands on each side of central maximum is the width of central maximum

$$= 2x = \frac{2\lambda D}{d}$$

$$= \frac{2 \times 5.4 \times 10^{-7} \times 1.4}{8 \times 10^{-4}}$$

$$= 1.89 \times 10^{-3} m = 1.89\ mm$$

39. A circular loop of radius $0.3\ cm$ lies parallel to a much bigger circular loop of radius $20\ cm$. The centre of the small loop on the axis of the bigger loop. The distance between their centres is $15\ cm$. If a current of $20\ A$ flows through the smaller loop, then the flux linked with bigger drop is

(A) $9.1 \times 10^{-11} Wb$

(B) $6 \times 10^{-11} Wb$

(C) $3.3 \times 10^{-11} Wb$

(D) $6.6 \times 10^{-9} Wb$

Solution: (A)

Magnetic flux linked with bigger circular loop is given by

$$\phi = \frac{\mu_0}{2} \cdot \frac{\pi I R_1^2 R_2^2}{(R_1^2 + x^2)^{3/2}}$$

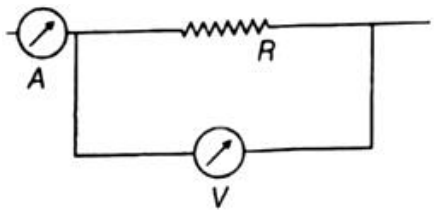
Putting the values,

$$\phi = \frac{4\pi \times 10^{-7} \times \pi \times 15 \times (0.3 \times 10^{-2})^2 \times (20 \times 10^{-2})^2}{[(0.3 \times 10^{-2})^2 + (15 \times 10^{-2})^2]^{3/2}}$$

By solving, we get

$$\phi = 9.116 \times 10^{-11} Wb$$

40. In the adjoining circuit diagram, the readings of ammeter and voltmeter are $2\ A$ and $120\ V$, respectively. If the value of R is 75Ω, then the voltmeter resistance will be



(A) 100Ω

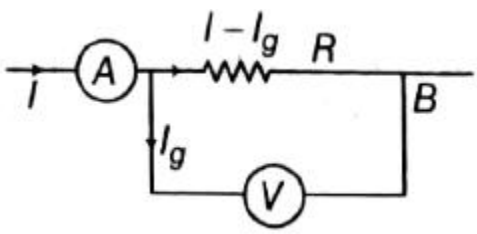
(B) 150Ω

(C) 300Ω

(D) 75Ω

Solution: (C)

$\because V_{AB} = (I - I_g)R = I_g.G$



Where, G =voltmeter (resistance)

Given, $V_{AB} = 120\ V, I = 2\ A, R = 75\Omega$

$\Rightarrow 120 = (2 - I_g)75 \Rightarrow I_g = 0.4\ A$

Now, $V_{AB} = I_g G \Rightarrow G = \frac{120}{0.4} = 300\Omega$

41. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion A body is momentarily at rest at the instant, if it reverse the direction.

Reason A body cannot have acceleration, if its velocity is zero at a given instant of time.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (C)

When a particle is released from rest position under gravity, then $v = 0$ but $a \neq 0$

42. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion The maximum height of projectile is always 25% of the maximum range.

Reason For maximum range, projectile should be projected at 90°

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (C)

To obtain maximum range, angle of projection must be 45°, i.e. $\theta = 45^o$.

$$\therefore H_{max} = \frac{u^2 \sin^2 45^o}{2g} = \frac{u^2}{2g}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{u^2}{4g} = \frac{R_{max}}{4}$$

So, H_{max} is 25% of R_{max}.

43. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Angle of repose is equal to angle of limiting friction.

Reason When a body is just at the point of motion, the force of friction of this stage is called as limiting friction.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

Angle or repose is equal to angle of limiting friction and maximum value of static friction is called the limiting friction.

44. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Two particles moving in the same direction do not lose all their energy in completely inelastic collision.

Reason Principle of conservation of momentum holds true for all kinds of collisions.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

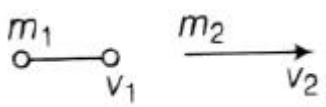
(D) Assertion is incorrect and Reason is correct

Solution: (A)

If it is completely inelastic collision, then

$m_1v_1 + m_2v_2 = m_1v + m_2v$

$$v = \frac{m_1v_1 + m_2v_2}{m_1 + m_2}$$



$$\therefore KE = \frac{p_1^2}{2m_1} + \frac{p_2^2}{2m_2}$$

As, p_1 and p_2 both simultaneously cannot be zero, therefore total KE cannot be lost.

45. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion The angular momentum of system always remain constant.

Reason For a system $\tau_{ext} = \frac{dL}{dt} = 0$

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

$$\tau_{ext} = \frac{dL}{dt} = 0$$

$\Rightarrow \frac{dL}{dt} = 0 \Rightarrow L =$ constant, i.e. $L_{\text{initial}} = L_{\text{final}}$

46. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion A pendulum is falling freely its time period becomes zero.

Reason Freely falling body has the acceleration equal to g.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

Time period of simple pendulum when it is falling under acceleration of 'a'.

$T = 2\pi\sqrt{\frac{l}{g-a}}$...(i)

In the case of freely falling, $a = g$

∴ From equation (i),

$$T = 2\pi\sqrt{\frac{l}{g-g}} \Rightarrow T = \infty$$

47. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Smaller drop of water resist deformation forces better than the larger drops.

Reason Excess pressure inside drop is inversely proportional to its radius.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

As excess pressure,

$$p = \frac{2s}{R} \Longrightarrow p \propto \frac{1}{R}$$

∴ Excess pressure inside smaller drop is large due to which smaller force resist deforming forces better.

48. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion In isothermal process, whole of the heat energy supplied to the body is converted into internal energy.

Reason According to the first law of thermodynamics,

$$\Delta Q = \Delta U + \Delta W$$

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

As there is no change in internal energy of the system during as isothermal change. Hence,

the energy taken by the gas is utilised by doing work against external pressure.

Hence, whole heat energy gapping to the body at isothermal process converted into work done.

Hence, Assertion is wrong.

49. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Internal energy of an ideal gas does not depend on volume of gas.

Reason Internal energy depends only on temperature of gas.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

Internal energy of gas depends only on temperature of gas.

50. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion To hear different beats difference of the frequencies of two sources should be less than 10.

Reason More the number of beats more in the confusion.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (C)

According to the property of persistence of hearing the impression of a sound heard perist on out mind for $\frac{1}{10}s$. To hear distinct beats, time interval between two successive beats should be greater than $\frac{1}{10}s$. Hence, difference in two frequencies must be less than 10.

51. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Mass of a body decreases slightly when it is negatively charged.

Reason Charging is due to transfer of electrons.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

Negatively charged body contains more electron than its natural state of mass is slightly increased.

52. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion A dielectric slab is inserted between plates of an isolated charged capacitor which remain same.

Reason Charge on an isolated system is conserved.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

Charge of plates remains same as there is no transfer of charge.

53. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Terminal voltage of a cell is greater than emf of cell during charging of the cell.

Reason The emf of a cell is always greater than its terminal voltage.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (C)

During charging, $E = V + ir$ (due to reversed current). In case of charging emf of a cell is less than its terminal voltage while in case of discharging emf is greater than terminal voltage

54. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion A magnetic field interacts with a moving charge and not with a stationary charge.

Reason A moving charge produce a magnetic field.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

A moving charge is equivalent to a current.

∴ It produce a field and can interacts with external magnetic field.

55. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Bulb generally get fused when they are switched on or off.

Reason When we switch on or off, a circuit current changes in it rapidly.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

Switching results in high decay/growth rate of current which results in a high. Current when

bulb is turned off (due to back emf). So, a bulb is must likely to get fused when it is just turned off

56. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion A convex mirror always make a virtual image.

Reason The ray always diverge after reflection from the convex mirror.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

Convex mirror always form virtual image becomes ray diverge after reflection.

57. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion If a glass slab is placed in front of one of the slits, then fringe with will decrease.

Reason Glass slab will produce an additional path difference.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

Fringe width does not change by the introduction of glass slab. Additional path is introduced due to insertion of glass slab.

58. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion If electrons in an atom were stationary, then they would fall into the nucleus.

Reason Electrostatic force of attraction acts between negatively charged electrons and positive nucleus.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (A)

In an atom electron revolves around nucleus, for this required centripetal force is provided by electrostatic force of attraction between electron and nucleus. As there is no other force, electrostatic force is unbalanced.

59. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Radioactive nuclei emits β^--particles.

Reason Electrons exist inside the nucleus.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (C)

For a β^--decay,

$${}^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}e$$

∴ Electrons do not exist inside the nucleus.

60. Direction This question contains two statements Assertion and Reason. This question has four alternative choices, only one of which is the correct answer.

Assertion Thickness of depletion layer is fixed in all semiconductor devices.

Reason No free charge carriers are available in depletion layer.

(A) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Assertion is correct and Reason is incorrect

(D) Assertion is incorrect and Reason is correct

Solution: (D)

Thickness of depletion layer depends upon the biasing of semiconductor devices and in the depletion layer, there is no free charge carries are available in depletion layer.

Chemistry

Single correct answer type:

1. In an adiabatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following

(A) $q = 0, \Delta T \neq 0, W = 0$

(B) $q \neq 0, \Delta T = 0, W = 0$

(C) $q = 0, \Delta T = 0, W = 0$

(D) $q = 0, \Delta T < 0, W \neq 0$

Solution: (C)

For free expansion, $W = 0$ and for adiabatic process, $q = O$.

$\because \Delta U = q + W = 0$, this means that internal energy remains constant. Therefore, $\Delta T = O$ in ideal gas as there is no intermolecular attraction. Hence, when such a gas expands under adiabatic conditions into a vacuum, no heat is absorbed or evolved. Since, no external work is done to separate the molecules.

2. Which of the following represents Wurtz-Fittig reaction?

(A) $C_6H_5l + 2Na + CH_3l \rightarrow C_6H_5CH_3 + 2Nal$

(B) $2C_6H_5l + 2Na \rightarrow C_6H_5C_6H_5 + 2Nal$

(C) $2CH_3CH_2l + 2Na \rightarrow CH_3CH_2CH_2CH_3 + 2Nal$

(D) $CH_3Br + AgF \rightarrow CH_3F + AgBr$

Solution: (A)

The Wurtz-Fittig reaction is the reaction of an aryl halide with alkyl halide and sodium metal to give substituted aromatic compound.

Thus, Wurtz Fittig reaction is

$C_6H_5I + 2Na + CH_3I \rightarrow C_6H_5CH_3 + 2NaI$

3. The work function of a metal is $4.2\ eV$. If radiation of 2000Å fall on the metal then the kinetic energy of the fastest photoelectron is

(A) $1.6 \times 10^{-19} J$

(B) $16 \times 10^{-10} J$

(C) $3.2 \times 10^{-19} J$

(D) $6.4 \times 10^{-10} J$

Solution: (C)

Given $E_o = 4.2\ eV$

$= 4.2 \times 1.60 \times 10^{-19} J$

$= 6.72 \times 10^{-19} J$

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

$\therefore E = \dfrac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{2000 \times 10^{-10}}$

$= 9.94 \times 10^{-19} J$

∴ Kinetic energy of electron emitted

$= (9.94 - 6.72) \times 10^{-19} J$

$= 3.22 \times 10^{-19} J$

4. The relative reactivities of acyl compounds towards nucleophilic substitution are in the order of

(A) acyl chloride > acid anhydride > ester > amide

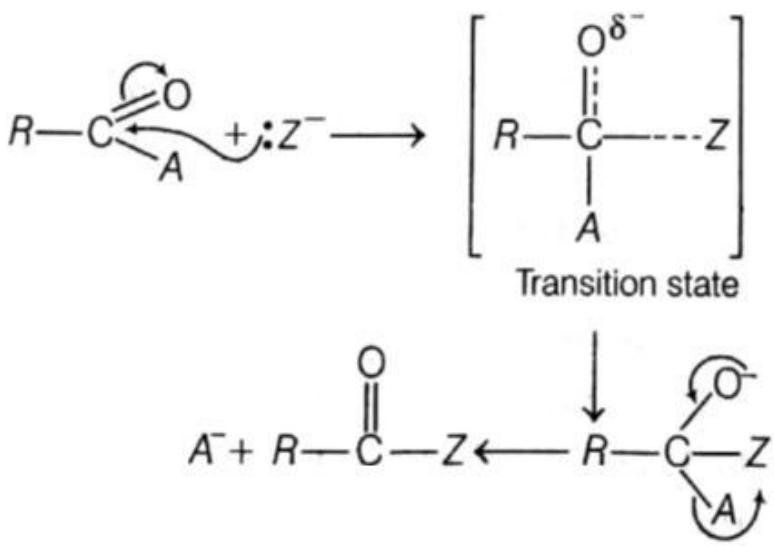
(B) ester > acyl chloride > amide > acid anhydride

(C) acid anhydride > amide > ester > acyl chloride

(D) acid chloride > ester > acid anhydride > amide

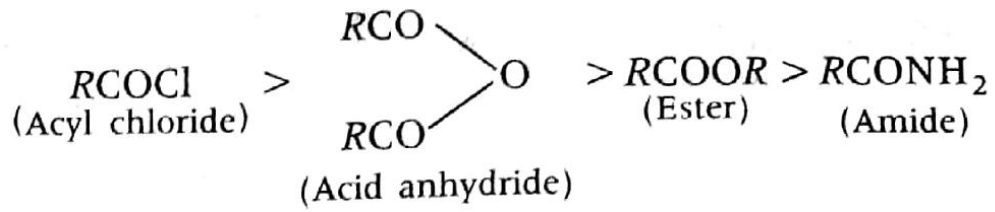
Solution: (A)

The ease of nucleophilic substitution depends upon the nature of leaving group. When the leaving tendency of a group in a compound is high, then the compound is more reactive towards nucleophilic substitution. The nucleophilic acyl substitution is completed in two steps as shown below.



The order of leaving tendency is

$Cl^- > RCOO^- > RO^- > NH_2^-$ and therefore, the order of reactivity of acyl compound is as



5. Food preservatives prevent spoilage of food due to microbial growth. The most commonly used preservatives are

(A) C_6H_5COONa

(B) Table salt, sugar

(C) Vegetable oils and sodium benzoate

(D) All of the above

Solution: (D)

The chemicals which are used to protect food from microbes action i.e. which arrest the process for fermentation, acidification and any other decomposition of food are known as food preservatives. Table salt, sugar, vegetable oil, vinegar, sodium benzoate (C_6H_5COONa), sodium metabisulphite ($Na_2S_2O_5$), vitamin E. Etc. are the common example of food preservatives.

6. Among the following statements, the correct statement about the half-life period for a first order reaction is

(A) Independent of concentration

(B) Proportional to concentration

(C) Inversely proportional to concentration

(D) Inversely proportional to the square of the concentration

Solution: (A)

For a first order reaction, the integrated rate law is written as,

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

Where, $k =$ Rate constant

$a =$initial concentration

$a - x =$concentration after time $'t'$

For half-life, $t = t_{1/2}, x = \frac{a}{2}$

On substituting the values, we get

$$k = \frac{2.303}{t_{1/2}} \log \frac{a}{a - \frac{a}{2}} = \frac{2.303}{t_{1/2}} \log 2$$

$$= \frac{0.693}{t_{1/2}}$$

$$k = \frac{0.693}{t_{1/2}}$$

Thus, $t_{1/2}$ of a first order reaction does not depend upon the concentration.

7. The electronic configuration of central metal atom/ion in $[Co(CN)_6]^{3-}$ is

(A) $t_{2g}^5 e_g^0$

(B) $t_{2g}^4 e_g^2$

(C) $t_{2g}^4 e_g^3$

(D) $t_{2g}^6 e_g^0$

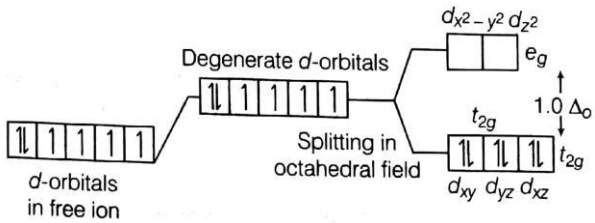
Solution: (D)

$[Co(CN)_6]^{3-}$ contains CO^{3+} as central metal ion.

The electronic configuration of Co^{3+} ion

$= [Ar]_{18} 3d^6$

The splitting in octahedral field is shown below



$Co^{3+} = 3d^6 (\text{or } t_{2g}^6 e_g)$

∴ There is no unpaired electron, so it is diamagnetic in nature.

8. A bromoalkane $'X'$ reacts with magnesium in dry ether to form compound $'Y'$. The reaction of $'Y'$ with methanol followed by hydrolysis yield an alcohol having molecular formula, $C_4H_{10}O$. The compound $'X'$ is

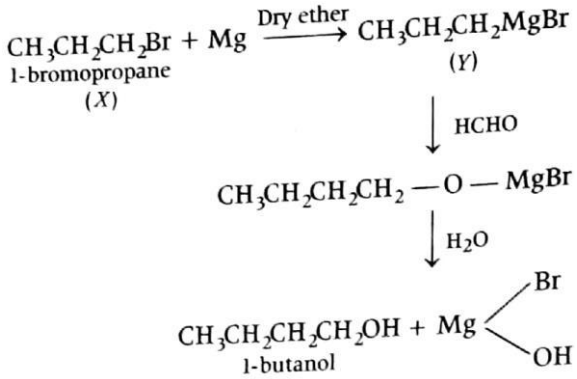
(A) Bromomethane

(B) Bromoethane

(C) 1-bromopropane

(D) 2-bromopropane

Solution: (C)



9. The spin only magnetic moment of $[MnBr_4]^{2-}$ is 5.9 BM. The geometry of this complex ion is

(A) Tetrahedral

(B) Octahedral

(C) Trigonal pyramidal

(D) Square planar

Solution: (A)

Since, the coordination number of Mn^{2+} ion in the complex ion is 4, it will have either tetrahedral (sp^3-hybridisation) or square planar (dsp^2-hybridisation) geometry. But the fact that the magnetic moment of the complex ion is $5.9BM$ suggests that it should have tetrahedral geometry rather than square planar because of the presence of five unpaired electrons in the d-orbitals.

The number of unpaired electrons can be determined as follows:

As we know that, magnetic moment $= \sqrt{n(n+2)}$

$5.9 = \sqrt{n(n+2)}$

On squaring both sides, the above equation becomes

$(5.9)^2 = n^2 + 2n$

$n^2 + 2n - 35 = 0$

On solving the above equation, we get $n = 5$

10. At equilibrium, the concentration of

$N_2 = 3.0 \times 10^{-3} M$

$O_2 = 4.2 \times 10^{-3} M$

and $NO = 2.8 \times 10^{-3} M$

in a sealed vessel at $800\ K$ and 1 atm pressure. What will be K_p for the given reaction?

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

(A) $0.328\ atm$

(B) $0.622\ atm$

(C) $0.483\ atm$

(D) $0.712\ atm$

Solution: (B)

Given, $N_2 = 3.0 \times 10^{-3} M$

$O_2 = 4.2 \times 10^{-3} M$

and $NO = 2.8 \times 10^{-3} M$

For the given reaction,

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

equilibrium constant K_C can be written as

$$K_C = \frac{[NO]^2}{[N_2][O_2]}$$

$$\therefore K_C = \frac{(2.8 \times 10^{-3} M)^2}{(3.0 \times 10^{-3} M)(4.2 \times 10^{-3} M)} = 0.622$$

$\because K_p = K_C.(RT)^{\Delta n}$

$\Delta n =$ Number of moles of gaseous products number of moles of gaseous reactants

$\Delta n = 2 - 2 = 0$

$\therefore K_p = K_C.(RT)^o$

$K_p = K_C$ or, $K_p = 0.622 atm$

11. Which of the following is an example of network solid?

(A) SO_2 (solid)

(B) l_2

(C) Diamond

(D) H_2O (ice)

Solution: (C)

Diamond is a giant molecule in which constituent atoms are held together by covalent bond. Hence, it is a network solid.

Note SO_2 (solid), H_2O (ice) and I_2 are the examples of molecular solid.

12. Affinity for hydrogen decreases in the group from fluorine to iodine. Which of the halogen acids should have highest bond dissociation enthalpy?

(A) HF

(B) HCl

(C) HBr

(D) HI

Solution: (A)

As the size of the halogen atom increases from F to I, $H-X$ bond length in halogen acids also increases from $H-F$ to HI.

$(HF < HCl < HBr < HI)$. The increase in HX bond length decreases the strength of HX bond from HF to HI $(HF > HCl > HBr > HI)$.

Due to successive decrease in the strength of HX bonds, bonds dissociation enthalpy decreases from HF to HI.

HX

Bond dissociation $\underset{574.0}{HF} > \underset{428.1}{HCl} > \underset{362.5}{HBr} > \underset{294}{HI}$

enthalpy (kJ/mol)

13. Which of the following compound has same oxidation state of the central metal atom in the cationic and anionic part?

(A) $[Pt(NH_3)_4]\ [PtCl_6]$

(B) $[Pt(NH_3)_4Cl_2]\ [PtCl_4]$

(C) $[Pt(Py)_4]\ [PtCl_4]$

(D) $K_4[Ni(CN)_6]$

Solution: (C)

$[Pt(Py_4)][PtCl_4]$

Let the oxidation state of Pt is x.

$x + 0 \times 4 + x + (-1) \times 4 = 0$

or, $2x = +4$ or, $x = +2$

Thus, it is the complex in which the central metal atom in cationic and anionic parts have same oxidation state.

74. The rate constant for the first order decomposition of a certain reaction is described by the equation

In $k(s^{-1}) = 14.34 - \frac{1.25\times10^4 K}{T}$. The energy of activation for this reaction is

(A) $1.26 \times 10^4 cal\ mol^{-1}$

(B) $4.29 \times 10^4 cal\ mol^{-1}$

(C) $3.12 \times 10^4 cal\ mol^{-1}$

(D) $2.50 \times 10^4 cal\ mol^{-1}$

Solution: (D)

Given that,

$\ln k(s^{-1}) = 14.34 - \frac{1.25\times10^4}{T} K$ ...(i)

We know that,

$\ln k(s^{-1}) = \ln A - \frac{E_a}{RT}$ ...(ii)

On comparing equation (i) and (ii), we get

$\frac{E_a}{R} = 1.25 \times 10^4 K$

$\therefore E_a = 1.25 \times 10^4 K \times R\ cal\ K^{-1} mol^{-1}$

$= 1.25 \times 10^4 K \times 2\ cal\ K^{-1} mol^{-1}$

$[\because R = 2\ cal\ K^{-1}\ mol^{-1}]$

$= 2.50 \times 10^4\ cal\ mol^{-1}$

15. In which of the following arrangements, the order is not strictly according to the property written against it?

(A) $CO_2 < SiO_2 < SnO_2 < PbO_2$ (oxidising power)

(B) $HF < HCl < HBr < Hl$ (acidic strength)

(C) $NH_3 > PH_3 < AsH_3 < SbH_3$ (basic strength)

(D) $B < C < O < N$ (first ionisation enthalpy)

Solution: (C)

The correct increasing order of basic strength

$NH_3 > PH_3 > ASH_3 > SbH_3$

NH_3 is the most basic because of its small size, the electron density of electron pair is concentrated over small region. As the size increases, the electron density gets diffused over a large surface area. Hence, the ability to donate the electron pair (basicity) decreases.

The other three statements given are correct.

16. For a Ag-Zn button cell, net reaction is $Zn(s) + Ag_2O(s)ZnO(s) + 2Ag(s)$

$\Delta G_f^o(Ag_2O) = -11.21\ kJmol^{-1}$

$\Delta G_f^o(ZnO) = -318.3\ kJ\ mol^{-1}$

Then, $E^o{}_{cell}$ of the button cell is

(A) $3.182\ v$

(B) $-1.621\ v$

(C) $1.591\ v$

(D) $-1.591\ V$

Solution: (C)

Given

$\Delta G_f^o(Ag_2O) = -11.21\ kJmol^{-1}$

$\Delta G_f^o(ZnO) = -318.3\ kJmol^{-1}$

As we know that,

$\Delta G^o = \Delta G_f^o(ZnO) - \Delta G_f^o(Ag_2O)$

Putting the values in the above given equation, we get

$\therefore \Delta G^o = (-318.30 + 11.21)kJ\ mol^{-1}$

$= -307.09\ kJ = -307.09 \times 10^3 J$

$\because \Delta G^o = -nFE_{cell}^o$

$\therefore -307.09 \times 10^3 = -2 \times 96500 \times E_{cell}^o$

or $E_{cell}^o = 1.591\ V$

17. Which of the following oxyacid does not contain $P — O — P$ bond?

(A) Isohypophosphoric acid

(B) Pyrophosphorus acid

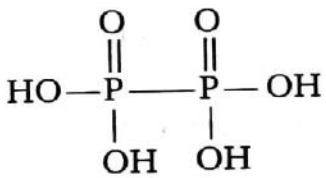
(C) Diphosphoric acid

(D) Hypophosphoric acid

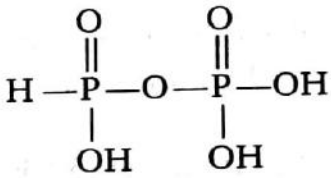
Solution: (D)

Hypophosphoric acid $(H_4P_2O_6)$ does not contain $P - O - P$ bond whereas, isohypophosphoric acid $(H_4P_2O_6)$, diphosphorus acid $(H_2P_2O_5)$ and diphosphoric acid $(H_4P_2O_7)$ all contain $P - O - P$ bonds.

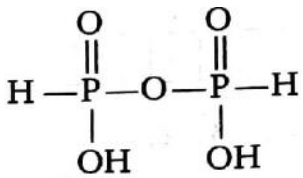
The structures of the following oxyacids of phosphorus is shown below:



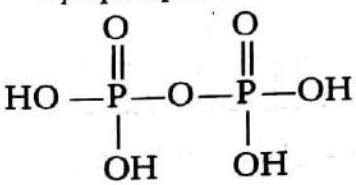
Hypophosphoric acid



Isohypophosphoric acid



Pyrophosphorus acid



Diphosphoric acid

78. Niobium crystallises in body centred cubic structure. If density is $8.55g\ cm^{-3}$, then the atomic radius of niobium is (atomic mass of niobium $=\ 93u$)

(A) $163\ pm$

(B) $143\ pm$

(C) $182\ \text{Å}$

(D) $152\ \text{Å}$

Solution: (B)

Given,

$\rho(\text{density}) = 8.55g\ cm^{-3}$

Atomic mass of niobium $= 93u$

As we know that,

Density $(\rho) = \frac{MZ}{a^3 N_A}$ ...(i)

Where, $M =$ atomic mass, $Z =$ number of unit cell

$a =$ edge length, $N_A =$ Avogadro's number

For $bcc, Z = 2$

Putting the value in equation (i), we get

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

or, $a^3 \times 3.61 \times 10^{-23} cm^3$

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

For body centred cube,

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

or, $r_{bcc} = \frac{\sqrt{3}}{4} \times 3.306 \times 10^{-8}$

or, $r_{bcc} = 1.43 \times 10^{-8} cm = 1.43 \times 10^{-10} m$

$= 143\ pm$

19. The $IUPAC$ name of the complex $[Pt(NH_3)_3Br(NO_2)Cl]Cl$ is

(A) Triamine chloridobromidonitro platinum (IV) chloride

(B) Triamine bromidochloridonitro platinum (IV) chloride

(C) Triamine bromidochloridonitro platinum (II) chloride

(D) Triamine chloridobromidonitro platinum (II) chloride

Solution: (B)

The oxidation state of central atom (Pt) is calculated as

Let the oxidation state of $Pt = x$, then

$(x \times 1) + 3 \times (0) + (1 \times -1) + (1 \times -1) + (1 \times -1) = +1$

$x - 3 = +1$

$x = +4$

Thus, the $IUPAC$ name of the complex $[Pt(NH)_3Br(NO_2)Cl]Cl$ is triamine bromidochloridonitro platinum (IV) chloride as the names of the different ligands are arranged alphabetically.

20. When an excess and a very dilute aqueous solution of KI is added to very dilute aqueous solution of silver nitrate. The colloidal particles of silver iodide which are associated with the Helmholtz double layer in the form of

(A) $AgI/Ag^+ : I^-$

(B) $AgI/K^+ : NO_3^-$

(C) $AgI/NO_3^- : Ag^+$

(D) $AgI/I^- : K^+$

Solution: (A)

When KI solution is added to $AgNO_3$ solution, positively charged solution results due to adsorption of Ag^+ from dispersion medium forming AgI/Ag^+ having acquired a positive charge, this layer attracts counter ions from the medium forming a second layer as $AgI/Ag^+ : I^-$.

21. $8NH_3 + 3Cl_2 \rightarrow X$

(Excess)

$NH_3 + 3Cl_2 \rightarrow Y$

(Excess)

What is X and Y in the above reaction?

(A) $X = 6NH_4Cl + N_2; Y = NCl_3 + 3HCl$

(B) $X = NCl_3 + 3HCl; Y = 6NH_4Cl + N_2$

(C) $X = NCl_3 + N_2; Y = 6NH_4Cl + 3HCl$

(D) $X = 6NH_4Cl + 3HCl; Y = NCl_3 + N_2$

Solution: (A)

$8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$

(Excess)

$NH_3 + 3\ Cl_2 \rightarrow NCl_3 + 3\ HCl$

$(Excess)$

Hence. $X = 6NH_4Cl + N_2$

$Y = NCl_3 + 3HCl$

22. The ionic radii (Å) of $C^{4-}$and O^{2-}respectively are 2.60 and 1.40. The ionic radius of the isoelectronic ion N^{3-} would be

(A) 1.31Å

(B) 2.83 Å

(C) 1.71 Å

(D) 2.63Å

Solution: (C)

C^{4-}, N^{3-} and O^{2-} are isoelectronic species.

The ionic radius of isoelectronic species decreases with increase in nuclear charge.

Hence, the order of ionic radius is

Species: $C^{4-} > N^{3-} > O^{2-}$

Ionic radii (Å): $2.60 > 1.71 > 1.40$

23. Which of the following products will be obtained when copper metal is reacted with HNO_3?

(A) NO and N_2O_5

(B) NO and NO_2

(C) NO_2 and N_2O_5

(D) HNO_2 and N_2

Solution: (B)

The products of the reaction of copper with HNO_3 depends upon the concentration of HNO_3 used.

Copper metal reacts with dilute HNO_3 to form nitrogen (II) oxide (NO).

$3Cu + 8HNO_3(dil.) \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

Copper metal reacts with conc. HNO_3 to form nitrogen (IV) oxide or nitrogen dioxide (NO_2)

$Cu + 4HNO_3(\text{conc.}) \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

84. A gas $'X'$ is used in filling balloons for meteorological observations. It is also used in gas-cooled nuclear reactors. Here, the gas X is

(A) Neon

(B) Argon

(C) Krypton

(D) Helium

Solution: (D)

Helium is used in filling balloons for meteorological observations. It is also used in gas-cooled nuclear reactors. Liquid helium is used as cryogenic agent for carrying out various experiments at low temperature.

25. A solid has a structure in which W atoms are located at the corners of a cubic lattice. O atoms at the centre of edges and Na atom at centre of the cube. The formula for the compound is

(A) $NaWO_2$

(B) $NaWO_3$

(C) Na_2WO_3

(D) $NaWO_4$

Solution: (B)

In a unit cell,

W atoms at the corner $= \frac{1}{8} \times 8 = 1$

O atoms at the centre of edges $= \frac{1}{4} \times 12 = 3$

Na atoms at the centre of the cube $= 1$

$\therefore W : O : Na = 1 : 3 : 1$

Hence, formula of compound is $NaWO_3$.

26. Benzoic acid undergoes dimerisation in benzene solution. The van't Hoff factor (i) is related to the degree of association $'x'$ of the acid as

(A) $i = (1 - x)$

(B) $i = (1 + x)$

(C) $i = \left(1 - \frac{x}{2}\right)$

(D) $i = \left(1 + \frac{x}{2}\right)$

Solution: (C)

$2C_6H_5COOH \rightarrow (C_6H_5COOH)_2$

Before association 1 mole

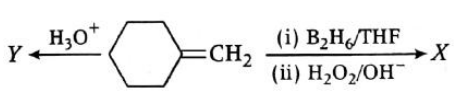
After association $1 - x \quad x/2$

Total $= 1 - x + \frac{x}{2} = 1 - \frac{x}{2}$

$\therefore i = \dfrac{1 - x/2}{1}$

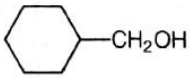
or, $i = 1 - \frac{x}{2}$

27.

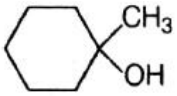


X and Y respectively are

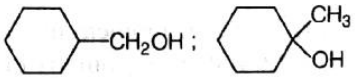
(A)

Both 

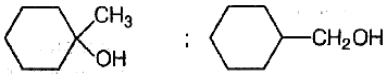
(B)

Both 

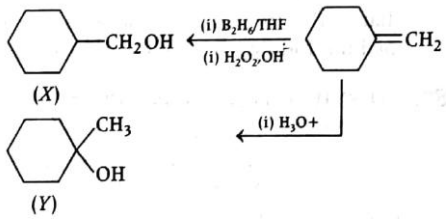
(C)



(D)



Solution: (C)



Due to hydration, addition of H_2O is by Markownikoff's rule and by hydroboration oxidation, addition of H_2O is by anti-markownikoff's rule.

28. At 25^oC, the molar conductance at infinite dilution for the strong electrolytes $NaOH$, $NaCl$ and $BaCl_2$ are $248 \times 10^{-4}, 126 \times 10^{-4}$ and $280 \times 10^{-4} Sm^2mol^{-1}$ respectively.

$\lambda_m^o Ba(OH)_2$ in Sm^2mol^{-1} is

(A) 362×10^{-4}

(B) 402×10^{-4}

(C) 524×10^{-4}

(D) 568×10^{-4}

Solution: (C)

Given,

$\lambda_m^o(NaOH) = 280 \times 10^{-4} Sm^2 mol^{-1}$

$\lambda_m^o(NaCl) = 126 \times 10^{-4} Sm^2 mol^{-1}$

$\lambda_m^o(BaCl_2) = 280 \times 10^{-4} Sm^2 mol^{-1}$

The reaction for the formation of $Ba(OH)_2$ can be written as

$BaCl_2 + 2\,NaOH \rightarrow Ba(OH)_2 + 2NaCl$

$\because \lambda_m^o Ba(OH)_2 = \lambda_m^o BaCl_2 + \lambda_m^o NaOH - 2\lambda_m^o NaCl$

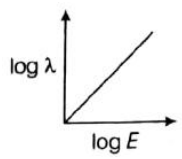
$\therefore \lambda_m^o Ba(OH)_2 = 280 \times 10^{-4} + 2 \times 248 \times 10^{-4} - 2 \times 126 \times 10^{-4}$

$= (280 + 496 - 252) \times 10^{-4}$

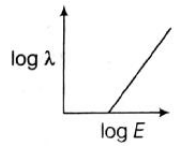
$= 524 \times 10^{-4} Sm^2 mol^{-1}$

89.

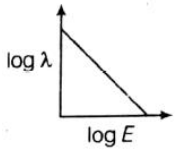
(A)



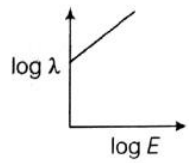
(B)



(C)



(D)



In the above reaction sequence, X is

(A) Cyclohexanone

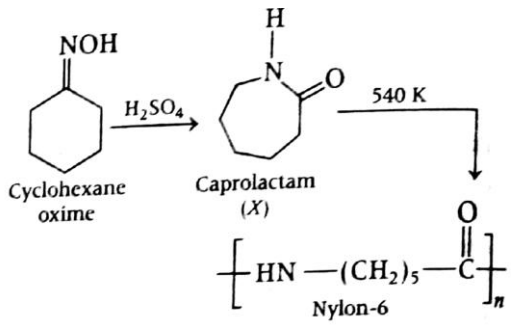
(B) Caprolactam

(C) Hexamethylene di-isocyanate

(D) $HO(CH_2)_6NH_2$

Solution: (B)

The given reaction in the question is the polymerization reaction of nylon-6 which is shown below



Caprolactam is the monomer of nylon-6. Thus, X is caprolactam.

30. The correct order of spin only magnetic moment (in BM) for Mn^{2+}, Cr^{2+} and Ti^{2+} ions is

(A) $Mn^{2+} > Ti^{2+} > Cr^{2+}$

(B) $Ti^{2+} > Cr^{2+} > Mn^{2+}$

(C) $Mn^{2+} > Cr^{2+} > Ti^{2+}$

(D) $Cr^{2+} > Ti^{2+} > Mn^{2+}$

Solution: (C)

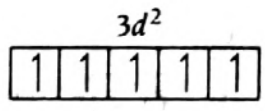
Spin only magnetic moment depends upon the number of unpaired electrons.

Magnetic moment, $\mu = \sqrt{n(n+2)}$

Where, $n =$ number of unpaired electrons

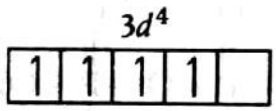
The electronic configuration for the given ions is as follow:

For $Mn^{2+}[Z = 25] = 1s^2, 2s^2, 2p^6, 3s^2 3p^6, 3d^2\ 4s^0$



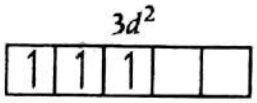
$\mu = \sqrt{5(5+2)} = \sqrt{35}$

For $Cr^{2+}[Z = 24] = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^4, 4s^0$



$\mu = \sqrt{4(4+2)} = \sqrt{24}$

For $Ti^{2+}[Z = 22] = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^2, 4s^0$



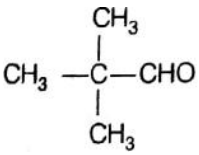
$\mu = \sqrt{2(2+2)} = \sqrt{8}$

∴ correct order of spin only magnetic moment is

$Mn^2 + Cr^{2+} > Ti^{2+}$.

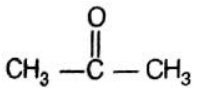
31. Which of the following compounds do not undergo aldol condensation?

(A)



(B) $CH_3 - CHO$

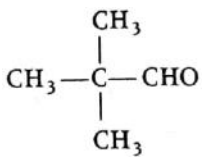
(C)



(D) CH_3CH_2CHO

Solution: (A)

Necessary condition for aldol condensation is the presence of atleast one α-H atom. Thus, among the given options,



do not undergoes aldol condensation as it does not contains any α-hydrogen atom.

32. A green yellow gas reacts with an alkali metal hydroxide to form a halate which can be used in fireworks and safety matches. The gas and halate are, respectively

(A) $Br_2, KBrO_3$

(B) $Cl_2, KClO_3$

(C) $l_2, NalO_3$

(D) $Cl_2, NaClO_3$

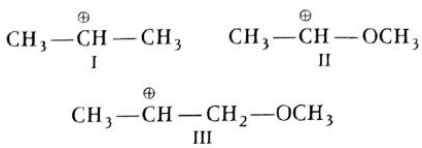
Solution: (B)

A halate will be formed from halogen and the greenish yellow gas is Cl_2.

The halate which is used in fireworks and safety matches is $KClO_3$. The reaction is as follow

$3Cl_2 + 6KOH \rightarrow KClO_3 + 5HCl + 3H_2O$

33. The correct order of decreasing stability of the following carbocation is



(A) II > I > III

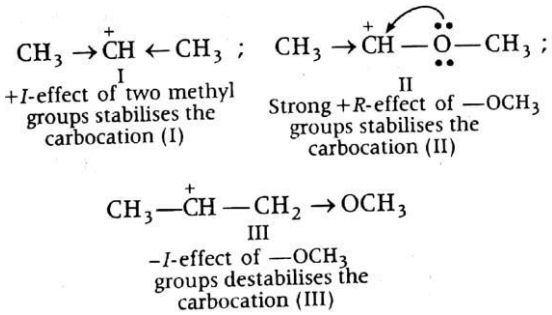
(B) II > III > I

(C) III > I > II

(D) I > II > III

Solution: (A)

Stability of the given cations can be understood by the following structures



Thus, the stability of carbocation decreases in the order,

$II > I > III$

34. Hydrolysis of sucrose with dilute aqueous sulphuric acid yields

(A) $1:2$ D-$(+)$- glucose; D-$(-)$- fructose

(B) $1:2$ D-$(-)$- glucose; D-$(+)$- fructose

(C) $1:1$ D-$(-)$- glucose; D-$(+)$- fructose

(D) $1:1$ D-$(+)$- glucose; D-$(-)$- fructose

Solution: (D)

On hydrolysis with dilute aqueous sulphuric acid, sucrose forms a equimolar mixture of D-$(+)$-glucose and D-$(-)$-fructose. The reaction for the hydrolysis of sucrose is as follow

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H_2SO_4} \underset{\text{D-(+)-glucose}}{C_6H_{12}O_6} + \underset{\text{D-(−)-fructose}}{C_6H_{12}O_6}$$

Solution of sucrose is dextrorotatory (specific rotation $= +66.1^o$) but after hydrolysis gives dextrorotatory glucose and levorotatory fructose. The solution of formed product is found to be levorotatory (specific rotation $= -20.0^o$)

35. Among the following complex ions, the one which shows geometrical isomerism will be

(A) $[Cr(H_2O)_4Cl_2]^+$

(B) $[Pt(NH_3)_3Cl\,]$

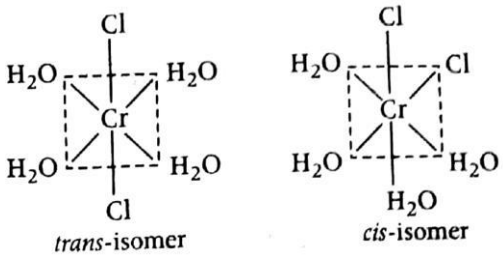
(C) $[CO(NH_3)_6]^{3+}$

(D) $[CO(CN)_5(NC)\,]^{3-}$

Solution: (A)

$[Cr(H_2O)_4Cl_2]^+$ shows geometrical isomerism because it is a MA_4B_2 type coordination compound which contains two set of equivalent ligands, four H_2O and $2Cl$.

Hence, the possible geometrical isomers are:



Hence, correct option is (A)

36. ΔH and ΔE for the reaction, $Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + H_2O(l)$ at constant temperature are related as

(A) $\Delta H = \Delta E$

(B) $\Delta H = \Delta E + RT$

(C) $\Delta H = \Delta E + 3RT$

(D) $\Delta H = \Delta E - 3RT$

Solution: (D)

For any chemical reaction,

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

Where,

Δn_g = total number of moles of gaseous products total number of moles of gaseous reactants

For the given reaction,

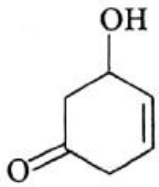
$Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + H_2O(l)$

$\Delta n_g = 0 - 3 = -3$

$\therefore \Delta H = \Delta E + (-3)RT$

$\Delta H = \Delta E - 3RT$

37. The correct $IUPAC$ name of the given compound is



(A) 7-hydroxy cyclohex -5-en-1 -one

(B) 3-hydroxy cyclohex-5-en-1 -one

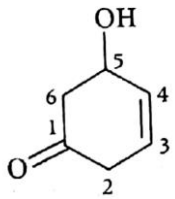
(C) 8-hydroxy cyclohex-3-en-1 -one

(D) 5-hydroxy cyclohex-3-en-1 -one

Solution: (D)

The correct $IUPAC$ name of the given compound is 5-hydroxy cyclohex -3-en-1-one.

The structure is shown below



38. Among the following rules, the one which is applied in the given reaction is

$CH_3CHBrCH_2CH_3 \xrightarrow{Alc.KOH}$

I. $CH_3CH = CHCH_3$ (major product)

II. $CH_2 = CHCH_2CH_3$ (minor product)

(A) Saytzeff's rule

(B) Hofmann 's rule

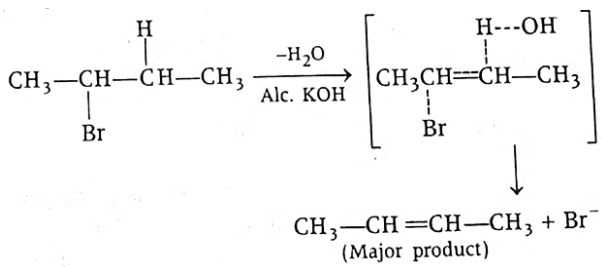
(C) Markownikoff's rule

(D) Kharasch effect

Solution: (A)

Alkyl halide on heating with alcoholic KOH undergoes dehydrohalogenation to yield alkene.

If in reaction, more than one alkene is formed, then according to Saytzeff rule, the most highly substituted alkene formed is the major product,



99. The solubility product of sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in mol/L) is

(A) 5.6×10^{-6}

(B) 3.1×10^{-4}

(C) 2×10^{-4}

(D) 4×10^{-4}

Solution: (C)

AX_2 is ionized as follows:

$$\underset{S\ mol\ L^{-1}}{AX_2} \rightleftharpoons \underset{S}{A^{2+}} + \underset{2S}{2X^-}$$

Solubility product of AX_2

$K_{sp} = [A^{2+}][X^-]^2 = [S] \times [2S]^2 = 4S^3$

$\because K_{sp}$ of $AX_2 = 3.2 \times 10^{-11}$

$\therefore 3.2 \times 10^{-11} = 4s^3$

or, $S^3 = 0.8 \times 10^{-11} = 8 \times 10^{-12}$

or, $S = \sqrt[3]{8 \times 10^{-12}}$

$= 2 \times 10^{-4}\ mol/L$

Solubility $= 2 \times 10^{-4}\ mol/L$

40. The structure of IF_7 is

(A) Square pyramidal

(B) Trigonal bipyramidal

(C) Octahedral

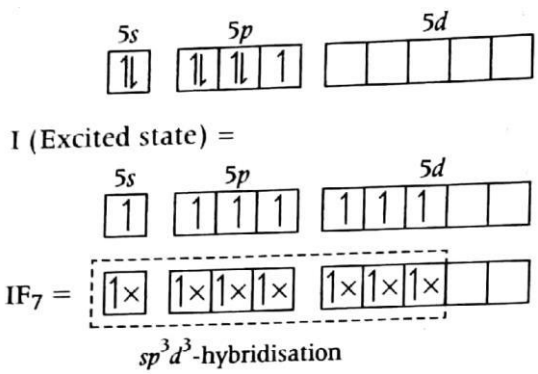
(D) Pentagonal bipyramidal

Solution: (D)

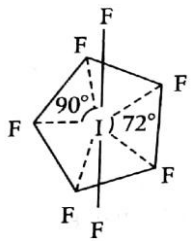
The structure of IF_7 is pentagonal bipyramidal.

It can be depicted as follow

$(z = 53)(\text{Ground state}) =$



Here, X denotes electrons of F-atoms. The structure of IF_7 is shown below:



Pentagonal bipyramidal structure

41. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Micelles are formed by surfactant molecules above the critical micellar concentration (CMC).

Reason (R) The conductivity of a solution having surfactant molecules decreases sharply at the CMC.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (B)

Both assertion and reason are true but reason is not the correct explanation of assertion.

At a certain concentration, surfactant molecules start to aggregate and from micelle. This concentration is called critical micellar concentration (CMC).

Aggregation of surfactant molecules (ions; $RCOO^{-}$), i.e. micelle formation causes effective fall in number of free ions to conduct electricity, thus conductivity decreases at CMC.

42. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) The pH of acid rain is less than 5.6.

Reason (R) Carbon dioxide present in the atmosphere dissolves in rain water and becomes carbonic acid.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (B)

Both assertion and reason are correct but reason is not the correct explanation of assertion.

Normally, rain water has a pH of 5.6 due to the presence of H^+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

$H_2O(l) + CO_2(g) \rightarrow H_2CO_3(aq)$

$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$

When the pH of rain water drops below 5.6, it is called acid rain.

43. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Electron gain enthalpy becomes less negative as we go down a group.

Reason (R) Size of the atom increases on going down the group and the added electron would be farther away from the nucleus.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Assertion and reason bot are correct and reason is the correct explanation of the assertion. Electron gain enthalpy becomes less negative as the size of an atom increases down the group. This is because

within a group screening effect increases on going downward and the added electron would be farther away from the nucleus.

44. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Among the two $O—H$ bonds in H_2O molecule, the energy required to break the first $O—H$ bond and the other $O—H$ bond is same.

Reason (R) This is because the electronic environment around oxygen is the same even after breakage of one O—H bond.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (D)

The bond enthalpies of the two $O—H$ bonds in $H—O—H$ are not equal. This is because electronic environment around O is not same after breakage of one $O—H$ bond. Therefore, both assertion and reason are incorrect.

45. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Nitration of benzene with nitric acid requires the use of concentrated sulphuric acid,

Reason (R) The mixture of concentrated sulphuric acid and concentrated nitric acid produces the electrophile, NO_2^+.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

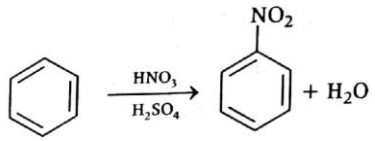
(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason are correct and reason is the correct explanation of the assertion. In nitration of benzene with nitric acid, sulphuric acid acts as catalyst. It helps in the formation of electrophile, i.e. nitronium ion NO_2^+.

The reaction is shown below:

$$HNO_3 + H_2SO_4 \rightarrow NO_2^+ + 2HSO_4^- + H_3O^+$$



46. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Beryllium carbonate is kept in the atmosphere of carbon dioxide,

Reason (R) Beryllium carbonate is unstable and decomposes to give beryllium oxide an carbon dioxide.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason are correct and reason is the correct explanation of the assertion. BeO is more stable than $BeCO_3$ due to small size and high polarising power of Be^{2+}.

As $BeCO_3$ is unstable and BeO is more stable thus when $BeCO_3$ is kept in an atmosphere of CO_2, a reversible process takes place and stability of $BeCO_3$ increases. The reaction is shown below

$BeCO_3 \rightleftharpoons BeO + CO_2$

47. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Separation of Zr and Hf is difficult.

Reason (R) Zr and Hf lie in the same group of the periodic table.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (B)

Assertion and reason are true but reason is not correct explanation of the assertion. Separation of Zr and Hf is difficult, it is not because of they lie in the same group of the periodic table. This is due to the lanthanide contraction which causes almost similar radii of both of them.

48. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Toxic metal ions are remove by the chelating ligands.

Reason (R) Chelating complexes tend to be more stable.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

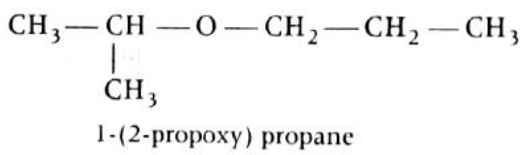
Solution: (A)

Assertion and reason both are correct and reason is the correct explanation of the assertion.

Toxic metal ions are removed by chelating ligands. When a solution of chelating ligand is added to solution containing toxic metal, ligands chelate the metal ions by formation of stable complex.

49. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) $IUPAC$ name of the compound



is

Reason (R) In $IUPAC$ nomenclature, ether is regarded as hydrocarbon derivative in which a hydrogen atom is replaced by-OR or-OAr group [where, $R = alkyl$ group and $Ar = aryl$ group].

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

$IUPAC$ name of the above given compound is correct, i.e. 1-(2-propoxy) propane. In this compound, hydrogen atom is replaced by— OR group and thus named ether.

Therefore, both assertion and reason is correct and reason is the correct explanation of the assertion.

50. Direction This question that follow two statements (Assertion and

Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study

both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) The reaction $2NO + O_2 \rightarrow 2NO_2$ and $2CO + O_2 \rightarrow 2CO_2$ proceeds at the same

rate because they are similar.

Reason (R) Both the reactions have same activation energy.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (D)

Both assertion and reason are false.

The reaction $2NO + O_2 \rightarrow 2NO_2$ and $2CO + O_2 \rightarrow 2CO_2$ proceeds at the different rates. Both the

reactions have different activation energies.

51. Direction This question that follow two statements (Assertion and

Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study

both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) The boiling points of alkyl halides decrease in the order $RI > RBr > RCl > RF$.

Reason (R) The boiling points of alkyl chlorides, bromides and iodides are considerably higher

than that of the hydrocarbon of comparable molecular mass.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (B)

Assertion and reason both are correct statements but reason is not the correct explanation of assertion. For the same hydrocarbon part, boiling point depends upon the atomic mass of halogen atom. Higher the mass of the halogen atom, higher will be the boiling point. So, we can say that boiling point decreases with decrease in atomic mass of halogen atom. Thus, the decreasing order of boiling point is $RI > RBr > RCl > RF$

52. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) N_2 is less reactive than P_4.

Reason (R) Nitrogen has more electron gain enthalpy than phosphorus.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (C)

Assertion is true but reason is false. N_2 is less reactive than P_4 due to high value of bond dissociation energy, which is because of the presence of triple bond between two N-atoms of N_2 molecule.

53. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) The molecular mass of the polymers cannot be calculated using the boiling point or freezing point method.

Reason (R) The freezing point method is used for determining the molecular mass of small molecules.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason are correct and reason is the correct explanation of assertion.

The molecular mass of large molecules is determined using the osmotic pressure technique. The molecular mass of smaller molecules is determined using the freezing point lowering method.

54. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) $NaCl$ reacts with concentrated H_2SO_4 to give colourless fumes with pungent smell. But on adding MnO_2 the fumes become greenish yellow.

Reason (R) MnO_2 oxidises HCl to chlorine gas which is greenish yellow.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason is correct and reason is the correct explanation of the assertion. $NaCl$ reacts with concentrated H_2SO_4 to give colourless fumes with pungent smell. This pungent smell is due to formation of HCl.

$NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$

But on adding MnO_2, the fumes become greenish yellow due to formation of chlorine gas.

55. Direction This question that follow two statements (Assertion and

Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study

both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) K_P can be equal to or less than or even greater than the value of K_C.

Reason (R) $K_p = K_C(RT)^{\Delta n}$

Relation between K_p and K_C depends on the change in the number of moles of gaseous reactants and

products.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason are correct and reason is the correct explanation of assertion.

$K_p = K_C(RT)^{\Delta n}$

$\Delta n =$ number of moles of gaseous products number of moles of gaseous reactants

When, $\Delta n < 1, K_p > K_C$

When, $\Delta n < 1, K_p > K_C$

When, $\Delta n = 0, K_p = K_C$

56. Direction This question that follow two statements (Assertion and

Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study

both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) CH_4 does not react with Cl_2 in dark.

Reason (R) Chlorination of CH_4 takes place in sunlight.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason are correct and reason is the correct explanation of the assertion.

Chlorination of CH_4 does not take place in dark as this reaction follows free radical mechanism and free radicals are generated only in the presence of sunlight.

57. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) CH_3OH and CH_3CH_2OH can be distinguished by haloform test.

Reason (R) Haloform test is given by 2° alcohol.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

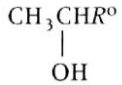
(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (B)

Haloform test is used to identify the compound (alcohol or carbonyl compound). In this reaction, alcohols (aldehydes and ketones) on heating with $X_2(Cl_2, Br_2$ and $I_2)$ and OH^- form CHX_3 (haloform). This test is given by CH_3CH_2OH,



(2° alcohols with $-OH$ at C_2), CH_3CO- group.

Therefore, both assertion and reason is correct but reason in not the correct explanation of the assertion.

58. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) For a Daniell cell Zn/Zn^{2+} || Cu^{2+}| Cu with $E_{cell} = 1.1\ V$, the application of opposite potential greater than $1.1\ V$ results into the flow of electrons from cathode to anode.

Reason (R) Zn is deposited at zinc electrode and Cu is dissolved at copper electrode.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (A)

Both assertion and reason are correct and reason is the correct explanation of assertion. On applying external voltage greater than $1.1\ V$ in a Daniell cell, the current flows in the reverse direction i.e. from Zn to Cu (anode to cathode).

The electrons flow from copper to zinc.

Zn is deposited at Zn electrode and Cu dissolves at Cu electrode. The reaction is

$Zn^{2+} + Cu \rightarrow Zn + Cu^{2+}$

59. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Most of the synthetic polymers are not biodegradable.

Reason (R) Polymerisation process induces toxic polymerisation.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (C)

Assertion is correct but reason is incorrect. Most of the synthetic polymers are not biodegradable because they are not easily broken by soil organisms and are hazardous to the environment.

60. Direction This question that follow two statements (Assertion and Reason) are given. Statement II (R) is purported to be the explanation for statement I (A). Study both the statements carefully and then mark your answers, according to the codes given below.

Assertion (A) Graphite is an example of tetragonal crystal system.

Reason (R) For a tetragonal system, $a = b \neq c$ and $\alpha = \beta = 90^o, \gamma = 120^o$.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) Both (A) and (R) are false.

Solution: (D)

Both assertion and reason are incorrect. Graphite is an example of hexagonal crystal system in which each C-atom is sp^2 -hybridised and is linked to three other C-atoms in a hexagonal planar structure. For tetragonal system, $a = b \neq c$ and $\alpha = \beta = \gamma = 90^o$. For hexagonal systems, $a = b \neq c$ and $\alpha = \beta = 90^o, \gamma = 120^o$.

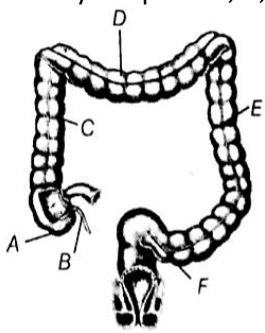
Biology

Single correct answer type:

1. Biomagnification can be defined as
(A) Decomposition of organic waste in water by the action of microbes
(B) Breeding of crops that are rich in minerals and vitamins, good proteins and healthier fats
(C) Increase in concentration of the toxicant at successive trophic levels
(D) Exploring the products of economic importance at molecular, genetic and species level diversity
Solution: (C)
Biomagnification is a phenomenon through which certain pollutants get accumulated in tissues in increasing concentrations at successive trophic levels along the food chain. Many pesticides such as DDT, have a long life. Thus, they get incorporated in food chain and get magnified at higher levels.

2. Leaf tendrils are found in
(A) Grapevine
(B) Peas
(C) Cucumber
(D) All of the above
Solution: (D)
Leaf tendrils are specialized thread-like sensitive structures, which are unbranched and devoid of scales. They can coil around a support and thus, help to the plants in climbing.

3. Diagram of large intestine is given below.
Identify the parts A, B, C, D, E and F.



(A) A —Sigmoid colon B —Vermiform appendix, C —Ascending colon, D — Transverse colon, E —Descending colon, F —Caecum
(B) A —Caecum, B —Vermiform appendix, C —Sigmoid colon, D —Ascending colon, E —Transverse colon, F —Descending colon
(C) A —Caecum, B —Vermiform appendix, C —Ascending colon, D —Transverse colon, E —Descending colon, F —Sigmoid colon
(D) A —Sigmoid colon, B —Vermiform appendix, C —Descending colon, D —Transverse colon, E —Ascending colon, F —Caecum
Solution: (C)

In the given figure $'A'$ represents caecum, $'B'$ is vermiform appendix. $'C'$ is ascending colon, $'D'$ is transverse colon, $'E'$ is descending colon and $'F'$ is sigmoid colon.

4. Select the incorrect statement(s) from the options given below with respect to dihybrid cross.
I. Tightly linked genes on the same chromosome show higher recombinations.
II. Genes far apart on the same chromosome show very few recombinations.
III. Genes loosely linked on the same chromosome show similar recombinations.
(A) I and II
(B) III and II
(C) I and III
(D) All of these
Solution: (D)
Mendel's law of independent assortment states that when the parents differ from each other in two or more pair of contrasting characters, the inheritance of one pair of factor is independent of the other. For the character to assort independently they should be located on separate non-homologous chromosomes. Genes present on the same chromosome show linkage. It means that these characters remain together and thus less number of combinations are formed. This phenomenon is called linkage and such genes are called linked genes.

5. Match the stages of meiosis in column I to their characteristic features in Column II and select the correct option using the codes given below.

Column I		Column II	
A.	Diakinesis	1.	Crossing over takes place
B.	Pachytene	2.	Terminalisation of chiasmata
C.	Zygotene	3.	Chromosomes align at equatorial place
D.	Metaphase	4.	Pairing of homologous chromosomes

Codes

	A	B	C	D
(A)	1	2	3	4
(B)	2	4	1	3
(C)	4	3	1	3
(D)	2	1	4	3

Solution: (D)
A. Diakinesis —Terminalisation of chiasmata
B. Pachytene — Crossing over takes place
C. Zygotene — Pairing of homologous chromosomes
D. Metaphase — Chromosomes align at equatorial plate

6. Read the following statements
I. Species diversity decreases as we move away from the equator towards the poles.
II. Stellar's sea cow and passenger pigeon got extinct due to overexploitation by man.
III. *Lantana* and *Eichhornia* are invasive weed in India.
IV. The historic convention on biological diversity was held in 1992.
Choose the option containing correct statements.
(A) I and II
(B) I, II and IV
(C) I, III and IV
(D) II, III and IV

Solution: (D)
Species diversity on earth is not uniformly distributed but shows interesting patterns. It is generally highest in the tropics and decreases towards the poles. Species richness of the tropics is due to relatively constant environment and more solar energy which contributes to greater productivity.

7. Characteristics of cancer are
(A) All viruses are oncogenic
(B) All tumours are cancers
(C) Cancerous cells show property of contact inhibition
(D) Cancer cells show metastasis
Solution: (D)
Cancerous cells which break away from the original site and can spread to the other parts of the body through bloodstream and lymphatic system constitute malignant tumours. The spread of cancer to other sites or organs in the body is called metastasis. Other statements are incorrect as cancer cells do not exhibit the peroperty of contact inhibition, all tumours are not cancerous, e.g., benign tumour and also not all viruses are on cogenic.

8. Select the incorrect match.
I. Sedimentary nutrient cycle—Nitrogen cycle
II. Pioneer species—Lichens
III. Secondary succession—Burned forests
IV. Pyramid of biomass in sea—Upright
(A) I and IV
(B) I and III
(C) II and III
(D) II and IV
Solution: (A)
Nitrogen cycle is an example of gaseous cycle where the material involved in circulation between biotic and abiotic components of biosphere are gases. The reservoir pool is atmosphere. On the other hand, in sedimentary cycle, the reservoir pool is lithosphere and the circulating material is non-gaseous, e.g. phosphorus, sulphur, etc. The pyramid of biomass in aquatic environment, e.g. sea is inverted.

9. Apical dominance is caused by
(A) Auxin
(B) Ethylene
(C) Gibberellin
(D) Cytokinin
Solution: (A)
Auxin hormone is responsible for apical dominance process as it inhibits the growth of lateral buds.

10. Consider the following four measures $(I - IV)$ that could be taken to successfully grow chickpea in an area where bacterial blight is common.
I. Spray with Bordeaux mixture.
II. Control of the insect vector of the disease pathogen.
III. Use of disease-free seeds only.
IV. Use of varieties resistant to the disease.
Which of the above measures can control the diseases?
(A) I, II and IV

(B) I, III and IV
(C) II, III and IV
(D) I, II and III
Solution: (B)
Bacterial blight of chickpea is caused by bacterium *Xanthomonas campestris.* The stem and the leaves of infected plant give blighted or burnt up appearance. Control measures include roguing, 3 –years crop rotation, disease-free seeds, spray of copper fungicides (Bordeaux mixture) and antibiotics besides sowing disease resistant varieties.

11. Match the organisms given in Column I to their functions given in Column II and choose the correct option.

Column I		Column II	
A.	Thiobacillus	1.	Free-living nitrogen-fixing cyanobacteria
B.	Nitrosomonas	2.	Denitrification
C.	Nostoc	3.	Free-living aerobic nitrogen-fixing bacteria
D.	Azotobacter	4.	NH_3 to Nitrite

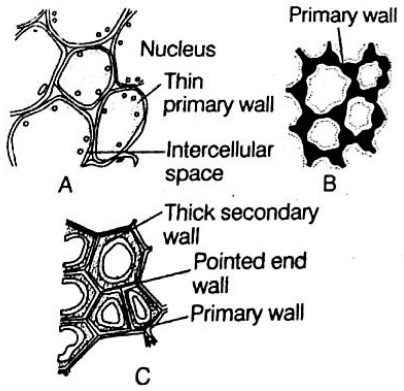
Codes

	A	B	C	D
(A)	2	4	1	3
(B)	4	1	3	2
(C)	3	4	1	2
(D)	3	2	4	1

Solution: (A)
A. *Thiobacillus* $-(2)$ Denitrification
B. *Nitrosomonas* $-(4)$ NH_3 to Nitrite
C. *Nostoc* $-(1)$ Free-living nitrogen-fixing cyanobacteria
D. *Azotobacter* $-(3)$ Free-living aerobic nitrogen-fixing bacteria

12. A plant has a butterfly-shaped flower with one standard, two wing like and two keel petals. To which family, this plant belongs?
(A) Malvaceae
(B) Papilionaceae
(C) Rubiaceae
(D) Compositae
Solution: (B)
The given plant belongs to the family Papilionaceae. Characters of this family include corolla papilionaceous, petals 5, posterior odd petals is called standard, two lateral ones fused to form a keel or carina.

13. Identify the permanent tissues shown in the following figures



(A) A —Collenchyma, B —Parenchyma, C —Sclerenchyma
(B) A —Scelerenchyma, B —Collenchyma, C —Parenchyma
(C) A —Collenchyma, B —Sclerenchyma, C —Parenchyma
(D) A —Parenchyma, B —Collenchyma, C —Sclerenchyma
Solution: (D)
In this figure, $'A'$ is Parenchyma, $'B'$ is Collenchyma and $'C'$ is Sclerenchyma.

14. Find the correct statements from the following
I. Gene therapy is a genetic engineering technique used to treat diseases at molecular level.
II. Calcitonin is medically useful recombinant product in the treatment of infertility.
III. *Bt* toxin is a biodegradable insecticide obtained from *Bacillus thuringiensis.*
(A) Only I
(B) Only II
(C) I and III
(D) I and II
Solution: (C)
Calcitonin is a thyroid hormone secreted by C —cells, which regulates the concentration of calcium and phosphorus in the blood. It has nothing to do with the treatment of infertility.
Statements I and III are correct.

15. A mutant plant is unable to produce materials or precursors that form Casparian strip. This plant would be
(A) Unable to transport water from roots to the leaves
(B) Able to exert greater root pressure than the normal plant
(C) Unable to transport food from leaves to roots
(D) Unable to control amount of water and solute it absorbs
Solution: (C)
Presence of Casparian strips in plants controls the amount of water and solute it absorbs. Thus, a plant that cannot produce Casparian strips effectively will be unable to control the amount of water and solute in plants.

16. Cell A has osmotic pressure of -20 bars and pressure potential of 5 bars, whereas cell B has osmotic pressure of -18 bars and pressure potential of 2 bars.
The direction of flow of water will be
(A) From cell B to cell A
(B) From cell A to B

(C) No flow of water
(D) In both the directions
Solution: (A)
The water potential is the chemical potential of the water, which is equivalent to diffusion pressure deficit with negative sign. Therefore, water potential (Ψ_A) of cell A is
$\Psi_A = \Psi_S + \Psi_P = -20 + 5 = -15$ bars
$\Psi_B = \Psi_S + \Psi_P = -18 + 2 = -2$ bars
Since, water moves from higher water potential to lower potential, the flow of water will be from cell B (-2 bars) to cell A(-15 bars).

17. If a recombinant DNA bearing gene for ampicillin resistance is transferred into *E. coli* cells and the host cells are spread on agar plates containing ampicillin, then
(A) Both transformed and untransformed recipient cells will die
(B) Both transformed and untransformed recipient cells will grow
(C) Transformed recipient cells will grow and untransformed recipient cells will die
(D) Transformed recipient cells will die and untransformed recipient cells will grow
Solution: (C)
Transformation is a procedure through which a piece of DNA is introduced in a host bacterium. DNA bearing ampicillin resistance gene (transformed recipient cells) when introduced into the plate containing ampicillin will grow while DNA not bearing ampicillin resistance gene (untransformed recipient cells) will die. The genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin, etc., are considered useful selectable markers for *E.coli.* The normal *E. coli* does not carry resistance against any of these antibiotics.

18. Adults of *Wuchereria bancrofti* attack
(A) Excretory system
(B) Digestive system
(C) Lymphatic system
(D) Nervous system
Solution: (C)
Wuchereria bancrofti is a digenetic human parasite that completes its life cycle in two host. The man is the final host that harbours the adult worm in the glands and lymph vessels.

19. Which of the following pathways occurs through cell wall?
(A) Apoplast pathway
(B) Vascular pathway
(C) Symplast pathway
(D) Non-vacuolar pathway
Solution: (A)
In apoplast pathway, water passes from root hairs to xylem through cell wall only without crossing any membranes. The apoplast involves a continuous system of cell walls and intercellular air spaces in plant tissues.

20. Which of the following plants are used to treat bone fractures?
(A) *Digitalin purpurea*
(B) *Hevea brasiliensis*
(C) *Cissus quadrangularis*
(D) *Lowsomia inermis*

Solution: (C)
Cissus quadrangularis is an ancient medicinal plant of India. It has the specific bone healing properties and helps in faster increase in bone tensile strength. It acts as a glucocorticoid antagonist. Since, anabolic compounds are known to act as antagonist to glucocorticoid receptor as well as promote bone growth and fracture healing, it has been concluded that *Cissus* possesses healing properties.

21. C_4 pathway is advantageous over C_3 pathway in plants. because it
(A) Occurs in relatively low CO_2 concentration
(B) Uses more amount of water
(C) Occurs in relatively low O_2 concentration
(D) Is less efficient in energy utilisation
Solution: (A)
A plant with the C_4 pathway is advantageous over a plant with a C_3 pathway as the former can occur in low CO_2 concentrations.
When the weather is hot and arid, the leaves close their stomata to reduce water loss. This closure results in low CO_2 concentrations and thus, leading to both loss of $RuBP$ and inhibition of Calvin-Benson cycle.

22. Production of human protein in bacteria by genetic engineering is possible because
(A) The human chromosome can replicate in the bacterial cell
(B) The mechanism of gene regulation is identical in humans and bacteria
(C) Bacterial cells can carry out RNA splicing reactions
(D) The genetic code is universal
Solution: (D)
Genetic code may be defined as the sequence of nucleotides in polynucleotide chain which determines the sequence of amino acids in a polypeptide chain. Thus, genetic code is universal. There is no ambiguity regarding genetic code. It means that each codon codes for the same amino acid in all organisms including bacteria, plants and animals.

23. Choose the correct statements with reference to organic evolution.
I. Flippers of whale and wings of bat exhibit analogy.
II. Wings of butterfly and wings of bird exhibit homology.
III. Organs with dissimilar structure are called analogous organs.
IV. Organs with similar structure and origin are called homologous organs.
(A) I and IV
(B) I and III
(C) III and IV
(D) II and IV
Solution: (C)
Homologous structures have the same embryonic origin and basic structure, but they do not perform same function, e.g. flipper of whale and wings of bat.
Analogous organs are the structures which are different in their basic structure and developmental origin, e.g. wings of butterfly and wings of bird.

24. *Triticale* is the first man-made cereal crop. Mention the type of hybridisation through which it was produced.
(A) Intervarietal hybridisation
(B) Interspecific hybridisation
(C) Intergeneric hybridisation

(D) Intravarietal hybridisation
Solution: (C)
Intergeneric crosses are made between plants belonging to different genera of the same family. The hybrids produced by this method are both scientifically as well as agronomically significant. For example, *Triticale* is an allopolyploid, which was produced by intergenic hybridisation between wheat (*Triticale*) and rye (*Secale*).

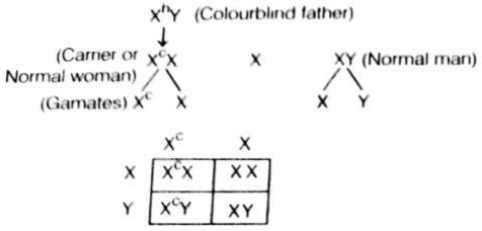
25. *Azolla* is used as a biofertiliser because it
(A) Has association of mycorrhiza
(B) Multiplies at faster rate to produce massive biomass
(C) Has association of nitrogen-fixing *Rhizobium*
(D) Has association of nitrogen-fixing cyanobacteria
Solution: (D)
Azolla is a pteridophyte and it is used as a biofertiliser because it has association with nitrogen-fixing cyanobacteria called *Anabaena azollae.*

26. Person $'A'$ cannot step out of his house. He has to spend his entire life in sterile isolation otherwise, he would quickly contract a fatal infection. This person has almost no effective immune system. This disease is also called as baby in a bubble syndrome. Identify the disease, this person $'A'$ is suffering from
(A) Cystic fibrosis
(B) Diabetes
(C) AIDS
(D) SCID
Solution: (D)
Severe Combined Immunodeficiency Disease (SCID), is a rare genetic disease that affects the immune system of the person. This disease can be treated by either bone-marrow transplant or by enzyme replacement therapy but neither of the two are completely curative. Thus, gene therapy have been attempted to cure it permanently.

27. The peppered moth (*Biston betularia*), the black-coloured form becomes dominant over the light-coloured form of moth in England during industrial revolution. This is an example of
(A) Appearance of the darker-coloured individuals due to very poor sunlight
(B) Protective mimicry
(C) Inheritance of darker colour character acquired due to the darker environment
(D) Natural selection whereby the darker forms were selected
Solution: (D)
Industrial melanism is an adaptation where the moths living in the industrial areas developed melanin pigments to match their body to the black soot (smoke) covered surroundings. The peppered moths exist into two strains— light (white) coloured and melanic (black). Before industrialisation, all moths were white and were unnoticed from predatory birds due to whitish lichens on the bark of trees. After industrialisation, the barks get covered by smoke so the white moths were more evidently visible and thus, picked up by birds. But black moths escaped unnoticed so they managed to survive resulting in more population of black moths and less population of white moths.

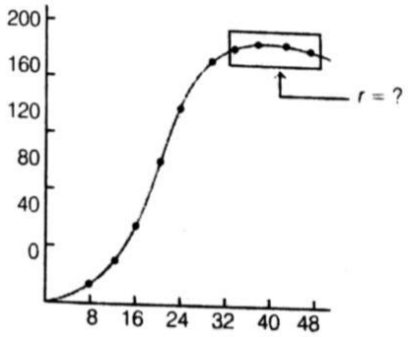
28. A normal woman whose father was colourblind. marries a normal man. What kinds of children can be expected and in what proportion?
(A) All daughters normal, 50% of sons colourblind
(B) All daughters normal. all sons colourblind

(C) 50% daughters colourblind, all sons normal
(D) All daughters colourblind, all sons normal
Solution: (A)

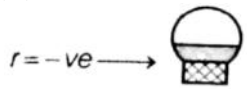


$X^CX = (50\%\ \text{carrier daughters})$
$XX = (50\%\ \text{normal daughters})$
$X^CY = (50\%\ \text{colourblind sons})$
$XY = (50\%\ \text{normal sons})$

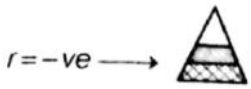
29. From the graph of population growth, select the correct option having correct value of $'r'$and bar graph.



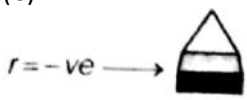
(A)



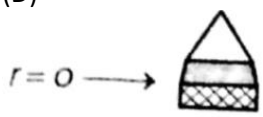
(B)



(C)



(D)



Solution: (D)
A bell-shaped polygon indicates a moderate proportion of young to old. As the rate of growth becomes slow and stable, the pre-reproductive and reproductive age group become more or less equal in size and post-reproductive group remains the smallest.

30. What is true about the isolated small tribal populations?
(A) Wrestlers who develop strong body muscles in their lifetime pass this character on their progeny

(B) There is no change in population size as they have a large gene pool
(C) There is a decline in population as boys marry girls only from their own tribe
(D) Hereditary diseases like colour blindness do not spread in the isolated population
Solution: (C)
Change in population density gives an idea of what is happening to the population. whether it is increasing or declining. This population density depends on natality, mortality, immigration and emigration. In an isolated small tribal population, if boys marry their own tribal girls then there will be decline in population because at some stage marriage will stop due to isolation and on the other hand marriages within same tribe will lead to homozygosity of disease and ultimately death, thus leading to decline in population.

31. Codons of glycine are
(A) $CCU.CCC, CCA, CCG$
(B) CGU, CGC, CGA, CGG
(C) $GGU, GGC, GGA.GGG$
(D) $ACU, ACC, ACA\ ACG$
Solution: (C)
The codons of glycine are GGU, GGC, GGA, GGG. A genetic code is the smallest unit to code one amino acid. This genetic code is defined as nucleotide sequence of nitrogenous bases, which specifies the amino acid sequence in a polypeptide molecule.

32. Which one of the following organisms do not evolve oxygen during photosynthesis?
(A) Blue-green algae
(B) Red algae
(C) Photosynthetic bacteria
(D) C_4 plants
Solution: (C)
The photosynthetic bacteria like purple non-sulphur bacteria photosynthesise using bacteriochlorophyll-*a* and *b* in anoxic environments, such as stagnant water. The reducing agent involved is hydrogen rather than oxygen hence, oxygen is not produced.

33. Which of the following biomolecules is common to respiration-mediated breakdown of fats, carbohydrates and proteins?
(A) Glucose-6-phosphate
(B) Pyruvic acid
(C) Fructose-1, 6 biphosphate
(D) Acetyl Co-A
Solution: (D)
Carbohydrates, fats and proteins, all can be used as a substrate in cellular respiration. All of them get converted to acetyl Co-A when they enter Krebs' cycle during aerobic cellular respiration.

34. Match Column I (Antibiotic) with Column II (Source) and choose the correct option from the codes given below.

Column I		Column II	
$A.$	Fumagillin	1.	*Gliocladium virens*
$B.$	Bacitracin	2.	*Streptomyces griseus*
$C.$	Streptomycin	3.	*Bacillus polymyxa*
$D.$	Viridin	4.	*Aspergillus fumigatus*

E.	Polymixin	5.	*Bacillus licheniformis*

Codes

	A	B	C	D	E
(A)	1	2	3	4	5
(B)	4	5	2	1	3
(C)	3	1	4	2	5
(D)	2	3	5	4	1

Solution: (B)

Column I		Column II	
A.	Fumagillin	4.	*Aspergillus fumigatus*
B.	Bacitracin	5.	*Bacillus licheniformis*
C.	Streptomycin	2.	*Streptomyces griseus*
D.	Viridin	1.	*Gliocladium virens*
E.	Polymixin	3.	*Bacillus polymyxa*

35. Arrange in correct order according to the given figures.

(A) A —Imbricate, B —Quincuncial, C —Valvate, D —Twisted, E —Vexillary
(B) A —Vexillary, B —Valvate, C —Twisted, D —Imbricate, E —Quincuncial
(C) A —Quincuncial, B —Twisted, C —Vexillary, D —Imbricate, E —Valvate
(D) A —Valvate, B —Twisted, C —Imbricate, D —Quincuncial, E —Vexillary
Solution: (D)
Valvate petals are close to each other and do not overlap. In **twisted**, petals overlap each other regularly. In **imbricate**, there are five petals, arranged in such a way that one petal is completely external and one is completely internal. In **quincuncial**, two out of five petals are completely external and remaining 3 are partially external and partially internal. In **vexillary**, the posterior petal overlaps the two smaller lateral petals and later in turn overlap the two anterior petals.

36. $cry\ II$ Ab and $cry\ I$ Ab produce toxins that control
(A) Cotton bollworms and corn borer, respectively
(B) Corn borer and cotton bollworms, respectively
(C) Tobacco budworms and nematodes, respectively
(D) Nematodes and tobacco budworms, respectively
Solution: (A)
Bt toxin genes are isolated from *Bacillus thuringiensis* and incorporated into several crop plants such as cotton. Two *cry* genes namely $cry\ I$ Ac and $cry\ II$ Ab have been incorporated in cotton. The genetically modified crop is called *Bt* cotton as it contains *Bt* toxin genes which protect it from cotton bollworms. Similarly $cry\ I$ Ab have been introduced in *Bt* corn to protect the same from corn borer.

37. Math the following columns.

Column I		Column II	
A.	Hinge	1.	Atlas and axis
B.	Saddle	2.	Frontal and parietal
C.	Pivot	3.	Carpal and metacarpal of humans

D.	Ball and socket	4.	Knee
		5.	Humerus and pectoral girdle

Codes

	A	B	C	D
(A)	2	5	3	1
(B)	3	2	5	4
(C)	4	3	1	5
(D)	1	4	2	3

Solution: (C)

Column I		Column II	
A.	Hinge	4.	Knee
B.	Saddle	3.	Carpal and metacarpal of thumbs
C.	Pivot	1.	Atlas and axis
D.	Ball and socket	5.	Humerus and pectoral girdle

38. Which one of the following conditions correctly describes the manner of determining the sex?
(A) Homozygous sex chromosomes (ZZ) determine female sex in birds
(B) XO type of sex chromosomes determine male sex in grasshopper
(C) XO condition in humans as found in Turner's syndrome determines female sex
(D) Homozygous sex chromosomes (XX) produce males in *Drosophila*
Solution: (B)
XO type of sex chromosomes determine male sex in grasshoppers. This type of sex-determination comes under XX-XO type. It is common in cockroaches, grasshoppers and bugs. The female has two homomorphic sex chromosomes XX and is homogametic. It produces similar eggs, each with one X-chromosome. The male has one chromosome only and is heterogametic. It produces two types of sperms—gynosperms with X and androsperms without X.
Other statements can be corrected as follows
In birds. the females are heterozygous and represented as ZW.
Female sex in humans is represented as XX.
In *Drosophila,* males are heterogametic, i.e. XY.

39. Read the following statements
I. Colostrum is recommended for the new borns because it is rich in antigens.
II. Chikungunya is caused by a Gram negative bacterium.
III. Tissue culture has proved useful in obtaining virus-free plants.
IV. Beer is manufactured by distillation of fermented grapes.
How many of the statement(s) is/are correct?
(A) Two
(B) One
(C) Three
(D) Four
Solution: (B)
Chikungunya is caused by chikungunya virus. Colostrum is the first breastmilk of mother, which contains antibodies (especially Ig A). It provides immunity to infants against various pathogens. Beer is manufactured by the fermentation of barley malt by yeast.
Tissue culture can be used to obtain virus-free healthy plants from diseased plants. It is because of the fact that meristematic cells are undifferentiated in nature.

40. A scion is grafted to a stock. The quality of fruits produced will be determined by the genotype of
(A) Stock
(B) Scion
(C) Both Stock and Scion
(d) Neither Stock nor Scion
Solution: (B)
In grafting technique, parts of two plants are joined to form a composite plant. One plant has a strong root system called the stock and the other plant has better flower or fruit yield called the scion. Hence, the fruit produced in such plants has the genotypes of the scion.

41. Assertion: Nitrogen-fixing bacteria of legume root nodules survive in oxygen depleted cells.
Reason: Leghaemoglobin completely removes oxygen from nodule cells.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
Enzyme nitrogenase is sensitive to O_2 and therefore, it is found in oxygen depleted cells. In the cells of root nodules leghaemoglobin is present and pigment is an oxygen scavenger. Hence, it provides anaerobic condition to nitrogen fixing bacteria.

42. Assertion: Cytochrome oxidase enzyme contains copper.
Reason: Cyanide combines with copper of cytochrome oxide and prevents oxygen to combine with it.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
The final stage of respiratory chain involves cytochrome oxidase, which contains copper. This stage can be specifically inhibited by cyanide or carbon monoxide. Cyanide combines with the copper and prevents oxygen from combining with it.

43. Assertion: In females. parturition is the act of giving birth to a baby.
Reason: Signals for parturition originate from a fully developed foetus.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
The act of giving birth to a baby is called parturition. It is induced by a complex neuroendocrine mechanism. The signals originate from a fully developed foetus and the placenta, which induces mild uterine contractions.

44. Assertion: Meiotic division occurs in reproductive cells.
Reason: Synapsis occurs during zygotene of meiosis.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
Meiotic division is a reductional division. It occurs in reproductive cells and maintains the fixed number of chromosomes in sexually reproducing organisms. Prophase$-I$ of meiotic division is a long phase, which is divided into five subphases, i.e. leptotene, zygotene, pachytene, diplotene and diakinesis. Synapsis or pairing of chromosomes occurs during the zygotene stage.

45. Assertion: Peptide and polypeptide hormones directly pass across the lipid bilayer of plasma membrane.
Reason: Oxytocin hormone can pass across the plasma membrane.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (D)
Peptide and polypeptide hormones such as oxytocin and vasopressin are water soluble hormones and are not soluble in lipid solution. Therefore, they cannot directly pass across the lipid bilayer of plasma membrane.

46. Assertion: In apomixis, the plants of new genetic sequence are produced.
Reason: In apomixis, two organisms of same genetic sequence meet.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (D)
In apomixis, the sexual reproduction is completely replaced by a sexual reproduction. It offers the possibility of indefinite multiplication of favourable biotypes without any variation due to segregation or recombination.

47. Assertion: The quiescent centre acts as a reservoir of relatively resistant cells, which constitute a permanent source of active initials.
Reason: The cells of the inactive region of quiescent centre become active, when the previous active initials get damaged.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (A)
Quiescent centre is found in the centre of the root apex. Cell divisions are very few in the quiescent centre. It may function as reserve meristem.

48. Assertion: Two turns of Krebs' cycle occur per glucose molecule used.
Reason: Each turn of Krebs' cycle produces $3\ NADH, 1FADH_2$ and $1\ ATP$ molecule.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false

(D) Assertion and Reason are false
Solution: (B)
Glucose is converted into two molecules of pyruvic acid so, two cycles of Krebs' cycle occur for one per glucose molecule. Each turn of Krebs' cycle produces $3\,NADH, 1\,FADH_2$ and $1\,ATP$ molecule. On oxidation, $NADH$ produces $3\,ATP$ molecules and $1\,FADH_2$, which in turn produces $2\,ATP$ molecules. Thus, in each turn of Krebs' cycle $12\,ATP$ molecules are produced. Two Krebs' cycles occur per glucose molecule because glycolysis results in the formation of 2 pyruvic acid molecules by glucose breakdown.

49. Assertion: Alcoholics may show deficiency symptoms of Wernicke's and Korsakoff's syndromes.
Reason: Alcohol acts as depressant.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
Alcohol acts as a depressant of nervous system and acts as sedative and reduces the efficiency of body organs by reducing blood supply. Deficiency of nutrients such as minerals, proteins and vitamins are found in alcoholics. Thiamine (B_1) deficiency causes Wernicke's and Korsakoff's syndromes. Wernicke's syndrome is characterised by mental disturbance, paralysis of eye movements and ataxia of gait. Korsakoff's syndrome is characterised by confusion and severe impairment of memory.

50. Assertion: BOD is an indicator of pollution in water.
Reason: High BOD is observed in highly polluted water.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (A)
Biological Oxygen Demand (BOD) is the amount of O_2 (in milligrams), required to decompose organic matter present in one litre of water which is heavily polluted. Increase in BOD value causes sharp decline in dissolved oxygen in water, hence, indicating that the water is polluted.

51. Assertion: Pork should be properly cooked to avoid *Taenia* infection.
Reason: Pork of pig contains hexacanth and cysticercus larvae.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (C)
Human get *Taenia* infection through direct or oral means. It occurs by eating raw or undercooked measly pork (pig muscle with cysticercus larvae of taenia). Infection in vegetarians occurs through improperly washed vegetables. So, proper cooking of pork and properly washed vegetables can help to avoid *Taenia* infection. The pork does not contain hexacanth larva as it gets converted into cysticurcus form in the voluntary muscles of the pig.

52. Assertion: Magnesium is important in photosynthesis and carbohydrate metabolism.
Reason: Mg^{2+} is involved in the synthesis of nucleic acids.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
Magnesium is constituent of chlorophyll molecule, without which, the photosynthesis would not occur. Many of the enzymes involved in carbohydrate metabolism require magnesium as an activator. Magnesium is also an activator for enzymes involved in the synthesis of nucleic acids (DNA, RNA).

53. Assertion: Phenylketonuria is recessive hereditary disease caused by body's failure to oxidise an amino acid phenylalanine to tyrosine, because of defective enzyme.
Reason: It is characterised by in the presence of phenylalanine acid in urine.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
Phenylketonuria occurs due to the deficiency of liver enzyme phenylalanine hydroxylase which converts phenylalanine into tyrosine. It occurs in people who are homozygously recessive. It results in a higher level of phenylalanine in blood, tissue fluids and urine.

54. Assertion: Caryopsis fruits differ from typical achenes with respect to the fusion of pericarp with the seed-coat (testa).
Reason: Caryopsis fruits commonly occur in the members of family-Poaceae.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (B)
Caryopsis and achenes develop from monocarpellary unilocular, one-seeded and superior ovaries. The only difference in them is that, in caryopsis, pericarp and seed coat are fused. Caryopsis is common in Poaceae family.

55. Assertion: The collenchyma is a thick-walled living tissue.
Reason: The collenchyma is thickened due to deposition of pectin.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (A)
Collenchyma is a specialised type of parenchyma which acts as a supporting tissue. The cell walls are irregularly thickened due to deposition of cellulose and pectin. It is a living tissue.

56. Assertion: In mitosis, two identical cells are produced from a single cell and karyokinesis is followed by cytokinesis.
Reason: Cytokinesis is of two types, i.e. by cell-furrow method and cell-plate method.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false

(D) Assertion and Reason are false
Solution: (B)
Mitosis is the process by which a cell nucleus divides (karyokinesis) to produce two daughter nuclei containing identical sets of chromosomes to the parent cell. It is usually followed immediately by division of cytoplasm (cytokinesis) to form two daughter cells. In plants, cytokinesis occurs by cell-plate method whereas in animals, it occurs by cell furrow method.

57. Assertion: Non-cyclic photophosphorylation occurs in the stroma of chloroplasts.
Reason: There is discontinuous flow of electrons in this process.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (D)
Non-cyclic photophosphorylation occurs in granum of chloroplast. It is an association of photosystem$-I$ and II. In this process, electron continuously flows from water to PS$-II$ to PS$-I$ and then to final electron acceptor. In this process, ATP is formed from ADP and O_2 is evolved.

58. Assertion: *Taenia solium* and *Dugesia* belong to Platyhelminthes.
Reason: Platyhelminthes are coelomates.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (C)
Taenia solium belongs to the class — Cestoda and *Dugesia* (*Planaria*) belongs to Turbellaria class of Platyhelminthes. These are acoelomates, i.e. they do not possess any fluid-filled cavity.

59. Assertion: The non-allelic genes for red hair and prickles are usually inherited together.
Reason: The genes for red hair and prickles are located on the same chromosome in close association.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (A)
Genes situated in the same chromosomes are said to be linked. All genes in a single chromosome form a linkage group and usually pass it into the same gamete and are inherited together as a result of linkage. These genes do not show independent assortment. e.g. genes for red hair and prickles are linked genes.

60. Assertion: Photomodulation of flower is phytochrome regulated process.
Reason: Active form of phytochrome (Pfr) directly induces floral induction in shoot buds.
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) Assertion true, but Reason is false
(D) Assertion and Reason are false
Solution: (C)
Phytochrome is a flavoprotein that controls photomodulation in plants. Flower induction occurs due to florigen in shoot buds.

General Knowledge

Single correct answer type:

1. Identify this famous personality?

(A) Vladimir Putin
(B) Donald Trump
(C) George W Bush
(D) Barack Obama
Solution: (B)
Donald Trump

2. The parliament of Japan is known as
(A) Assembly
(B) Key
(C) Senate
(D) Diet
Solution: (D)
Diet

3. Name the person given in the figure.

(A) Ban-Ki-Moon
(B) Kim Jong-Un
(C) Haan Myeong-Sook
(D) Win Myint
Solution: (B)
Kim Jong-Un

4. Pruning is an essential part in cultivation of
(A) Rubber
(B) Tobacco
(C) Coffee
(D) Tea
Solution: (D)
Tea

5. An Ordinary Bill passed by the State Assembly can be delayed by the Legislative Council for a maximum period of
(A) 1 month
(B) 6 months
(C) 3 months
(D) 4 months
Solution: (C)
3 months

6. Which of the following hills are found where the Eastern ghats and the Western ghats meet?
(A) Anaimalai Hills
(B) Cardamom Hills
(C) Nilgiri Hills
(D) Shevoroy Hills
Solution: (C)
Nilgiri Hills

7. The transition zone between two ecosystems is called
(A) Biome
(B) Biotope
(C) Ecotone
(D) Sere
Solution: (C)
Ecotone

8. The non-permanent members of the Security Council are elected for
(A) One year
(B) Two years
(C) Three years
(D) Six months
Solution: (B)
Two years

9. The Fundamental Right which has been described by Dr. B R Ambedkar as 'The heart and soul of the Constitution' is the right to
(A) Equality
(B) Property
(C) Freedom of Religion
(D) Constitutional Remedies
Solution: (A)

Equality

10. One of the leaders who founded the Swaraj Party was
(A) Mahatma Gandhi
(B) B G Tilak
(C) K Kamaraj
(D) Chittaranjan Das
Solution: (D)
Chittaranjan Das

11. The policy of price control in markets was launched by
(A) Sher Shah
(B) Ashoka
(C) Akbar
(D) Alauddin Khalji
Solution: (D)
Alauddin Khalji

12. The place which has the longest day and the shortest night on 22nd December, is
(A) Chennai
(B) Madrid
(C) Melbourne
(D) Moscow
Solution: (C)
Melbourne

13. From which sports 'Gary Player' is associated with?
(A) Cricket
(B) Golf
(C) Hockey
(D) Table Tennis
Solution: (B)
Golf

14. Rashid khan has become the youngest captain in international cricket history. He belongs to which country?
(A) Nepal
(B) Bangladesh
(C) Afghanistan
(D) Sri Lanka
Solution: (C)
Afghanistan

15. Who among the following is/are the recipient of Rajiv Gandhi Khel Ratna Award 2017?
(A) Virat Kohli
(B) Devendra Jhajharia
(C) Sardara Singh
(D) Both Devendra Jhajharia and Sardara Singh

Solution: (D)
Both Devendra Jhajharia and Sardara Singh

16. Which of the following acts gave representation to the Indians for the first time in legislation?
(A) Indian Councils Act, 1909
(B) Indian Councils Act, 1919
(C) Government of India Act, 1919
(D) Government of India Act, 1935
Solution: (A)
Indian Councils Act, 1909

17. How many members of the Rajya Sabha retire from the house every 2 years?
(A) $1/6$ of the total members
(B) $1/3$ of the total members
(C) $1/12$ of the total members
(D) $5/6$ of the total members
Solution: (B)
$1/3$ of the total members

18. The depiction of the stories of the previous lives of Gautam Buddha was firstly done in the art of
(A) Sarnath Pillar of Ashoka
(B) Bharat Stupa
(C) Ajanta Caves
(D) Ellora Caves
Solution: (D)
Ellora Caves

19. The earliest Surat factories were established by the
(A) Portuguese
(B) Dutch
(C) English
(D) French
Solution: (C)
English

20. In which year Gandhiji established Sabarmati Ashram in Gujarat?
(A) 1916
(B) 1917
(C) 1918
(D) 1929
Solution: (B)
1917