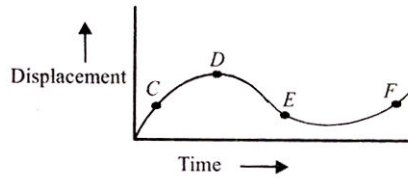


Sol: Here, $u = 0$, $g = 10\text{ms}^{-2}$, $h = 20\text{ m}$
 Let v be the velocity with which the stone hits the ground

$$\therefore v^2 = u^2 + 2gh$$

$$\text{or } v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20\text{ m/s } (\because u = 0)$$

Q.4 The displacement-time graph of a moving particle is shown below. The instantaneous velocity of the particle is negative at the point



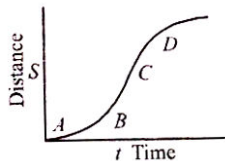
- (a) *E* (b) *F* (c) *C* (d) *D*

Ans: (a)

Sol: The velocity (v) = $\frac{ds}{dt}$.

Therefore, instantaneous velocity at point *E* is negative.

Q.5 A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point.



- (a) *D* (b) *A* (c) *B* (d) *C*

Ans: (d)

Sol: Because the slope is highest at *C*, $v = \frac{ds}{dt}$ is maximum.

Q.6 A 500 kg car takes a round turn of radius 50 m with a velocity of 33 km/hr. The centripetal force is

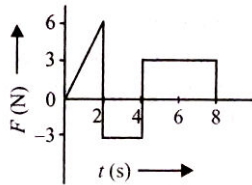
- (a) 1000 N (b) 250 N (c) 750 N (d) 1200 N

Ans: (a)

Sol: $F_{centripetal} = \frac{mv^2}{R}$; $v = \left(36 \times \frac{5}{18}\right) \text{ m/s}$

$$F_{centripetal} = \frac{500 \times \left(36 \times \frac{5}{18}\right)^2}{50} = 1000\text{ N}$$

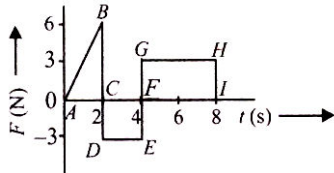
- Q.7** The force F acting on a particle of mass m is indicated by the force-time graph shown below. The change in momentum of the particle over the time interval from zero to 8 s is



- (a) 24 N s (b) 20 N s (c) 12 N s (d) 6 N s

Ans: (c)

Sol:



Change in momentum = Area under $F-t$ graph in that interval
 = Area of ΔABC - Area of rectangle $CDEF$ + Area of rectangle $FGHI$
 = $\frac{1}{2} \times 2 \times 6 - 3 \times 2 + 4 \times 3 = 12 \text{ N s}$

- Q.8** 250 N force is required to raise 75 kg mass from a pulley. If rope is pulled 12 m then the load is lifted to 3 m, the efficiency of pulley system will be
 (a) 25% (b) 33.3% (c) 75% (d) 90%

Ans: (c)

Sol: Load $W = Mg = 75 \times 10 = 750 \text{ N}$

Effort (P) = 250 N

\therefore Mechanical advantage

$$= \frac{\text{load}}{\text{effort}} = \frac{W}{P} = \frac{750}{250} = 3.$$

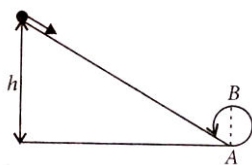
Velocity ratio

$$= \frac{\text{distance travelled by effort}}{\text{distance travelled by load}} = \frac{12}{3} = 4$$

$$\text{Efficiency, } \eta = \frac{\text{Mechanical advantage}}{\text{Velocity ratio}}$$

$$= (3/4) \times 100 = 75\%$$

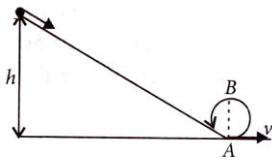
- Q.9** A body initially at rest and sliding along a frictionless track from a height h (as shown in the figure) just completed a vertical circle of diameter $AB = D$. the height h is equal to



- (a) $\frac{3}{2}D$ (b) D (c) $\frac{7}{5}D$ (d) $\frac{5}{4}D$

Ans: (d)

Sol:



As body is at rest initially, i.e., speed = 0.

At point A, speed = v .

As track is frictionless, so total mechanical energy will remain constant.

$$\therefore (T.M.E)_i = (T.M.E)_f$$

$$0 + mgh = \frac{1}{2}mv^2 + 0 \text{ or } h = \frac{v^2}{2g}$$

For completing the vertical circle, $v \geq \sqrt{5gR}$

$$\therefore h = \frac{5gR}{2g} = \frac{5}{2}R = \frac{5}{4}D$$

Q.10 A stationary particle explodes into two particles of masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2 . The ratio of their kinetic energies E_1 / E_2 is

(a) m_2 / m_1

(b) 1

(c) m_1 / m_2

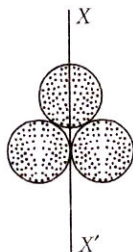
(d) $m_1 v_2 / m_2 v_1$

Ans: (a)

Sol: $m_1 v_1 = m_2 v_2$ (conservation of linear momentum)

$$\frac{E_1}{E_2} = \frac{(1/2)m_1 v_1^2}{(1/2)m_2 v_2^2} = \frac{m_1^2 m_2^2}{m_2^2 v_2^2} \cdot \frac{m_2}{m_1} = \frac{m_2}{m_1}$$

Q.11 Three identical spherical shells, each of mass m and radius r are placed as shown in figure. Consider an axis XX' which is touching to two shells and passing through diameter of third shell. Moment of inertia of the system consisting of these three spherical shells about XX' axis is



(a) $\frac{16}{5}mr^2$

(b) $4mr^2$

(c) $\frac{11}{5}mr^2$

(d) $3mr^2$

Ans: (b)

Sol: Net moment of inertia of the system.

$$I = I_1 + I_2 + I_3$$

The moment of inertia of a shell about its diameter,

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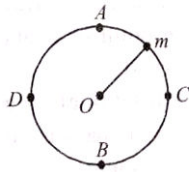
$$I_1 = \frac{2}{3}mr^2$$

The moment of inertia of a shell about its tangent is given by

$$I_2 = I_1 + mr^2 = \frac{2}{3}mr^2 + mr^2 = \frac{5}{3}mr^2$$

$$\therefore I = 2 \times \frac{5}{3}mr^2 + \frac{2}{3}mr^2 = \frac{12mr^2}{3} = 4mr^2$$

Q.12 As shown in the figure at point O a mass is performing vertical circular motion. The average velocity of the particle is increased, then at which point will the string break?



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

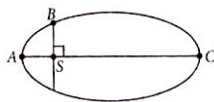
Ans: (b)

Sol: When a sphere is rotating in a vertical circle, it exerts the maximum outward pull when it is at the lowest point B.

Therefore, tension at B is maximum = Weight + $\frac{mv^2}{R}$

So, the string breaks at point B.

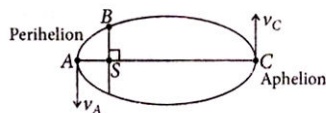
Q.13 The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are K_A , K_B and K_C respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then



- (a) $K_A < K_B < K_C$ (b) $K_A > K_B > K_C$
 (c) $K_B < K_A < K_C$ (d) $K_B > K_A > K_C$

Ans: (b)

Sol:



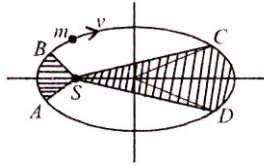
Point A is perihelion and C is aphelion.

So, $v_A > v_B > v_C$

As kinetic energy $k = \frac{1}{2}mv^2$ or $k \propto v^2$

So, $K_A > K_B > K_C$.

- Q.14** The figure shows elliptical orbit of a planet m about the sun S . The shaded area SCD is twice the shaded area SAB . If t_1 is the time for the planet to move C to D and t_2 is the time to move from A to B then



- (a) $t = 4t_2$ (b) $t_1 = 2t_2$ (c) $t_1 = t_2$ (d) $t_1 > t_2$

Ans: (b)

Sol: Equal areas are swept in equal time.

t_1 , the time taken to go from C to $D = 2t_2$

where t_2 is the time taken to go from A to B .

As it is given that area $SCD = 2SAB$.

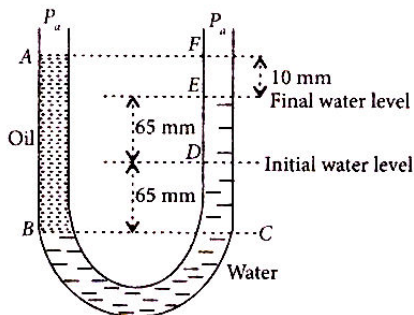
- Q.15** A planet is moving in an elliptical orbit around the sun. If T , V , E and L stand respectively for its kinetic energy, gravitational potential energy, total energy and magnitude of angular momentum about the centre of force, which of the following is correct?

- (a) T is conserved
 (b) V is always positive
 (c) E is always negative
 (d) L is conserved but direction of vector L changes continuously

Ans: (c)

Sol: In a circular or elliptical orbital motion torque is always acting parallel to displacement or velocity. So, angular momentum is conserved. In attractive field, potential energy is negative. Kinetic energy changes as velocity increases when distance is less. But if the motion is in a plane, the direction of L does not change.

- Q.16** A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is



- (a) 425 kg m^{-3} (b) 800 kg m^{-3} (c) 928 kg m^{-3} (d) 650 kg m^{-3}

Ans: (c)

Sol: Pressure at point C,

$$P_C = P_a + \rho_{\text{water}} g h_{\text{water}}$$

where $h_{water} = CE = (65 + 65) \text{ mm} = 130 \text{ mm}$

Pressure at point B, $P_B = P_a + \rho_{oil} gh_{oil}$

where $h_{oil} = AB = (65 + 65 + 10) \text{ mm} = 140 \text{ mm}$

In liquid, pressure is same at same liquid level,

$$P_B = P_C \Rightarrow \rho_{oil} gh_{oil} = \rho_{water} gh_{water}$$

$$\rho_{oil} = \frac{130 \times 10^3}{140} = \frac{13}{14} \times 10^3 = 928.57 \text{ kg m}^{-3}$$

Q.17 If the radius of a star is R and it acts as black body, what would be the temperature of the star, in which the rate of energy production is Q ?

- (a) $\frac{Q}{4\pi R^2 \sigma}$ (b) $\left(\frac{Q}{4\pi R^2 \sigma}\right)^{-1/2}$ (c) $\left(\frac{4\pi R^2 \sigma}{Q}\right)^{1/4}$ (d) $\left(\frac{Q}{4\pi R^2 \sigma}\right)^{1/4}$

Ans: (d)

Sol: According to Stefan's law, $Q = \sigma AT^4$

$$\text{or } T = \left(\frac{Q}{\sigma A}\right)^{1/4} = \left(\frac{Q}{\sigma 4\pi R^2}\right)^{1/4}$$



Q.18 A Centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registers 140°F . What is the fall in temperature as registered by the centigrade thermometer?

- (a) 80°C (b) 60°C (c) 40°C (d) 30°C

Ans: (c)

Sol: Here, $F = 140^\circ$

$$\text{Using } \frac{F - 32}{180} = \frac{C}{100},$$

$$\therefore \frac{140 - 32}{180} = \frac{C}{100} \Rightarrow C = 60^\circ\text{C}$$

we get, fall in temperature = 40°C

Q.19 The ratio of the specific heats $\frac{C_p}{C_v} = \gamma$ in terms of degrees of freedom (n) is given by

- (a) $\left(1 + \frac{2}{n}\right)$ (b) $\left(1 + \frac{n}{2}\right)$ (c) $\left(1 + \frac{1}{n}\right)$ (d) $\left(1 + \frac{n}{3}\right)$

Ans: (a)

Sol: For n degrees of freedom, $C_v = \frac{n}{2}R$

Also, $C_p - C_v = R$

$$C_P = C_v + R = \frac{n}{2}R + R = \left(\frac{n}{2} + 1\right)R$$

$$\gamma = \frac{C_P}{C_v} = \frac{\left(\frac{n}{2} + 1\right)R}{\left(\frac{n}{2}\right)R} = \frac{n+2}{n} \quad \therefore \quad \gamma = 1 + \frac{2}{n}$$

Q.20 In an adiabatic change, the pressure and temperature of a monatomic gas are related as $P \propto T^C$, where C equals

(a) $\frac{3}{5}$

(b) $\frac{5}{3}$

(c) $\frac{2}{5}$

(d) $\frac{5}{2}$

Ans: (d)

Sol: For adiabatic change, $PV^\gamma = \text{constant}$

$$\Rightarrow P \left(\frac{RT}{\rho} \right)^\gamma = \text{constant} \Rightarrow p^{1-\gamma} T^\gamma = \text{constant}$$

$$\Rightarrow P \propto T^{\frac{-\gamma}{1-\gamma}}$$

Therefore, the value of constant $C = \frac{\gamma}{(\gamma-1)}$. For monoatomic gas, $\gamma = \frac{5}{3}$.

$$\text{Therefore } C = \frac{5/3}{(5/3)-1} = \frac{5/3}{2/3} = \frac{5}{2}$$

Q.21 Out of the following functions representing motion of a particle which represents SHM

(1) $y = \sin \omega t - \cos \omega t$

(2) $y = \sin^3 \omega t$

(3) $y = 5 \cos \left(\frac{3\pi}{4} - 3\omega t \right)$

(4) $y = 1 + \omega t + \omega^2 t^2$

(a) Only (1)

(b) Only (4) does not represent SHM

(c) Only (1) and (3)

(d) Only (1) and (2)

Ans: (c)

Sol: $y = \sin \omega t - \cos \omega t$

$$= \sqrt{2} \left[\frac{1}{\sqrt{2}} \sin \omega t - \frac{1}{\sqrt{2}} \cos \omega t \right] = \sqrt{2} \sin \left(\omega t - \frac{\pi}{4} \right)$$

It represents a SHM with time period, $T = \frac{2\pi}{\omega}$.

$$y = \sin^3 \omega t = \frac{1}{4} [3 \sin \omega t - \sin 3\omega t]$$

It represents a periodic motion with time period $T = \frac{2\pi}{\omega}$ but not SHM.

$$y = 5 \cos\left(\frac{3\pi}{4} - 3\omega t\right)$$

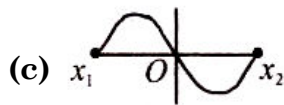
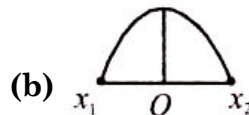
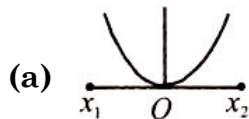
$$= 5 \cos\left(3\omega t - \frac{3\pi}{4}\right) \quad (\because \cos(-\theta) = \cos\theta)$$

It represents a SHM with time period, $T = \frac{2\pi}{3\omega}$.

$$y = 1 + \omega t + \omega^2 t^2$$

It represents a non-periodic motion. Also it is not physically acceptable as $y \rightarrow \infty$ as $t \rightarrow \infty$.

Q.22 A particle of mass m oscillates with simple harmonic motion points x_1 and x_2 , the equilibrium position being O . Its potential energy is plotted. It will be as given below in the graph



Ans: (a)

Sol: Potential energy of particle performing SHM varies parabolically in such a way that at mean position it becomes zero and maximum at extreme position.

Q.23 Two sound waves with wavelength 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second.

(a) 6 (b) 12 (c) 0 (d) 1

Ans: (a)

Sol: Frequency = $\frac{\text{velocity}}{\text{wavelength}}$

$$\therefore \nu_1 = \frac{v}{\lambda_1} = \frac{330}{5} = 66 \text{ Hz}$$

$$\text{and } \nu_2 = \frac{v}{\lambda_2} = \frac{330}{5.5} = 60 \text{ Hz}$$

$$\begin{aligned} \text{Number of beats per second} &= \nu_1 - \nu_2 \\ &= 66 - 60 = 6. \end{aligned}$$

Q.24 Two stationary sources each emitting waves of wavelength λ , an observer moves from one source to another with velocity u . Then number of beats heard by him

- (a) $\frac{2u}{\lambda}$ (b) $\frac{u}{\lambda}$ (c) $\sqrt{u\lambda}$ (d) $\frac{u}{2\lambda}$

Ans: (a)

Sol: $f' = \frac{v-u}{v} f$; $f'' = \frac{v+u}{v} f$

Number of beats = $f'' - f' = \frac{2u}{\lambda}$

Q.25 The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and A , is

- (a) Independent of the distance between the plates
 (b) Linearly proportional to the distance between the plates
 (c) Proportional to the square root of the distance between the plates
 (d) Inversely proportional to the distance between the plates

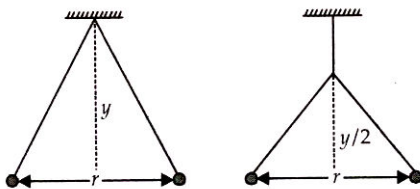
Ans: (a)

Sol: For isolated capacitor, charge $Q = \text{constant}$.

Electrostatic force, $F_{\text{plate}} = \frac{Q^2}{2A\epsilon_0}$

F is independent of the distance between plates.

Q.26 Two pith balls carrying equal charges are suspended from a common point by strings of equal length, the equilibrium separation between them is r . Now the strings are rigidly clamped at half the height. The equilibrium separation between the balls now become



- (a) $\left(\frac{2r}{\sqrt{3}}\right)$ (b) $\left(\frac{2r}{3}\right)$ (c) $\left(\frac{1}{\sqrt{2}}\right)^2$ (d) $\left(\frac{r}{3\sqrt{2}}\right)$

Ans: (d)

Sol: Let m be mass of each ball and q be charge on each ball.

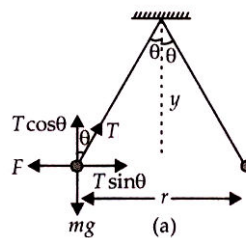
Force of repulsion,

$$F = \frac{1}{4\pi\epsilon_0 r^2}$$

In equilibrium

$$T \cos \theta = mg \quad \dots(i)$$

$$T \sin \theta = F \quad \dots(ii)$$

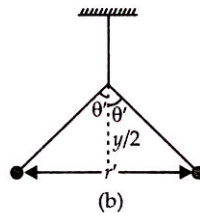


Divide (ii) by (i), we get, $\tan \theta = \frac{F}{mg} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \frac{q}{mg}$

From figure (a),

$$\frac{r/2}{y} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \frac{q}{mg} \quad \dots(\text{iii})$$

$$\tan \theta' = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \frac{q}{mg}$$



From figure (b),

$$\frac{r'/2}{y/2} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \frac{q}{mg} \quad \dots(\text{iv})$$

Divide (iv) by (iii), we get

$$\frac{2r'}{r} = \frac{r^2}{r'^2} \Rightarrow r'^3 = \frac{r^3}{2} \Rightarrow r' = \frac{r}{\sqrt[3]{2}}$$

Q.27 A parallel plate condenser with oil between the plates (dielectric constant of oil $K = 2$) has a capacitance C . If the oil is removed, then capacitance of the capacitor becomes

- (a) $\frac{C}{\sqrt{2}}$ (b) $2C$ (c) $\sqrt{2}C$ (d) $\frac{C}{2}$

Ans: (d)

Sol: Capacitance of capacitor with oil between the plate, $C = \frac{K\epsilon_0 A}{d}$

If oil is removed capacitance, $C' = \frac{\epsilon_0 A}{d} = \frac{C}{K} = \frac{C}{2}$

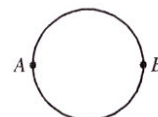
Q.28 A wire of resistance $12 \text{ ohms per meter}$ is bent to form a complete circle of radius 10 cm . The resistance between its two diametrically opposite points, A and B as shown in the figure is



- (a) 3Ω (b) $6\pi\Omega$ (c) 6Ω (d) $0.6\pi\Omega$

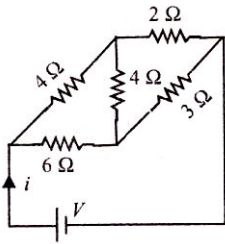
Ans: (d)

Sol: Wire of length $2\pi \times 0.1 \text{ m}$ of $12\Omega/\text{m}$ is bent to a circle.
Resistance of each part
 $= 12 \times \pi \times 0.1 = 1.2\pi\Omega$



\therefore Resistance between A and B = $0.6\pi\Omega$.

Q.29 For the network shown in the figure the value of the current i is



- (a) $\frac{9V}{35}$ (b) $\frac{18V}{5}$ (c) $\frac{5V}{9}$ (d) $\frac{5V}{18}$

Ans: (d)

Sol: Since given circuit is in the form of Wheatstone bridge,

$$\frac{1}{R_{eq}} = \frac{1}{(4+2)} + \frac{1}{(6+3)}; \quad R_{eq} = 18/5 \Omega$$

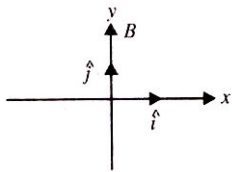
$$V = iR_{eq} \Rightarrow i = \frac{V}{R_{eq}} = \frac{5V}{18}.$$

Q.30 The magnetic force acting on a charged particle of charge $-2\mu\text{C}$ in a magnetic field of 2 T acting in y direction, when the particle velocity is $(2\hat{i} + 3\hat{j}) \times 10^6 \text{ ms}^{-1}$ is

- (a) 4 N in z direction (b) 8 N in y direction
(c) 8 N in z direction (d) 8 N in $-z$ direction

Ans: (d)

Sol:



$$\begin{aligned} \text{Lorentz force} &= q(\vec{v} \times \vec{B}) \\ &= (-2 \times 10^6)[(2\hat{i} + 3\hat{j}) \times 10^6 \times 2\hat{j}] = -8 \hat{k} \text{ N.} \\ &= 8 \text{ N in } -z \text{ direction.} \end{aligned}$$

Q.31 A galvanometer of resistance, G , is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is

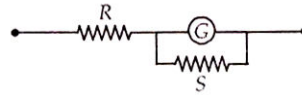
- (a) $\frac{G}{(S+G)}$ (b) $\frac{S^2}{(S+G)}$ (c) $\frac{SG}{(S+G)}$ (d) $\frac{G^2}{(S+G)}$

Ans: (d)

Sol: Let resistance R is to be put in series with galvanometer G to keep the main current in the circuit unchanged.

$$\therefore \frac{GS}{G+S} + R = G$$

$$R = G - \frac{GS}{G+S} \Rightarrow R = \frac{G^2 + GS - GS}{G+S}$$



$$R = \frac{2}{G+S}$$

Q.32 Curie temperature above which

- (a) paramagnetic material becomes ferromagnetic material
- (b) ferromagnetic material becomes diamagnetic material
- (c) ferromagnetic material becomes paramagnetic material
- (d) paramagnetic material becomes diamagnetic material

Ans: (c)

Sol: At curie temperature, there is a change from ferromagnetic to paramagnetic behaviour. Above this temperature, the paramagnetic substance obeys Curie Weiss law, even those substances which are not ferromagnetic but only paramagnetic also obey Curie Weiss law above the Curie temperature only.

Q.33 A bar magnet of magnetic moment \vec{M} is placed in a magnetic field of induction \vec{B} . The torque exerted on it is

- (a) $\vec{M} \times \vec{B}$
- (b) $-\vec{M} \cdot \vec{B}$
- (c) $\vec{M} \cdot \vec{B}$
- (d) $-\vec{B} \times \vec{M}$

Ans: (b)

Sol: _____

Q.34 The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor has inductance

- (a) 0.138 H
- (b) 138.88 H
- (c) 1.389 H
- (d) 13.89 H

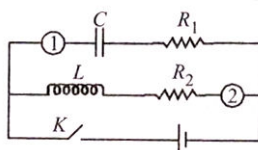
Ans: (d)

Sol: Magnetic potential energy stored in an inductor is given by

$$U = \frac{1}{2} LI^2 \Rightarrow 25 \times 10^{-3} = \frac{1}{2} \times L \times (60 \times 10^{-3})^2$$

$$L = \frac{25 \times 2 \times 10^{-3}}{3600} = \frac{500}{36} = 13.89 \text{ H}$$

Q.35 In the circuit given in figure, 1 and 2 are ammeters. Just after key K is pressed to complete the circuit, the reading will be



- (a) zero in 1, maximum in 2
- (b) maximum in both 1 and 2
- (c) zero in both 1 and 2
- (d) maximum in 1, zero in 2

Ans: (d)

Sol: At $t = 0$

- (i) capacitor offers negligible resistance
- (ii) inductor offers large resistance to current flow.

Q.36 The structure of solids is investigated by using

- (a) cosmic rays
- (b) X-rays
- (c) γ -rays
- (d) infra-red radiations

Ans: (b)

Sol: X-rays are used for the investigation of structure of solids.

Q.37 A 100Ω resistance and a capacitor of 100Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged. the peak value of the displacement current is

- (a) 2.2 A
- (b) 11 A
- (c) 4.4 A
- (d) $11\sqrt{2}$ A

Ans: (a)

Sol: Here, $R = 100\Omega$, $X_c = 100\Omega$

Net impedance, $Z = \sqrt{R^2 + X_L^2} = 100\sqrt{2}\Omega$

Peak value of displacement current

= Maximum conduction current in the circuit

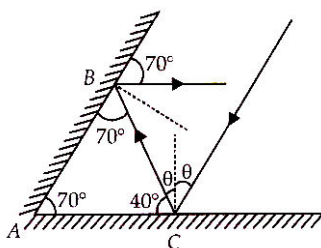
$$= \frac{\epsilon_0}{Z} = \frac{220\sqrt{2}}{100\sqrt{2}} = 2.2\text{ A}$$

Q.38 Two plane mirrors are inclined at 70° . A ray incident on one mirror at angle, θ after reflection falls on second mirror and is reflected from there parallel to first mirror. The value of θ is

- (a) 45°
- (b) 30°
- (c) 55°
- (d) 50°

Ans: (d)

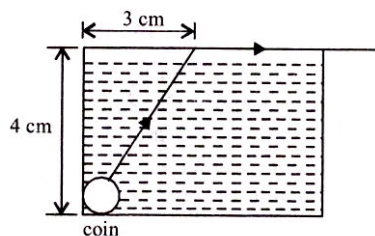
Sol: Different angles as shown in the figure. A Division of Aggarwal Educare



$$\theta + 40^\circ = 90^\circ$$

$$\therefore \theta = 90^\circ - 40^\circ = 50^\circ$$

- Q.39** A ray of light is incident on a 60° prism at the minimum deviation position. The angle of refraction at the first face (i.e., incident face) of the the prism is



- (a) zero (b) 30° (c) 45° (d) 60°

Ans: (b)

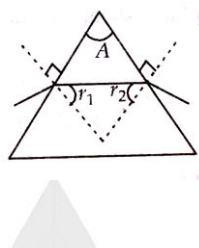
Sol: Angle of prism, $A = r_1 + r_2$

For minimum deviation

$$r_1 = r_2 = r \quad \therefore A = 2r$$

Given, $A = 60^\circ$

$$\text{Hence, } r = \frac{A}{2} = \frac{60^\circ}{2} = 30^\circ$$



- Q.40** A source of light is placed at a distance of 50 cm from a photo cell and the stopping potential is found to be V_0 . If the distance between the light source and photo cell is made 25 cm, the new stopping potential will be :

- (a) $V_0/2$ (b) V_0 (c) $4V_0$ (d) $2V_0$

Ans: (b)

Sol: By changing the position of source of light from photocell, there will be a change in the intensity of light falling on photocell.

As stopping potential is independent of the intensity of the incident light, hence stopping potential remains same i.e., V_0 .

- Q.41** Photoelectric work function of a metal is 1 eV. Light of wavelength $\lambda = 3000 \text{ \AA}$ falls on it. The photo electrons come out with a maximum velocity

- (a) 10 metres/sec (b) 10^2 metres/sec
(c) 10^4 metres/sec (d) 10^6 metres/sec

Ans: (d)

Sol: $h\nu = W + \frac{1}{2}mv^2$ or $\frac{hc}{\lambda} = W + \frac{1}{2}mv^2$

Here, $\lambda = 3000 \text{ \AA} = 3000 \times 10^{-10} \text{ m}$

and $W = 1 \text{ eV} = 1.6 \times 10^{-19} \text{ joule}$

$$\therefore \frac{(6.6 \times 10^{-34})(3 \times 10^8)}{3000 \times 10^{-10}}$$

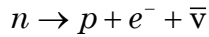
$$= (1.6 \times 10^{-19}) + \frac{1}{2} \times (9.1 \times 10^{-31})v^2$$

Solving we get $v \cong 10^6 \text{ m/s}$

- Q.42** In a radioactive decay process, the negatively charged emitted β -particles are
- the electrons produced as a result of the decay of neutrons inside the nucleus
 - the electrons produced as a result of collisions between atoms
 - the electrons orbiting around the nucleus
 - the electrons present inside the nucleus

Ans: (a)

Sol: In beta minus decay (β^-), a neutron is transformed into a proton and an electron is emitted with the nucleus along with an antineutrino.



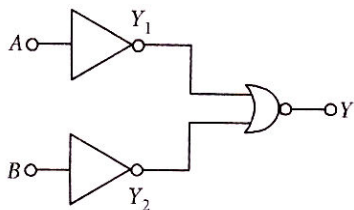
where $\bar{\nu}$ is the antineutrino.

- Q.43** The figure represents the observed intensity of X-rays emitted by an X-ray tube, as a function of wavelength. The sharp peaks A and B denote
- white radiations
 - characteristic radiations
 - band spectrum
 - continuous spectrum

Ans: (b)

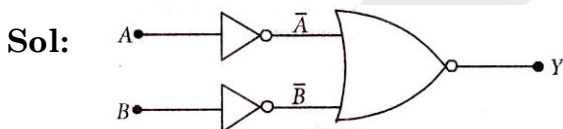
Sol: _____

- Q.44** Which logic gate is represented by the following combination of logic gates?



- (a) AND (b) NOR (c) OR (d) NAND

Ans: (a)



The Boolean expression of this arrangement is

$$Y = \overline{\overline{A}} + \overline{\overline{B}} = \overline{\overline{A \cdot B}} = A \cdot B$$

Thus, the combination represents AND gate.

- Q.45** The following truth-table belongs to which one of the following four gates?

A	B	Y
1	1	0
1	0	0
0	1	0
0	0	1

- (a) XOR (b) NOR (c) OR (d) NAND

Ans: (b)

Sol: For NOR gate, $Y = \overline{A + B}$. Therefore from the given truth table

A	B	A + B	$Y = \overline{A + B}$
1	1	1	0
1	0	1	0
0	1	1	0
0	0	0	1

CHEMISTRY

Q.46 Equal masses of H_2 , O_2 and methane have been taken in a container of volume V at temperature $27^\circ C$ in identical conditions. The ratio of the volumes of gases $H_2 : O_2 : \text{methane}$ would be

- (a) 8 : 16 : 1 (b) 16 : 8 : 1 (c) 16 : 1 : 2 (d) 8 : 1 : 2

Ans: (c)

Sol: According to Avogadro's hypothesis, ratio of the volumes of gases will be equal to the ratio of their no. of moles.

$$\text{So, No. of moles} = \frac{\text{Mass}}{\text{Mol. Mass}}$$

$$n_{H_2} = \frac{w}{2}; n_{O_2} = \frac{w}{32}; n_{CH_4} = \frac{w}{16}$$

$$\text{So, the ratio is } \frac{w}{2} : \frac{w}{32} : \frac{w}{16} \text{ or } 16 : 1 : 2$$

Q.47 Given the numbers: 161 cm, 0.141 cm, 0.0161 cm. The number of significant figures for the three numbers is

- (a) 3, 3 and 4 respectively (b) 3, 4 and 4 respectively
(c) 3, 4 and 5 respectively (d) 3, 3 and 3 respectively

Ans: (d)

Sol: Zeros placed left to the number are never significant, therefore the no. of significant figures for the numbers.

161 cm = 0.161 cm and 0.0161 cm are same, i.e. 3

Q.48 Two electrons occupying the same orbital are distinguished by

- (a) azimuthal quantum number
(b) spin quantum number
(c) principal quantum number
(d) magnetic quantum number

Ans: (b)

Sol: For the two electrons occupying the same orbital values of n , l and m_l are same

but m_s is different, i.e., $+\frac{1}{2}$ and $-\frac{1}{2}$

Q.49 The orientation of an atomic orbital is governed by

- (a) principal quantum number
- (b) azimuthal quantum number
- (c) spin quantum number
- (d) magnetic quantum number

Ans: (d)

Sol: Principal quantum number represents the name, size and energy of the shell to which the electron belongs. Azimuthal quantum number describes the spatial distribution of electron cloud and angular momentum. Magnetic quantum number describes the orientation of distribution of electron cloud. Spin quantum number represents the direction of electron spin around its own axis.

Q.50 Identify the wrong statement in the following.

- (a) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius.
- (b) Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius.
- (c) Atomic radius of the elements increases as one moves down the first group of the periodic table
- (d) Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table.

Ans: (a)

Sol: As positive charge on the cation increases, effective nuclear charge increases. Thus atomic size decreases.

Q.51 In the periodic table from left to right in a period, the atomic volume

- (a) decreases
- (b) increases
- (c) remains same
- (d) first decrease then increases

Ans: (d)

Sol: Atomic volume is the volume occupied by one gram of an element. Within a period from left to right, atomic volume first decreases and then increases.

Q.52 The correct bond order in the following species is

- (a) $O_2^+ < O_2^- < O_2^{2+}$
- (b) $O_2^- < O_2^+ < O_2^{2+}$
- (c) $O_2^{2+} < O_2^+ < O_2^-$
- (d) $O_2^{2+} < O_2^- < O_2^+$

Ans: (b)

Sol: O_2^- O_2 O_2^+ O_2^{2+}
B.O. : 1.5 2.0 2.5 3.0

Q.53 The correct order in which the O–O bond length increases in the following is

- (a) $O_2 < H_2O_2 < O_3$
- (b) $O_3 < H_2O_2 < O_2$
- (c) $H_2O_2 < O_2 < O_3$
- (d) $O_2 < O_3 < H_2O_2$

Ans: (d)

Sol: Bond lengths of O–O in O_2 is 1.21 \AA , in H_2O_2 is 1.48 \AA , and in O_3 is 1.28 \AA .
Therefore, correct order of the O–O bond length is $H_2O_2 > O_3 > O_2$.

Q.54 Maximum deviation from ideal gas is expected from
(a) $\text{CH}_4(\text{g})$ (b) $\text{NH}_3(\text{g})$ (c) $\text{H}_2(\text{g})$ (d) $\text{N}_2(\text{g})$

Ans: (b)

Sol: NH_3 is a polar molecule, thus more attractive forces between HN_3 molecule.

Q.55 At STP, 0.50 mol H_2 gas and 1.0 mol He gas
(a) have equal average kinetic energies
(b) have equal molecular speeds
(c) occupy equal volumes
(d) have equal effusion rates

Ans: (a)

Sol: Because average kinetic energy depends only on temperature $KE = \frac{3}{2}nkT$

Q.56 Assume each reaction is carried out in an open container. For which reaction will $\Delta H = \Delta E$?

- (a) $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g})$ (b) $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$
(c) $\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}_2(\text{g}) + \text{CO}_2(\text{g})$ (d) $\text{PCl}_5(\text{g}) \rightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$

Ans: (b)

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

For $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$

$\Delta n_g = 2 - (1 + 1) = 0$. i.e., $\Delta H = \Delta E$

Q.57 At 27°C latent heat of fusion of a compound is 2930 J/mol . Entropy change is
(a) 9.77 J/mol-K (b) 10.77 J/mol-K
(c) 9.07 J/mol-K (d) 0.977 J/mol-K

Ans: (a)

Sol: $\Delta S = \frac{Q}{T} = \frac{2930}{300} = 9.77 \text{ J/mol K}$

Q.58 Aqueous solution of which of the following compounds is the best conductor of electric current?

- (a) Hydrochloric acid, HCl (b) Ammonia, NH_3
(c) Fructose, $\text{C}_6\text{H}_{12}\text{O}_6$ (d) Acetic acid, $\text{C}_2\text{H}_4\text{O}_2$

Ans: (a)

Sol: HCl is a strong acid and dissociates completely into ions in aqueous solution.

Q.59 The ionization constant of ammonium hydroxide is 1.77×10^{-5} at 298 K . Hydrolysis constant of ammonium chloride is

- (a) 6.50×10^{-12} (b) 5.65×10^{-13} (c) 5.65×10^{-12} (d) 5.65×10^{-10}

Ans: (d)

Sol: NH_4Cl is a salt of strong acid and weak base, so hydrolysis constant is

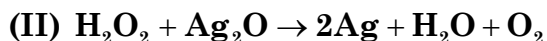
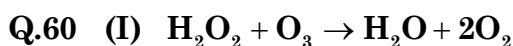
$$K_h = \frac{K_w}{K_b}$$

Given, $K_b(\text{NH}_4\text{OH}) = 1.77 \times 10^{-5}$

$$K_w = 10^{-14}$$

$$\therefore k_h = \frac{10^{-14}}{1.77 \times 10^{-5}} = 0.565 \times 10^{-9}$$

or $k_h = 5.65 \times 10^{-10}$



Role of hydrogen peroxide in the above reactions is respectively

(a) oxidizing in (I) and reducing in (II)

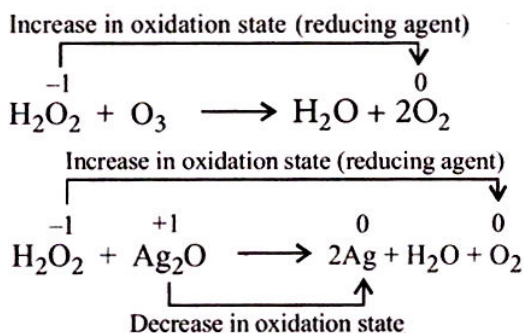
(b) reducing in (I) and oxidizing in (II)

(c) reducing in (I) and (II)

(d) oxidizing in (I) and (II)

Ans: (c)

Sol:



H_2O_2 acts as reducing agent in all those reactions in which O_2 is evolved.

Q.61 Which of the following is redox reaction?

(a) Evaporation of H_2O

(b) Both oxidation and reduction

(c) H_2SO_4 with NaOH

(d) In atmosphere O_3 from O_2 by lighting

Ans: (b)

Sol: Redox reactions are those chemical reactions which involve transfer of electrons from one chemical species to another.

Q.62 The O – O – H bond angle in H_2O_2 is

(a) 106°

(b) $109^\circ 28'$

(c) 120°

(d) 97°

Ans: (d)

Sol: Bond angle of O – O – H in H_2O_2 is 97° .

Q.63 Which of the following metal evolves hydrogen on reacting with cold dilute HNO_3 ?

(a) Mg

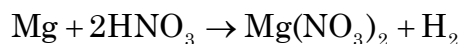
(b) Al

(c) Fe

(d) Cu

Ans: (a)

Sol: Mg reacts with nitric acid to give $\text{Mg}(\text{NO}_3)_2$ and evolves H_2



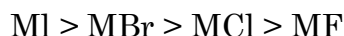
Q.64 In the case of alkali metals, the covalent character decreases in the order

- (a) $\text{MF} > \text{MCl} > \text{MBr} > \text{MI}$
- (b) $\text{MF} > \text{MCl} > \text{MI} > \text{MBr}$
- (c) $\text{MI} > \text{MBr} > \text{MCl} > \text{MF}$
- (d) $\text{MCl} > \text{MI} > \text{MBr} > \text{MF}$

Ans: (c)

Sol: Alkali metals are highly electropositive and halogens are electronegative. Thus for the halides of a given alkali metal, the covalent character decreases with increase in electronegativity of halogens.

\therefore Order of covalent character of halides is



Q.65 Compared with the alkaline earth metals, the alkali metals exhibit

- (a) smaller ionic radii
- (b) highest boiling points
- (c) greater hardness
- (d) lower ionization energies

Ans: (d)

Sol: The alkali metals are larger in size and have smaller nuclear charge thus they have lower ionization energy in comparison to alkaline earth metals.

Q.66 The stability of +1 oxidation state among Al, Ga, In and Tl increases in the sequence

- (a) $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$
- (b) $\text{Tl} < \text{In} < \text{Ga} < \text{Al}$
- (c) $\text{In} < \text{Tl} < \text{Ga} < \text{Al}$
- (d) $\text{Ga} < \text{In} < \text{Al} < \text{Tl}$

Ans: (a)

Sol: In group 13 elements, stability of +3 oxidation state decreases down the group while that Hence, stability of +1 oxidation state increases in the sequence :
 $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$.

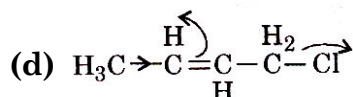
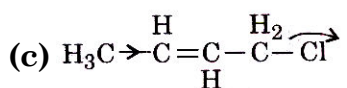
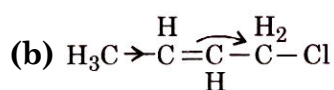
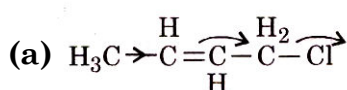
Q.67 Glass is a

- (a) liquid
- (b) solid
- (c) supercooled liquid
- (d) transparent organic polymer

Ans: (c)

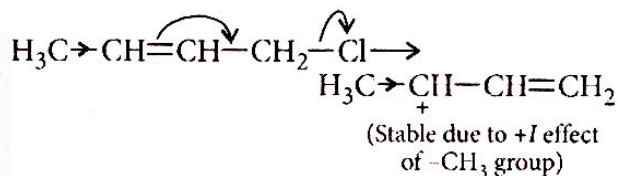
Sol: Glass is a supercooled liquid which forms a non-crystalline solid without a regular lattice.

Q.68 Which of the following is the most correct electron displacement for a nucleophilic reaction to take place?

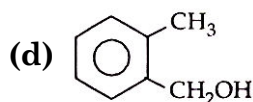
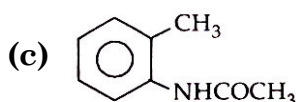
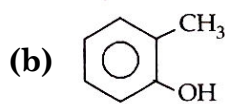
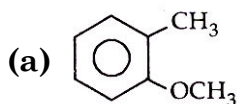


Ans: (a)

Sol: Nucleophilic will attack a stable carbocation (S_N1 reaction).



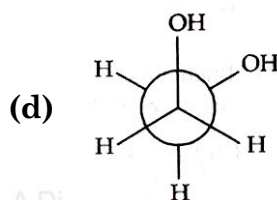
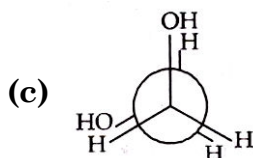
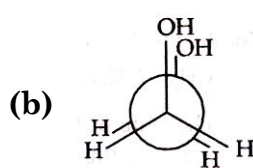
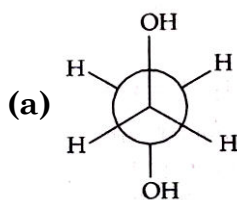
Q.69 Which one of the following is most reactive towards electrophilic reagent?



Ans: (b)

Sol: +R effect of $-\text{OH}$ group is greater than that of $-\text{OCH}_3$ group.

Q.70 Which of the following conformers for ethylene glycol is most stable?



Ans: (d)

Sol: The conformation (d) is most stable because of intermolecular H-bonding.

Q.71 Which one of these is not compatible with arenes?

- (a) Electrophilic additions (b) Delocalisation of π -electrons
(c) Greater stability (d) Resonance

Ans: (a)

Sol: Arenes undergo nucleophilic substitution reaction and are resistant to addition reactions, due to delocalisation of π -electrons. These are also stabilized by resonance.

Q.72 Green chemistry means such reactions which

- (a) are related to the depletion of ozone layer
(b) study the reactions in plants
(c) produce colour during reactions
(d) reduce the use and production of hazardous chemicals

Ans: (d)

Sol: Green chemistry is the design, development and implementation of chemical products and processes to reduce or eliminate the use and generation of substances hazardous to human health and the environment. Green chemistry also refers to the redesign of chemical products and processes with the goal of reducing or eliminating any negative environmental or health effects.

Q.73 A metal crystallises with face-centred cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is
(a) 288 pm (b) 408 pm (c) 144 pm (d) 204 pm

Ans: (a)

Sol: For a face centred cubic (fcc) structure,

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

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

Q.74 Ionic solids, with Schottky defects, contain in their structure
(a) cation vacancies only
(b) cation vacancies and interstitial cations
(c) equal number of cation and anion vacancies
(d) anion vacancies and interstitial anions

Ans: (c)

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

Q.75 The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 mole of P and 2 mol of Q would be
(a) 72 torr (b) 140 torr (c) 68 torr (d) 20 torr

Ans: (a)

Sol: By Raoult's Law

$$P_T = P_P^o X_P^o + P_Q^o X_Q^o$$

where $P_P^o = 80 \text{ torr}$, $P_Q^o = 60 \text{ torr}$, $X_P = \frac{3}{5}$, $X_Q = \frac{2}{5}$

$$P_T = 80 \times \frac{3}{5} + 60 \times \frac{2}{5} = 48 + 24 = 72 \text{ torr}$$

Q.76 How many grams of CH_3OH should be added to water to prepare 150 mL solution of 2 M CH_3OH ?
(a) 9.6×10^3 (b) 2.4×10^3 (c) 9.6 (d) 2.4

Ans: (c)

Sol: Since the molecular mass of CH_3OH is 32, therefore quantity of CH_3OH to prepare

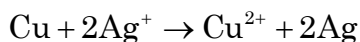
$$150 \text{ mL solution of } 2 \text{ M } \text{CH}_3\text{OH} = \left(\frac{2}{1000} \right) \times 150 \times 32 = 9.6 \text{ g}$$

Q.77 For the reduction of silver ions with copper metal, the standard cell potential was found to be + 0.46 V at 25°C. The value of standard Gibbs energy, ΔG° will be ($F = 96500 \text{ C mol}^{-1}$)

- (a) -89.0 kJ (b) -89.0 J (c) -44.5 kJ (d) -98.0 kJ

Ans: (a)

Sol: The cell reaction can be written as



We know, $\Delta G^\circ = -nFE^\circ_{\text{cell}}$

$$= -2 \times 96500 \times 0.46 = -88780 \text{ J}$$

$$= -88.780 \text{ kJ} = -89 \text{ kJ}$$

Q.78 Equivalent conductances of and ions are 127 and respectively. Equivalent conductance of BaCl_2 at infinite dilution is

- (a) 139.5 (b) 101.5 (c) 203 (d) 279

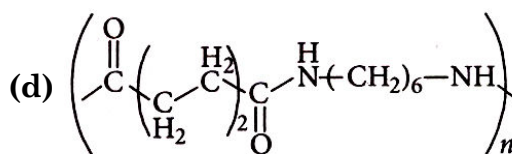
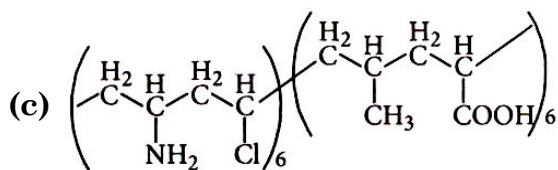
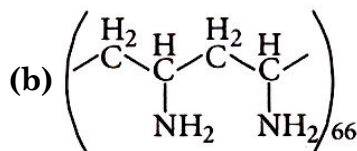
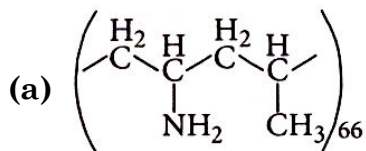
Ans: (a)

Sol:
$$\lambda_\infty = \frac{1}{n^+} \lambda_+^\infty + \frac{1}{n^-} \lambda_-^\infty$$

$$\text{So, } \lambda_\infty (\text{BaCl}_2) = \frac{1}{2} \times \lambda_{\text{Ba}^{2+}}^\infty + \frac{1}{1} \times \lambda_{\text{Cl}^-}^\infty$$

$$= \frac{1}{2} \times 127 + 76 = 63.5 + 76 = 139.5$$

Q.79 Which one of the following structures represents nylon 6, 6 polymer?



Ans: (d)

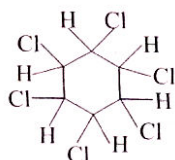
Sol: Nylon 6,6 is obtained by condensing adipic acid ($\text{HOOC}(\text{CH}_2)_4\text{COOH}$) with hexamethylenediamine ($\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$).

Q.80 Gammexane is

- (a) bromobenzene (b) benzyl chloride
(c) chlorobenzene (d) benzene hexachloride

Ans: (d)

Sol: Gammexane is an isomeric form of benzenehexachloride (BHC).



- Q.81 Position of non polar and polar part in micelle**
(a) polar at outer surface but non polar at inner surface
(b) polar at inner surface non polar at outer surface
(c) distributed over all the surface
(d) are present in the surface only

Ans: (a)

Sol: Micelles are the clusters or aggregates formed in solution by association of solids. Usually such molecules have a lyophobic group and a lyophilic group. The long hydrocarbon is the lyophobic portion which tries to recede away from the solvent water and the ionisable lyophilic group which tends to go into water resulting into ions. As the concentration is increased the lyophobic parts receding away from the solvent approach each other and form a cluster, the lyophobic ends are in the interior lyophilic groups projecting outward in contact with the solvent.

- Q.82 Cassiterite is an ore of**
(a) Sb **(b) Ni** **(c) Mn** **(d) Sn**

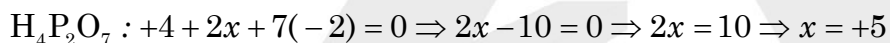
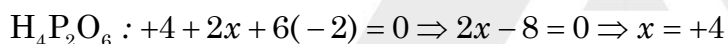
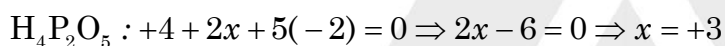
Ans: (d)

Sol: Cassiterite is also called as Tin stone (SnO_2), an ore of tin (Sn).

- Q.83 Oxidation states of P in $\text{H}_4\text{P}_2\text{O}_5$, $\text{H}_4\text{P}_2\text{O}_6$, $\text{H}_4\text{P}_2\text{O}_7$ are respectively**
(a) +3, +5, +4 **(b) +5, +3, +4** **(c) +5, +4, +3** **(d) +3, +4, +5**

Ans: (d)

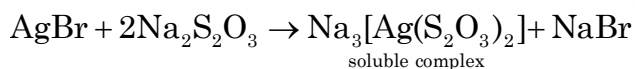
Sol: The oxidation state can be calculated as :



- Q.84 Hypo is used in photography to**
(a) reduce AgBr grains to metallic silver
(b) converts metallic silver to silver salt
(c) remove undecomposed silver bromide as a soluble complex
(d) remove reduced silver

Ans: (c)

Sol: Undecomposed AgBr forms a soluble complex with hypo and the reaction is given as:



- Q.85 Coordination number of Ni in $[\text{Ni}(\text{C}_2\text{O}_4)_3]^{4-}$ is**
(a) 3 **(b) 6** **(c) 4** **(d) 2**

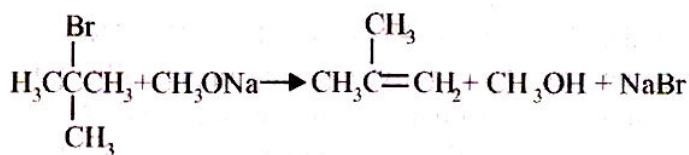
Ans: (b)

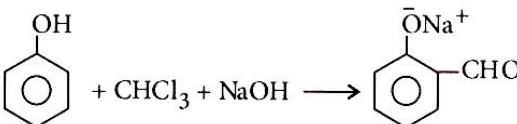
Sol: $\text{C}_2\text{O}_4 \rightarrow$ bidentate ligand
 3 molecules attached from two sides with Ni makes co-ordination number 6.

- Q.86 Reaction of *t*-butoxide bromide with sodium methoxide produces**
(a) sodium *t*-butoxide **(b) *t*-butyl methyl ether**
(c) isobutane **(d) isobutylene**

Ans: (d)

Sol: Isobutylene is obtained.



Q.87 In the reaction,  the electrophile involved is

(a) dichloromethyl cation ($\overset{+}{\text{C}}\text{HCl}_2$)

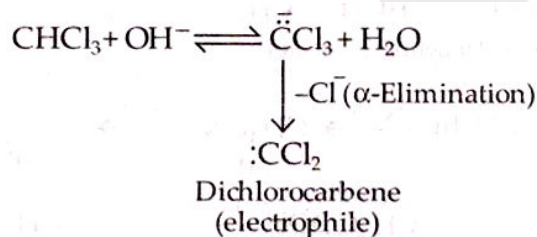
(b) formyl cation ($\overset{+}{\text{C}}\text{HO}$)

(c) dichloromethyl anion ($\overset{-}{\text{C}}\text{HCl}_2$)

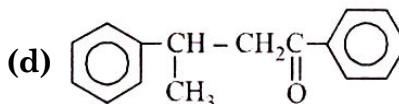
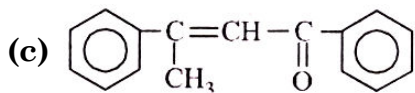
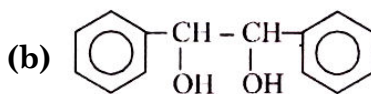
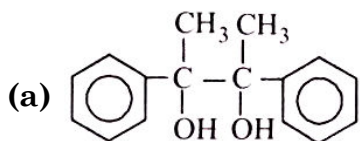
(d) dichlorocarbene ($:\text{CCl}_2$)

Ans: (d)

Sol: It is Reimer-Tiemann reaction. The electrophile formed is dichlorocarbene ($:\text{CCl}_2$) which is formed according to the following mechanism :

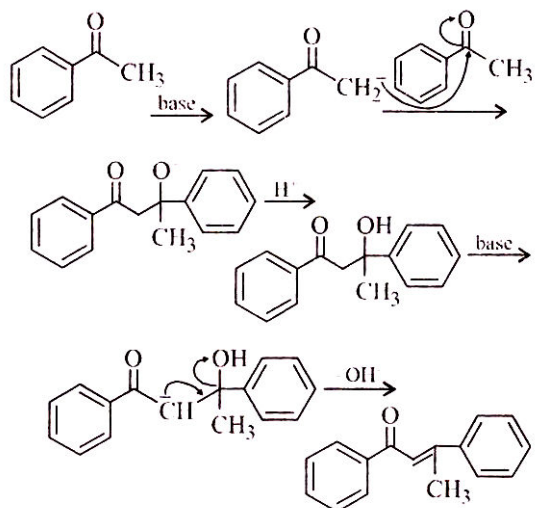


Q.88 Acetophenone when reacted with a base, $\text{C}_2\text{H}_5\text{ONa}$, yields a stable compound which has the structure

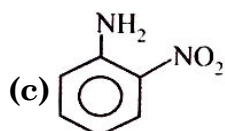
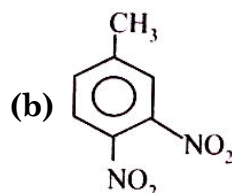
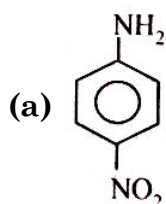


Ans: (c)

Sol: The first step is a simple condensation reaction. The last step is an example of E1cB mechanism and the leaving group is hydroxide, which is unusual. Still this step manages to take place owing to the stability incorporated therein the product, which is a conjugated carbonyl compound.



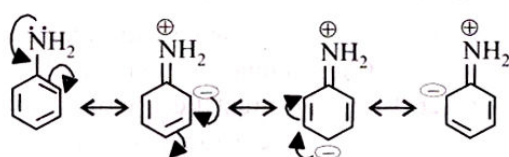
Q.89 An aniline on nitration gives



(d) both (a) and (c)

Ans: (d)

Sol:



As, NO_2^+ electrophile can attack both *ortho* and *para* positions, therefore both (a) and (c) product will be obtained.

Q.90 Which of the following is correct about H-bonding in nucleotide?

(a) A - T, G - C (b) A - G, T - C (c) G - T, A - C (d) A - A, T - T

Ans: (a)

Sol: _____

BIOLOGY

- Q.91** A taxon is
(a) a group of related families
(b) a group of related species
(c) a type of related species
(d) a taxonomic group of any ranking

Ans: (d)

Sol: The word taxon signifies a taxonomic unit, is a name designating an organism or group of organisms. A taxon is assigned a rank and can be placed at a particular level in a systematic hierarchy reflecting evolutionary relationships.

- Q.92** The book '*Genera Plantarum*' was written by
(a) Engler and Prantl (b) Bentham and Hooker
(c) Bessey (d) Hutchinson

Ans: (b)

Sol: Bentham and Hooker in their monumental work *Genera Plantarum* (1862-1883) have provided elaborate keys for the easy identification of 202 natural orders and genera. Engler and Prantl wrote *Die natuerlichen pflanzenfamilien*. Hutchinson wrote a book titled "The Families of Flowering Plants".

- Q.93** One of the major components of cell wall of most fungi is
(a) cellulose (b) hemicellulose
(c) chitin (d) peptidoglycan

Ans: (c)

Sol: Fungal cell wall contains chitin or fungal cellulose along with other polysaccharides, proteins, lipids and a number of other substances.

- Q.94** Viruses have
(a) DNA enclosed in a protein coat
(b) prokaryotic nucleus
(c) single chromosome
(d) both DNA and RNA

Ans: (a)

Sol: Viruses are nucleoprotein entities which are able to utilize synthetic machinery of a living cell of the host organism for its multiplication which does not involve growth and division. They have either RNA or DNA as genetic material and a protein coat.

- Q.95** Basophilic prokaryotes
(a) grow and multiply in very deep marine sediments
(b) occur in water containing high concentrations of barium hydroxide
(c) readily grow and divide in sea water enriched in any soluble salt of barium
(d) grow slowly in highly alkaline frozen lakes at high altitudes.

Ans: (a)

Sol: Basophilic prokaryotes are facultatively anaerobic bacteria. They grow and multiply in very deep marine sediments. Most basophiles grow better at a pH of 8.5 or higher.

Q.96 An important criterion for modern day classification is

- (a) resemblances in morphology**
- (b) anatomical and physiological traits**
- (c) breeding habits**
- (d) presence or absence of notochord**

Ans: (b)

Sol: Taxonomy and classification are apart of the broader field of systematics which is the study of diversity of organisms. Classification of a part of systematics as it lists the unique characters of each taxon.

Q.97 Monoecious plant of *Chara* shows occurrence of

- (a) upper antheridium and lower oogonium on the same plant**
- (b) upper oogonium and lower antheridium on the same plant**
- (c) antheridiphore and archegoniophore on the same plant**
- (d) stamen and carpel on the same plant**

Ans: (b)

Sol: All species of *Chara* reproduce sexually and show highly advanced oogamy. The sex organs are the most distinctive features of the Order Charales and are the most complicated among the thallophytes. Male and Female gametophytes are called antheridia and oogonia respectively. Male fructification (cluster of antheridia) is called globule and the female is nucle. They are at the nodes of short branches, globule towards lower side and nucle (female structure) towards upper side.

Q.98 A plant in which sporophytic generation is represented by zygote is

- (a) *Pinus***
- (b) *Selaginella***
- (c) *Chlamydomonas***
- (d) *Dryopteris***

Ans: (c)

Sol: A plant in which sporophytic generation is represented by zygote is *Chlamydomonas*. It is a type of algae that has gametophytic plant body (haploid). It reproduce sexually by gametes which are isogametes that fuse to produce diploid zygote which is the only sporophytic generation.

Q.99 Important characteristic that hemichordates share with chordates is

- (a) ventral tubular nerve cord**
- (b) pharynx with gill slits**
- (c) pharynx without gill slits**
- (d) absence of notochord**

Ans: (b)

Sol: An important characteristics that hemichordates and chordates share is presence of pharyngeal gill slits. Gill slits are dorsal in position in hemichordates whereas they are lateral in chordates. A true notochord does not occur in hemichordates. Nervous system is distinctly of vertebrate type being intraepidermal in position and having a ventral nerve cord.

Q.100 Uricotelism is found in

- (a) mammals and birds**
- (b) fish and fresh water protozoans**
- (c) birds, land reptiles and insects**
- (d) frogs and toads**

Ans: (c)

Sol: Uricotelism means excretion of uric acid. Uric acid excretion occurs in organisms which develop in an enclosed egg (where water is severely limited) or which normally experience very dry terrestrial environment as adult organisms. Uric acid is discharged as thick paste or as solid pellet. Examples : terrestrial reptiles, birds, insects, gastropod mollusc, etc.

Q.101 A wood boring mollusc/shipworm is
(a) *Chiton* (b) *Teredo* (c) *Limax* (d) *Patella*

Ans: (b)

Sol: The common name of *Teredo* is shipworm which belongs to the Class Bivalvia of the Phylum Mollusca. In it, head is absent and food is wedge shaped for burrowing. Shell consists of two valves. The common name of *Chiton* is the coat of mail shell (Class Amphineura). *Limax* is the grey slug (Class Gastropoda) and *Patella* is true limpet (Class Gastropoda).

Q.102 Which one of the following figures represents the placentation in *Dianthus*?
(a) (b) (c) (d)

Ans: (b)

Sol: The figure given in option (b) represents the free central placentation. In free central placentation, ovary is unilocular and ovules are borne on the axis in the centre of the ovary and septa are absent. It is seen in *Dianthus* and *Primrose*.

Q.103 Tegmen develops from
(a) funiculus (b) chalaza
(c) inner integument (d) outer integument

Ans: (c)

Sol: Outer protective covering of seed is called seed coat which develops from integuments of ovules. The seeds developing from bitegmic ovule have two layers. The outer is called testa and inner layer or tegmen develops from inner integuments.

Q.104 The balloon-shaped structures called tyloses
(a) originate in the lumen of vessels
(b) characterise the sapwood
(c) are extensions of xylem parenchyma cells into vessels
(d) are linked to the ascent of sap through xylem vessels

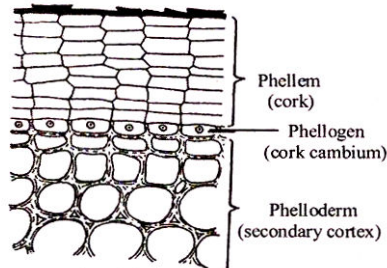
Ans: (c)

Sol: Tyloses are balloon-like extensions of parenchyma cells that protrudes into the lumen of a neighbouring xylem vessel or tracheid through a pit in the cell wall. Tyloses form most commonly in order woody tissue, possibly in response to injury, they may eventually block the vessels and thus prevent the spread of fungi and other pathogens within the plant. Tyloses may become filled with tannin, gums, pigments, etc., giving heartwood its dark colour, and their walls can remain thin or become lignified.

Q.105 The periderm includes
(a) secondary phloem (b) cork
(c) cambium (d) all of these

Ans: (b)

Sol: In hypodermis or outer cortical cells, a layer becomes meristematic which is known as cork cambium or phellogen. This phellogen also cuts off cells both on its outer side and inner side. The cells cut off on outer side are phellem or cork cells and cortex. Phellem, phellogen and phelloderm collectively constitute periderm. The function of periderm is protective (because at maturity epidermis ruptures and hence the function is performed by periderm).



Structure of periderm (showing 3 layers)

Q.106 Which one of the following is correct pairing of a body part and the kind of muscle tissue that moves it?

- (a) Biceps of upper arm - Smooth muscle fibres
- (b) Abdominal wall - Smooth muscle
- (c) Iris - Involuntary smooth muscle
- (d) Heart wall - Involuntary unstrained muscle

Ans: (c)

Sol: Smooth muscles are called as involuntary muscles as action of these muscles is controlled by autonomic nervous system i.e., not under the control of animal's will. Iris of eyes consist of smooth involuntary muscles. Abdominal wall also have smooth muscles. Biceps of upper arm is made of skeletal muscles while heart wall consists of cardiac muscles.

Q.107 Which pair is correct?

- (a) Sweat - Temperature regulation
- (b) Saliva - Sense of food taste
- (c) Sebum - Sexual attraction
- (d) Humerus - Hindleg

Ans: (a)

Sol: Sweat is secreted by sweat glands of skin and helps in regulating body temperature. Saliva is secreted by salivary glands and helps in digestion (carbohydrate digestion). Sebum is the waxy secretion secreted by sebaceous glands. Sebum is a fatty mildly antiseptic material that protects, lubricates, and waterproofs the skin hair and prevent desiccation. Humerus is the long bone of the upper arm. It articulates with the scapula at the glenoid cavity and with the ulna and radius at the below.

Q.108 Which one of the following organelle in the figure correctly matches with its function?

- (a) Golgi apparatus, formation of glycolipids.
- (b) Rough endoplasmic reticulum, protein synthesis.
- (c) Rough endoplasmic reticulum, formation of glycoproteins.
- (d) Golgi apparatus, protein synthesis.



Ans: (b)

Sol: The given figure shows endoplasmic reticulum bearing ribosomes on their surface. It is called rough endoplasmic reticulum or RER, RER is actively involved in protein synthesis and secretion.

Q.109 Which one of the following structures between two adjacent cells is an effective transport pathway?

- (a) Plasmodesmata (b) Plastoquinones
(c) Endoplasmic reticulum (d) Plasmalemma

Ans: (a)

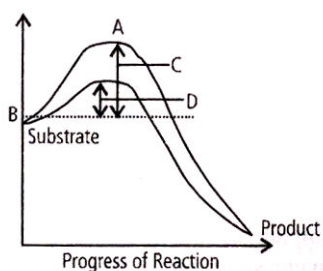
Sol: Plasmodesmata are fine cytoplasmic strands that connect the protoplasts of adjacent plant cells by passing through their cell walls. Plasmodesmata are cylindrical in shape (about 20-40 nm in diameter) and are lined by the plasma membrane of the two adjacent cells. They permit the passage between cells of substances including ions, sugars, amino acids, and macromolecules.

Q.110 Names of Schleiden and Schwann are associated with

- (a) protoplasm as the physical basis of life
(b) cell theory
(c) theory of cell lineage
(d) nucleus functions as control centre of cell

Ans: (b)

Q.111 The figure given below shows the conversion of a substrate into product by an enzyme. In which one of the four options (A-D) the components of reaction labelled as A, B, C and D are identified correctly?



A	B	C	D
(a) Potential energy	Transition State	Activation energy with enzyme	Activation energy without enzyme
(b) Transition state	Potential energy	Activation energy with enzyme	Activation energy without enzyme
(c) Potential energy	Transition State	Activation energy with enzyme	Activation energy without enzyme
(d) Activation energy with enzyme	Transition state	Activation energy without enzyme	Potential energy

Ans: (b)

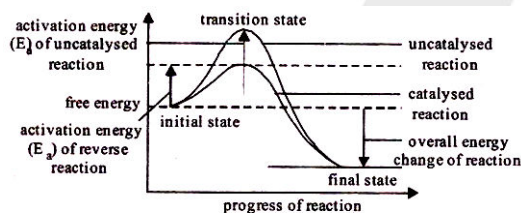
Sol: _____

Q.112 Role of enzyme in reactions is to/as

- (a) decrease activation energy
- (b) increase activation energy
- (c) inorganic catalyst
- (d) none of the above

Ans: (a)

Sol: All molecules require certain amount of energy for activation (to overcome energy barrier) before they can react. This energy is called activation energy. This energy is recovered when products are formed. The essence of an enzyme is its ability to speed up (catalyze) a reaction by making or breaking specific covalent bonds (bonds in which atoms are held together by sharing of electrons). Enzymes act by somehow lowering the temperature at which a given bond is unstable i.e., they speed up a reaction by lowering the activation energy. It is the magnitude of the activation energy which determines how fast the reaction will proceed.



Graph showing energy requirement of catalysed and uncatalysed reactions.

Q.113 During cell growth, DNA synthesis replication fork, which checkpoint should be predominantly activated?

- (a) S-phase
- (b) G₁-phase
- (c) G₂-phase
- (d) M phase

Ans: (a)

Sol: In S-phase (synthetic phase) of cell cycle, the chromosomes replicate. For this their DNA molecules function as templates and form carbon copies. The DNA content double i.e., 1 C to 2C for haploid cells and 2C and to 4C for diploid cells. As a result duplicate sets of genes are formed. Along with replication of DNA new chromatin fibres are formed which, however, remain attached in pairs and the number of chromosomes does not increase. As chromatin fibres are elongated chromosome comes to have two chromatin threads or sister chromatids which remain attached at a common point called centromere.

Q.114 Meiosis II performs

- (a) separation of sex chromosomes
- (b) synthesis of DNA and centromere
- (c) separation of homologous chromosomes
- (d) separation of chromatids

Ans: (d)

Sol: Meiosis II is shorter than the typical mitotic division because of the shortening of prophase of this division. The division maintains the number of chromosomes produce at the end of reduction division. Hence, it is called homotypic or equational division, though it is similar to mitosis. The main function of homotypic division or meiosis II is to separate the chromatids of univalent chromosomes which differ from each other in their linkage groups due to crossing over.

Q.115 Water potential is equal to

- (a) $\psi_s + O.P$ (b) $\psi_s = T.P$ (c) $\psi_p + \psi_w$ (d) $\psi_s + \psi_p$.

Ans: (d)

Sol: Water potential is the difference in the free energy or chemical potential per unit molal volume of water in a system and that of pure water at the same temperature and pressure.

Water potential is represented by Greek letter ψ (psi) or ψ_w . Water potential is the sum total of ψ_s and ψ_p .

Therefore, $\psi_w = \psi_s + \psi_p$.

Q.116 Main function of lenticel is

- (a) transpiration (b) guttation
(c) gaseous exchange (d) bleeding

Ans: (c)

Sol: Lenticels generally appear under stomata. The lenticel of phellogen itself also has intercellular spaces. Because of this relatively open arrangement of cells, the lenticels are regarded as structures permitting the entry of air through the periderm. Lenticels are characteristics of woody stem but they are also found in roots of trees and other perennials for entry of oxygen through them.

Q.117 Manganese is required is

- (a) plant cell wall formation
(b) photolysis of water during photosynthesis
(c) chlorophyll synthesis
(d) nucleic acid synthesis

Ans: (b)

Sol: Manganese (Mn^{2+}) is used for photolysis of water to produce oxygen and electrons during light reaction of photosynthesis. It is the phenomenon of breaking up of water into hydrogen and oxygen in the illuminated chloroplast. It acts as an essential cofactor.

Q.118 If by radiation all nitrogenase enzyme are inactivated, then there will be no

- (a) fixation of nitrogen in legumes
(b) fixation of atmospheric nitrogen
(c) conversion from nitrate to nitrite in legumes
(d) conversion from ammonium to nitrate in soil

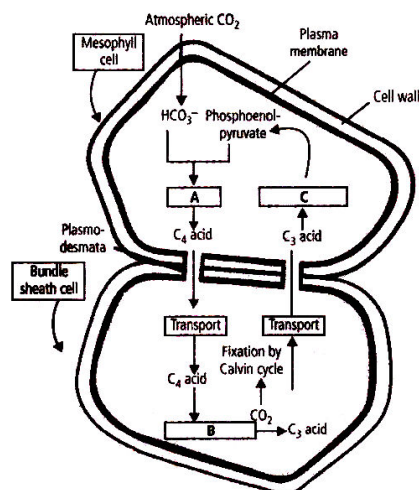
Ans: (a)

Sol: The process by which N_2 is reduced to NH_4^+ is called nitrogen fixation.

Nitrogenase enzyme catalyses this reduction. It is only carried out by prokaryotic microorganisms. Principal N_2 -fixers include certain free living cyanobacteria in

symbiotic associations with fungi in lichens or with ferns, mosses and liverworts; and by bacteria or other microbes associated symbiotically with roots, especially those of legumes. About 15 percent of the nearly 20,000 species in the family Fabaceae (Leguminosae) have been examined for N_2 fixation and approximately 90 percent of these have root nodules in which fixation occurs. So without active nitrogenase enzyme there will be no N_2 fixation in legumes.

Q.119 Study the pathway given below :



In which of the following options correct words for all the three blanks A, B and C are indicated?

A	B	C
(a) Decarboxylation	Reduction	Regeneration
(b) Fixation	Transamination	Regeneration
(c) Fixation	Decarboxylation	Regeneration
(d) Carboxylation	Decarboxylation	Regeneration

Ans: (c)

Sol: A - Fixation of CO_2 by PEP carboxylase

B - Decarboxylation

C - Regeneration

Q.120 For assimilation of one CO_2 molecule, the energy required in form of ATP and $NADPH_2$ are

- (a) 2 ATP and 2 $NADPH_2$
- (b) 5 ATP and 3 $NADPH_2$
- (c) 3 ATP and 2 $NADPH_2$
- (d) 18 ATP and 12 $NADPH_2$

Ans: (c)

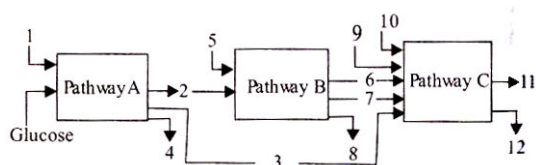
Sol: Photosynthesis is actually oxidation reduction process in which water is oxidised and CO_2 is reduced to carbohydrates. The reduction of CO_2 to carbohydrates needs assimilatory powers, i.e., ATP and $NADPH_2$. The process of photosynthesis involves two steps-

- (i) Light dependent phase or photochemical reaction.
- (ii) Light independent phase or dark reaction.

In Calvin cycle, CO_2 acceptor molecule is RuBP or RuDP. The enzyme catalyzing this reaction is RuBP-carboxylase/oxygenase (RuBisCO). As Calvin cycle takes in only one carbon (as CO_2) at a time, so it takes six turns of the cycle to produce a

net gain of six carbons (i.e., hexose of glucose). In this cycle, for formation of one mole of hexose sugar (Glucose), 18 ATP and 12 NADPH₂ are used. For 6 molecules of CO₂ it needs 18 ATP and 12 NADPH₂ molecules so for assimilation of one molecule of CO₂ it needs 3 ATP and 2 NADPH₂ molecules.

Q.121 The three boxes in this diagram represent the three major biosynthetic pathways in aerobic respiration. Arrows represent net reactants or products.



Arrows numbered 4, 8 and 12 can all be

- (a) H₂O (b) FAD⁺ or FADH₂
(c) NADH (d) ATP

Ans: (d)

Sol: In the given diagram, pathway A represents glycolysis, pathway B represents Krebs' cycle and pathway C represents oxidative phosphorylation. Arrows numbered 4, 8 and 12 can all be ATP.

Q.122 R.Q. is

- (a) C/N (b) N/C (c) CO₂/O₂ (d) O₂/CO₂

Ans: (c)

Sol: The ratio of the volume of CO₂ released to volume of O₂ absorbed in the respiratory process is termed as the respiratory ratio of Respiratory Quotient.

$$\text{R.Q.} = \frac{\text{Volume of CO}_2 \text{ evolved}}{\text{Volume of O}_2 \text{ absorbed}}$$

Value of R.Q. varies from one respiratory substrate to another, w.g., R.Q. of carbohydrates is equal to 1, R.Q. of lipids and proteins are less than 1, that of organic acid is greater than 1.

Q.123 An enzyme that can stimulate germination of barely seeds is

- (a) invertase (b) α-amylase (c) lipase (d) protease

Ans: (b)

Sol: The process by which the dormant embryo of seed resumes active growth and forms a seedling is known as germination. The initial step in germination process is the uptake of water and rehydration of the seed tissues by the process of imbibition. The first visible sign of germination is the emergence of the radicle from the seed. But this event is preceded by a series of biochemical reactions. Imbibition of water causes the embryo within seed to produce α- and β-amylase. These enzymes hydrolyze the starch stored in endosperm into glucose which is necessary for use both as a respiratory substrate and as source of carbon skeletons of the molecules needed for growth.

Q.124 Which one increase in the absence of light?

- (a) Uptake of minerals
(b) Uptake of water
(c) Elongation of internodes
(d) Ascent of sap

Ans: (c)

Sol: Stem elongation takes place in the absence of light due to etiolation. But uptake of minerals, uptake of water and ascent of sap all these processes are related to photosynthesis which takes place only in the absence of light.

Q.125 Which one of the following correctly represents the normal adult human dental formula?

- (a) $\frac{3}{3}, \frac{1}{1}, \frac{3}{2}, \frac{1}{1}$ (b) $\frac{2}{2}, \frac{1}{1}, \frac{3}{2}, \frac{3}{3}$ (c) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{3}{3}$ (d) $\frac{3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{3}{3}$

Ans: (c)

Sol: An adult human has 32 permanent teeth which are of four different types (heterodont dentition) namely, incisors (I), canines (C), premolars (PM) and molars (M). Arrangement of teeth in each half of the upper and lower order, I, C, PM, M is represented by a dental formula which in human is $\frac{2123}{2123}$.

Q.126 The layer of cells that secrete enamel of tooth is

- (a) osteoblast (b) odontoblast (c) dentoblast (d) ameloblast

Ans: (d)

Sol: Tooth is mainly made of ivory-like substance called dentine. In the crown part of the tooth, dentine is covered by enamel (hardest substance in the body), containing calcium, especially apatite and secreted by cells of ectodermal origin called ameloblasts of the oral epithelium and protects the underlying dentine of the tooth. The pulp cavity of tooth is lined by dentine-forming cells called odontoblasts. Osteoblasts are the bone-forming cells.

Q.127 Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls.

- (a) Pneumonia (b) Asthma (c) Pleurisy (d) Emphysema

Ans: (d)

Sol: Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of the lungs. Many of the septa between the alveoli are destroyed and much of the elastic tissue of the lungs is replaced by connective tissue. As the alveolar septa collapse, the surface area for gas exchange is greatly reduced. There is loss of elasticity in the walls of bronchioles or alveolar sacs. As a result, the sacs remain filled with air even after expiration. The exhalation becomes more difficult. The lungs remain inflated. Major causes of emphysema are cigarette smoking and the inhalation of smoke or other toxic substances over a period of time.

Q.128 Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct?

The patient has been inhaling polluted air containing unusually high content of

- (a) carbon disulphide (b) chloroform
(c) carbon dioxide (d) carbon monoxide

Ans: (d)

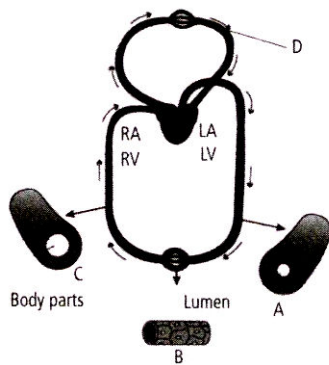
Sol: Carboxyhaemoglobin, a stable compound, is formed when haemoglobin readily combines with carbon monoxide. Carbon monoxide converts iron (II) to iron (III) in its reaction with haemoglobin. In this form haemoglobin does not carry oxygen resulting in its (oxygen) starvation and leads to asphyxiation and in extreme cases to death. The affinity of haemoglobin for CO is 250 times its affinity for O₂ and COHb liberates CO very slowly and also due to that compound the dissociation curve of the remaining HbO₂ shift to the left, decreasing the amount of O₂ released.

Q.129 Doctors use stethoscope to hear the sounds produced during each cardiac cycle. The second sound is heard when
(a) AV node receives signal from SA node.
(b) AV valves open up
(c) Ventricular walls vibrate due to gushing in of blood from atria.
(d) Semilunar valves close down after the blood flows into vessels from ventricles.

Ans: (d)

Sol: Second heart sound i.e., dup is caused by the closure of the semilunar valves and marks the end of ventricular systole.

Q.130 The figure shows blood circulation in humans with labels A to D. Select the option which gives correct identification of label and functions of the part.



- (a) B-Capillary-Thin without muscle layer and wall two cell layers thick**
- (b) C-Vein-thin walled and blood flows in jerks/spurts**
- (c) D-Pulmonary vein-Takes oxygenated blood to heart, pO = 95 mmHg**
- (d) A-Artery-Thick walled and blood flows evenly**

Ans: (c)

Sol: A-Artery : Carries blood from heart to different body parts. It is thick-walled and elastic. The flow of blood in it is intermittent.

B-Capillary : Nutrients, hormones, gases etc. can diffuse into tissue cells through capillaries and *vice versa*. It is thin-walled, and only one layer thick resting on basement membrane.

C-Vein : Brings blood from different body parts to the heart. It is thin-walled and acts as low-resistance conduct for blood flow.

D-Pulmonary vein : Two pulmonary veins from each lung transport the oxygenated blood to the left atrium.

Q.131 Conversion of ammonia to urea is done by

- (a) ornithine cycle**
- (b) arginine cycle**
- (c) fumaric cycle**
- (d) citrulline cycle**

Ans: (a)

Sol: The principle nitrogenous excretory compound in humans is urea. Urea is produced in a series of reactions (urea cycle) which take place in the mitochondrial matrix and cytosol of liver cells. Urea cycle (ornithine cycle) is the series of biochemical reactions that converts ammonia, which is highly toxic and carbon dioxide to the much less toxic urea during the excretion of metabolic nitrogen derived from the deamination of excess amino acids. The urea is ultimately excreted in solution in urine.

Q.132 Human urine is usually acidic because

- (a) potassium and sodium exchange generates acidity
- (b) hydrogen ions are actively secreted into the filtrate
- (c) the sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries.
- (d) excreted plasma proteins are acidic

Ans: (b)

Sol: _____

Q.133 What is sarcomere?

- (a) Part between two H-line
- (b) Part between two A-line
- (c) Part between two I-band
- (d) Part between two z-line

Ans: (d)

Sol: A striated muscle fibre is bounded by sarcolemma. It shows alternating dark and light cross bands, the striations. Dark band is called A band which has at its middle a light zone termed H zone. Light band is known as I band which is crossed through its centre by a dark membrane called Z line. The part of the muscle fibre between two successive Z lines functions as a contractile unit called sarcomere.

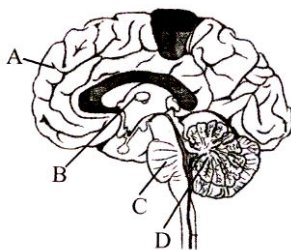
Q.134 Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction

- (a) Calcium
- (b) Magnesium
- (c) Sodium
- (d) Potassium

Ans: (c)

Sol: Calcium ion plays an important role in muscle contraction. Calcium ions bind to troponin causing a change in its shape and position of tropomyosin to which troponin binds. This shift exposes the active sites on F-actin molecules. Myosin cross-bridges are then able to bind to these active sites.

Q.135 A sagittal section of human brain is shown here. Identify at least two labels from A-D.



- (a) C-Mid brain, D-Cerebellum
- (b) A_Cerebrum, C-Pons
- (c) B-Corpus callosum, D-Medulla
- (d) A-Cerebral hemispheres, B-Cerebellum

Ans: (b)

Sol: A - Cerebral hemisphere
B - Thalamus
C - Pons varolii
D - Cerebellum

Q.136 Given below is a diagrammatic cross section of a single loop of human cochlea.

Which one of the following options correctly represents the names of three different parts?

- (a) D : Sensory hair cells, A : Endolymph
B : Tectorial membrane
- (b) A : Perilymph, B : Tectorial membrane,
C : Endolymph
- (c) B : Tectorial membrane, C : Perilymph,
D : secretory cells
- (d) C : Endolymph, D : Sensory hair cells

Ans: (b)

Sol: A → Perilymph
B → Tectorial membrane
C → Endolymph
D → sensory air cells



Q.137 Vagus nerve is

- (a) X
- (b) IX
- (c) VII
- (d) V

Ans: (a)

Sol: Vagus nerve is the tenth cranial nerve. It arises from the side of medulla oblongata. It innervates the larynx, trachea, oesophagus, stomach, lungs, heart and intestines. It is a mixed nerve. It controls the visceral sensations and visceral movements, i.e., heart beat, respiratory movements, peristalsis, sound production, etc.

Q.138 Figure shows human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristic and/or functions.

- (a) C - Medulla - inner zone of kidney and contains complete nephrons.
- (b) D - Cortex - outer part of kidney and do not contain any part of nephrons.
- (c) A - Adrenal gland - located catecholamines which stimulate glycogen breakdown
- (d) B - Pelvis - broad funnel shaped space inner to hilum, directly connected to loops of Henle.

Ans: (c)

Sol: In the given figure, A is adrenal gland which secretes two catecholamines; adrenaline (epinephrine) and norepinephrine (norepinephrine). Adrenaline increases the conversion of glycogen to glucose providing quick energy for "fight or flight" response. B is renal pelvis which is a sac like cavity of the kidney of Henle. C is medulla, the inner region of kidney containing loop of Henle, collecting ducts and ducts of Bellini. D is cortex which has proximal and distal convoluted tubules and contains Malpighian corpuscles.

- Q.139 MSH is secreted by**
 (a) anterior lobe of pituitary
 (b) middle lobe of pituitary
 (c) posterior lobe of pituitary
 (d) endostyle

Ans: (b)

Sol: Middle lobe of pituitary secretes a hormone named melanocyte-stimulating hormone. It stimulates the synthesis of black pigment melanin in the skin and also causes dispersal of melanin granules in the pigment cells, thereby darkening the colour in certain animals (fishes amphibians). In amn it has no such role. Anterior lobe of pituitary secretes FSH, LH, TSH, ACTH and STH. Posterior lobe of pituitary secretes oxytocin and vasopressin.

- Q.140 Examine the figure (A-D) given below and select the right option out of (a - d), in which all the four structures A B, C and D are identified correctly.**

A	B	C	D
(a) Rhizome	Sporangiophore	Polar cell	Globule
(b) Runner	Archegoniophore	Synergid	Antheridium
(c) offset	Archegoniophore	Antipodals	Oogonium
(d) Sucker	Seta	Megaspore mother cell cup	gemma

Ans: (c)

Sol: A - offset of water hyacinth (*Eichhornia*)
 B - Antheridiophore of *Marchantia*
 C - Antipodals of the mature embryo sac
 D - Oogonium of *Chara*

- Q.141 Adventive embryony in Citrus is due to**
 (a) nucellus
 (b) integuments
 (c) zygotic embryo
 (d) fertilized egg

Ans: (a)

Sol: Presence of more than one embryo inside the seed is called polyembryony. It is more common in gymnosperms than angiosperms. In angiosperms, it is generally present as an unusual feature in few cases *Citrus*, mango etc. In *Citrus* many embryos (like nucellus). This is commonly called adventive polyembryony. In *Citrus* upto 10 nucellar embryos are formed.

- Q.142 During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called**
 (a) organizer phenomena
 (b) axis formation
 (c) anamorphosis
 (d) pattern formation

Ans: (a)

Sol: During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called organizer phenomenon. The organizer is the part of an embryo consisting of undifferentiated cells that follow a specific course of development by identifying the polarity of particular region.

Q.143 Gonads develop from embryonic

- (a) ectoderm (b) endoderm
(c) mesoderm (d) both mesoderm and endoderm

Ans: (c)

Sol: Gonads, muscles, dermis, kidneys, etc., develop from mesoderm. Ectoderm produces epidermis, glands, nervous system, etc. Pancreas, lining of urinary bladder, etc., develop from endoderm.

Q.144 What is the work of copper-T?

- (a) To inhibit ovulation
(b) To inhibit fertilization
(c) To inhibit implantation of blastocyst
(d) To inhibit gametogenesis

Ans: (b,c)

Sol: Copper-T is an intrauterine device (IUD) used by women as a birth control. An IUD is a small device which is placed inside the uterus. The vertical and horizontal arms of the Copper-T contain copper which is slowly released into the uterine cavity. Copper stops sperm from making their way up through the uterus into the tubes, and it reduces the ability of sperm to fertilize the egg. It also prevents a fertilized egg (blastocyst) from successfully implanting in the lining of the uterus if fertilization has occurred.

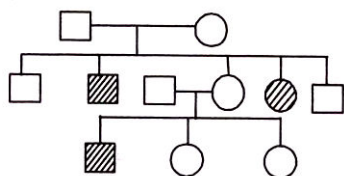
Q.145 The present population of the world is about

- (a) 15 trillion (b) 6 billion
(c) 500 million (d) 100 million

Ans: (b)

Sol: As this question appeared in 1997, so the population of world in mid 19947 was 5, 840, 324, 240 i.e., approximately 6 billion.

Q.146 Study the pedigree chart given below. What does it show?



- (a) Inheritance of a condition like phenylketonuria as an autosomal recessive trait.
(b) The pedigree chart is wrong as this not possible.
(c) Inheritance of a recessive sex-linked disease like haemophilia.
(d) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria.

Ans: (a)

Sol: This chart shows inheritance of an autosomal recessive trait like phenylketonuria. An autosomal recessive trait may skip a generation. It appears in case of marriage between two heterozygous individuals ($Aa \times Aa = 3Aa + 1aa$), a recessive individual with hybrid ($Aa \times Aa = 3Aa + 2aa$) and two recessive ($aa \times aa = \text{all } aa$). Phenylketonuria is an inborn, autosomal recessive metabolic disorder in which homozygous recessive individual lacks the enzyme phenylalanine hydroxylase.

The heterozygous individuals are normal but carries.

Q.147 Segregation of Mendelian factors (no linkage, no crossing over) occurs during

- (a) anaphase I (b) anaphase II (c) diplotene (d) metaphase I

Ans: (a)

Sol: Segregation of Mendelian factors (no linkage, no crossing over) occurs during anaphase I. At anaphase I, actual segregation occurs, but two similar alleles occurs in the dyad chromosome which separate at anaphase II.

Q.148 Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme?

- (a) 5' _____ CGTTCG _____ 3'
3' _____ ATGGTA _____ 5'
(b) 5' _____ GATATG _____ 3'
3' _____ CTAATA _____ 5'
(c) 5' _____ GAATTC _____ 3'
3' _____ CTTAAG _____ 5'
(d) 5' _____ CACGTA _____ 3'
3' _____ CTCAGT _____ 5'

Ans: (c)

Sol: Palindromic nucleotide sequences in the DNA molecules are groups of bases that form the same sequence when read in both forward and backward direction. In the given question, only option (c) represents a palindromic sequence, that can be

Q.149 Nucleosome core is made of

- (a) H₁, H₂A, H₂B and H₃ (b) H₁, H₂A, H₂B, H₄
(c) H₁, H₂A, H₂B, H₃ and H₄ (d) H₂A, H₂B, H₃ and H₄

Ans: (d)

Sol: Nucleosome core is made up of H₂A, H₂B, H₃ and H₄. It is about 7-10 nm in diameter, consisting of histones around which a DNA strand, about 120 base pair long is wrapped in chromosomes.

Q.150 Genetic variation in a population arises due to

- (a) recombination only
(b) mutation as well as recombination
(c) reproductive isolation and selection
(d) mutations only.

Ans: (b)

Sol: The genetic variations exist due to reshuffling of genes caused by recombination or by mutations. The recombination are produced by the routine reshuffling of genes during independent assortment of chromosomes, reciprocal crossing of genes during crossing over and random fertilization of gametes. Mutation is the sudden inheritable discontinuous variation which appears in an organism due to permanent changes in its genotype. Mutation can occur at any stage during the development. Mutations are heritable changes, that is, if they appear in somatic cells they are inherited to daughter cells by mitosis but if they appear in gamete cells they are inherited to the offsprings. The former are known as somatic mutations and latter as germ mutations. They bring about a change in the genetic message and cause variation.

- Q.151** Two zoogeographical regions, separated by high mountain ranges, are
- (a) Nearctic and Palaearctic
 - (b) Neotropica and Ethiopian
 - (c) Oriental and Australian
 - (d) Palaearctic and Oriental

Ans: (d)

Sol: Scudder in 1857 recognised six zoogeographical regions on the basis of distribution of terrestrial vertebrates, chiefly mammals.

- (i) The Palaearctic region
- (ii) The Ethiopian region
- (iii) The Indian region (Oriental)
- (iv) The Australian region
- (v) The Neotropical region
- (vi) The Neoarctic region

The Palaearctic region includes the whole northern part of the Old World, i.e., whole of Europe, northern part of Africa and Asia, North of the Himalayas.

Oriental region includes the whole of India, Ceylon, South China, Burma, Thailand, Malaya of Peninsula, Malayan Islands. The Palaearctic and Oriental regions are separated by Himalayan range.

- Q.152** If a person shows production of interferons in his body, the chances are that he has got in infection of

- (a) tetanus
- (b) malaria
- (c) typhoid
- (d) measles

Ans: (d)

Sol: Interferons are antiviral proteins that increase the resistance of cell to attack by viruses. As measles is a viral disease, so body produces interferons. Measles is an acute infectious eruptive viral disease of childhood, caused by an RNA containing Rubeola virus/Polynosa morbillorum. Typhoid and tetanus are bacterial diseases caused by Salmonella typhi and Clostridium tetani respectively. Malaria is a protozoan disease caused by Plasmodium species.

- Q.153** Which of the following is correct regarding AIDS causative agent HIV?

- (a) HIV is enveloped virus containing one molecule of single-stranded RNA and one molecule of reverse transcriptase
- (b) HIV is enveloped virus that contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase.
- (c) HIV is unenveloped retrovirus
- (d) HIV does not escape but attacks the required immune response.

Ans: (b,d)

Sol: HIV is spherical virus with a diameter of about 90-120 nm. Its genome consists of a single stranded RNA filament segmented into two identical filaments and associated with reverse transcriptase enzymes. The envelope consists of a lipid bilayer derived from host cell membrane and projecting knob like glycoprotein spikes. It contains two protein coats. HIV is a retrovirus that attacks helper T cells. Without an adequate supply of helper cells, the immune system cannot signal B cells to produce antibodies to kill infected cells, thus body becomes susceptible to kill infected cells, thus body becomes susceptible to infections. This immune deficiency is described by the name acquired immune deficiency syndrome or AIDS.

Q.154 A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called

- (a) strip farming (b) shifting agriculture
(c) ley farming (d) contour arming

Ans: (c)

Sol: Ley farming is an agricultural system where the field is alternately seeded for grain and left fallow for growing hay or used for pature. During the fallow/pasture period the soil is filled with roots of grasses and other plants. New ploughing mixes them in he soil and also increases the amount of nitrogen in the soil especially when legume forage are used. It also protects soil from erosion by maintaing constant soil coverage.

Q.155 Which one of the following is a viral disease of poultry?

- (a) Coryza (b) New castle disease
(c) Pasteurellosis (d) Salmonellosis

Ans: (b)

Sol: New castle disease is a highly contagious zoonic bird disease affecting many domestic and wild avian species. The causal agent, New castle disease virus (NDV), is a negative-sense single stranded RNA virus. Transmission occurs b exposure to faecal and other ecretions from infected birds, and through contact with contaminated feed, water, equipment and clothing. Sings of infection with NDV vary greatly depending on factors such as the strain of virus and the health, age and species of the host, They can include respiratory signs (gasping, coughing), nervous signs (depression, inappetence, drooping wings, paralysis), swelling of the eyes and neck, diarrhoea, rough or thin-shelled aggs and reduced egg production.

Q.156 High milk yielding varieties of cows are obtained by

- (a) use of surrogate mothers
(b) superovulation
(c) artificial insemination
(d) all of these

Ans: (d)

Sol: High milk yielding varieteis of cows are obtained by use of surrogate mothers, superovulation artificial insemination. To get an increased yield of milk surrogate mothers are used in dairy. SUpervulation is the hormonal stimulation of multiple ovarian fillicles resulting in release from the ovary of a large number of oocytes (ova) than normal. So, implanation into surrogate mothers increases the number of offspring, usually from highly selected cows. Artifical insemination is a reasonably straight forward process to remove semen from a chosen male animal and tranfer it into a female, at the appropriate stage of the oestrous cycle. This process is well developed in case of dairy cattle breeding for more milk production.

Q.157 A common biocontrol agent for the control of plant diseases is

- (a) baculovirus (b) *Bacillus thuringiensis*
(c) *Glomus* (d) *Trichoderma*

Ans: (d)

Sol: The natural method of pest and pathogen conrol involving use of viruses, bacteria and other insects (which are their natural predators and pests) is called biocontrol or biological control. For example, free living fungs *Trichoderma* exerts

biocontrol over several plant pathogens for the control of plant diseases. Baculoviruses (mostly of genus *Nucleopolyhedrovirus*) are also used as biocontrol agents but they are used for the control of insects and arthropods. *Bacillus thuringiensis* is a soil bacterium which is used as biopesticide. Glous species ar the most common fungal partners of mycorrhiza residing in the roots of higher plants.

Q.158 Gobar gas contains mainly

- (a) $\text{CO}_2 + \text{H}_2$ (b) $\text{CO}_2 + \text{H}_2\text{O}$ (c) CH_4 only (d) $\text{CH}_4 + \text{CO}_2$

Ans: (b)

Sol: Biogas or gobas gas is a methane rich fuel gas produced by anaerobic breakdown or digestion of biomass with the help of methanogenic bacteria. It is made up of methan (50-70%), carbon dioxide (30-40%) with traces of nitrgoen, hydrogen sulphide and hydrogen.

Q.159 Which ofthe following is not a feature of the plasmids?

- (a) Transferable (b) Single-stranded
(c) Independent replication (d) Circular structure

Ans: (b)

Sol: Plasmids are extra-chromosomal, selfreplicatting, usually circular, double-stranded DNA molecules that serve as vectors which carry foreign DNA segment and replicate inside host cell.

Q.160 The linking of antibiotic resistnace gene with the plasmid vector became possible with

- (a) DNA polymerase (b) exonucleases
(c) DNA ligase (d) endonucleases

Ans: (c)

Sol: The construction of the first recombinant DNA emerged from the possibility of linking a gene encoding antibiotic resistance with a native plasmid. The cutting of DNA at specific locations became possible with thw discovery of the so-called 'molecular scissors' - restriction enzymes. The cut piece of DNA was then linked with the plasmid DNA. This plasmid DNA acts as vector to transfer the piece of DNA attched to it. The linking of antibitoc resistance gene with the the plasmid vector became possible with the enzyme DNA ligase, which acts on cut DNA molecules and joins their ends. This makes a new combination of circular autonomously replicating DNA created in vitro and is known as recombinant DNA.

Q.161 Restriction endonucleases are

- (a) used for in *vitro* DNA synthesis
(b) used in genetic engineering
(c) synthesized by bacteria
(d) present in mammalian celld for degradation of DNA

Ans: (d)

Sol: Restriction endonucleases were found by Arber in 1962 in bacteria. They act as "molecular scissors" or chemical scalpels. They recognize the specific base sequence at palindrome sites in DNA duplex and cut its strands. For example, restrictions endonclease *EcoRI* found in the colon bacteria *E. Coli* recognizes the base sequence GAATTC in DNA duplex and cuts its strands between G and A.

Q.162 A 'new' variety of rice was patented by a foreign company, through such varietes have been present in India for a long time. This is related to
(a) CO-667 (b) Sharbati Sonora
(c) Lerma Rojo (d) Basmati

Ans: (d)

Sol: In 1997, a Texas company got patent rights on Basmati rice through the US Patent and Trademark Office. This allowed the company to sell a 'new' variety of Basmati, in the US and abroad. This new variety of Basmati had actually been derived from Indian farmers' varieties. Indian Basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty. It caused a brief diplomatic crisis between Indian and United States with India threatening to take the matter to WTO (World Trade Organisation) as violation of TRIPS (Trade Related Aspects of Intellectual Property Rights). Both voluntarily and due to review decisions by United States patent office, Rice Teclost most of the claims of the patent.

Q.163 The first transgenic crop was
(a) tobacco (b) cotton (c) pea (d) flax

Ans: (a)

Sol: Transgenic plants are those plants in which a foreign gene has been introduced and stably integrated into host DNA. The first transgenic plants were produced in tobacco (*Nicotiana tabacum*). A gene resistant to PPT (L-phosphinothricin), an active ingredient of herbicide 'Basta', was isolated from *Medicago sativa*. It inhibits the enzyme GS (Glutamine synthase) which is involved in ammonia assimilation. This gene resistant to PPT was incorporated into tobacco, as a result of which transgenic tobacco was produced which was resistant to PPT.

Q.164 Besides paddy fields, cyanobacteria are also found inside vegetative part of
(a) *Equisetum* (b) *Psilotum* (c) *Pinus* (d) *Cycas*

Ans: (d)

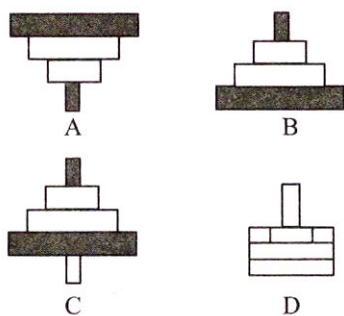
Sol: Coralloid roots of *Cycas* have symbiotic association with blue-green algae like *Nostoc* and *Anabaena*. Coralloid roots are irregular, negatively geotropic, dichotomously branched coral like roots which do not possess root hairs and root caps.

Q.165 Mycorrhiza is an example of
(a) symbiotic relationship (b) ectoparasitism
(c) endoparasitism (d) decomposers

Ans: (a)

Sol: In mutualism or symbiosis both the organisms in association are mutually benefitted and further this association is obligatory, i.e., necessary for existence of symbiosis. It is association between roots of higher plants and fungal hyphae. The fungal hyphae supply water and nutrients to the plant and in turn get food from the plant. So both the organisms are mutually benefitted.

Q.166 Which of the following representations shows the pyramid of numbers in a forest ecosystem?



(a) D

(b) A

(c) B

(d) C

Ans: (c)

Sol: The representation of forest ecosystem in pyramid of numbers is always upright because higher trophic level comprising of tertiary consumers is generally smaller than that of the lower trophic levels (i.e., secondary consumer, than primary consumer and primary producer).

The pyramid of number is inverted in case of single tree producer which can provide nourishment to several herbivores such as birds which can further support larger population of ectoparasites.

Q.167 Which of the following pairs is a sedimentary type of biogeochemical cycle?

(a) Phosphorus and nitrogen

(b) Phosphorous and sulphur

(c) Oxygen and nitrogen

(d) Phosphorous and carbon dioxide

Ans: (b)

Sol: Biogeochemical cycles are of two types: gaseous and sedimentary. In gaseous nutrient cycles, the materials involved in circulation between biotic and abiotic components of biosphere are gases or vapours and the reservoir pool is atmosphere or hydrosphere, e.g., carbon, hydrogen, oxygen, nitrogen, water. In sedimentary nutrient cycles, materials involved in circulation between biotic and abiotic components of biosphere are non-gaseous and the reservoir pool is lithosphere, e.g., phosphorus, calcium, magnesium, Sulphur has both sedimentary and gaseous nutrient cycles.

Q.168 When man eats fish which feeds on zooplanktons which have eaten small plants, the producer in this chain is

(a) small plants

(b) fish

(c) man

(d) zooplankton

Ans: (a)

Sol: The transfer of food energy from producers to consumers through a series of organisms with repeated eating and being eaten is known as food chain. Green plants are always the first link of food chain because they alone are capable of synthesising organic food by using light energy by photosynthesis. The logical sequence of a food chain is :

Producer → Consumers → Decomposer

Small plants → Zooplanktons → Fish → man

(Primary producer)	(Primary consumer)	(Secondary consumer)	(Tertiary consumer)
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Q.169 The 10% energy transfer law of food chain was given by
(a) Lindemann (b) Tansley (c) Stanley (d) Weismann

Ans: (a)

Sol: Herbivores are eaten by primary carnivores. Only 10% of the herbivores productivity is utilized for raising productivity of primary carnivores. The rest is consumed in ingestion, respiration, maintenance of body heat and other activities. Higher carnivores similarly are able to retain only 10% of energy present in primary carnivores. It is called 10% law which was proposed by Lindemann. Accordingly, if plant trapped 20J of energy, mice will have 2 J, snake will have 0.2 J and hence, peacock will have 0.02 J of energy.

Q.170 The largest tiger reserve in India is

- (a) Valmiki
- (b) Nagarjunasagar-Srisilam
- (c) Periyar
- (d) Nagarhole

Ans: (b)

Sol: Nagarjunasagar - Srisailam Tiger Reserve is the largest tiger reserve in India. It is present in Andhra Pradesh with a total area of 3568 km². The core area of this reserve is 1200 km²

Q.171 Red list contains data or information on

- (a) all economically important plants
- (b) plants whose products are in international trade
- (c) threatened species
- (d) marine vertebrates only

Ans: (c)

Sol: A red data book or red list is a catalogue of taxa facing risk of extinction. Red data book or red list was initiated in 1963.

Q.172 World Summit on Sustainable Development (2002) was held in

- (a) Argentina
- (b) South Africa
- (c) Brazil
- (d) Sweden

Ans: (b)

Sol: Conservation of biodiversity is a collective responsibility of all nations. The historic Convention on Biological Diversity ('The Earth Summit') held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits. In a follow-up, the World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

Q.173 Biodiversity to IURN Red List, what is the status of Red Panda (*Ailurus fulgens*)?

- (a) 1992
- (b) 1996
- (c) 2000
- (d) 2002

Ans: (d)

Sol: Biodiversity Act of India provides for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected there with or incidental there to. The biodiversity act of India was passed in 2002.

This act of parliament received the assent of President of India on the 5th February 2003.

Q.174 Joint Forest Management Concept was introduced in India during
(a) 1980s (b) 1990s (c) 1960s (d) 1970s

Ans: (a)

Sol: In india, Joint Forest Management was started in 1980s. Village and tribal communities are being involved in developmen and protection of degraded forests on share basis.

Q.175 Kyoto protocol was endorsed at
(a) CoP - 6 (b) CoP - 4 (c) CoP - 3 (d) CoP - 5

Ans: (c)

Sol: Kyoto protocol is an international treaty to reduce emission of green house gases which was adopted at the third session of the Conference of Parties (CoP - 3) to the UNFCCC (United Nations Framework CONvention on Climate Change) in 1997, in Kyoto, Japan.

Q.176 DDT residues are rapidly passed through food chain causing biomagnification because DDT is
(a) moderately toxic
(b) non-toxic to aquatic animals
(c) water soluble
(d) lipo soluble

Ans: (d)

Sol: Biomagnification is caused by non-degradable pollutatt like DDT. HEavy metals and persistent pesticides (e.g., organochlorine or chlorinated hydrocarbons like DDT) pass into food chain and increase in amount per unit weight or organisms with the rise in trophic level because they are lipo soluble.

Q.177 In 1984, the Bhopal gas tragedy took place because methyl isocyanate
(a) reacted with DDT
(b) reacted with ammonia
(c) reacted with CO
(d) reacted with water

Ans: (d)

Sol: Bhopal gas tragedy occurred on 3 December 1984 in a Union Carbide pesticide plant. WHEN water and MIC mixed, and exothermic chemica reaction started, which produced a lot of heat. As a result the safety value of the tank burst because of the increase in pressure. This burst was so violent that even concrete around the tank also broke. The high moisture content (aerosol) in the dischage while evaporating gave rise to a heavy gas which rapidly sank to the ground. It caused several ailments like partial or complete blindness, disorders like, gastrointestinal disorders in many survicing people.

Q.178 Formation of ozone is maximum over
(a) Europe (b) Africa (c) India (d) Antarctica

Ans: (d)

Sol: Depletion in the concentration of ozone over a restricated area as spring time decline over Antartica is called ozone hole. Ozone hole was discovered over Antartica by Faman et al, 1985. It is quite karge (23 million square km in 1992

