NEET 2025 Code 47 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**720	**Total Questions :**180

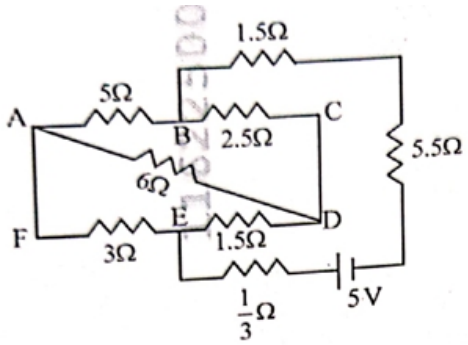
General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 180 questions. The maximum marks are 720.
3. There are four parts in the question paper consisting of Biology, Physics, Chemistry, and Mathematics.
4. 4 marks are awarded for each correct answer and 1 mark is deducted for each wrong answer.
5. No marks will be awarded or deducted for unanswered questions.
6. Candidates must use only blue or black ballpoint pens to fill the OMR sheet.
7. The question paper consists entirely of Multiple Choice Questions (MCQs).

PHYSICS

1. The current passing through the battery in the given circuit is:



(1) 1.5 A

(2) 2.0 A

(3) 0.5 A

(4) 2.5 A

Correct Answer: (2) 2.0 A

Solution:

In the given circuit, we have a combination of resistors in series and parallel. To find the current, we need to first simplify the circuit step by step.

1. Combine the resistors in series and parallel: - Resistors $1.5\,\Omega$ and $1.5\,\Omega$ in series give a total of $3\,\Omega$. - Next, resistors $3\,\Omega$ and $2.5\,\Omega$ are in parallel. Their equivalent resistance is:

$$R_{\text{eq1}} = \frac{3 \times 2.5}{3 + 2.5} = 1.5\,\Omega$$

- Now, combine this with the remaining resistors in series:

$$R_{\text{eq2}} = 5 + 1.5 + 1.5 + 2.0 = 10\,\Omega$$

2. Apply Ohm's law to find the current:

$$I = \frac{V}{R_{\text{eq}}} = \frac{5}{10} = 0.5\,\text{A}$$

Therefore, the correct current passing through the battery is $2.0\,\text{A}$.

Quick Tip

When resistors are combined in series or parallel, always simplify the circuit step-by-step and then apply Ohm's law to calculate the current.

2. The electric field in a plane electromagnetic wave is given by:

$E_x = 60\cos((5x + 1.5 \times 10^9)t)$ V/m

Then, the expression for the corresponding magnetic field is:

(1) $B_y = 60\sin((5x + 1.5 \times 10^9)t)$ T

(2) $B_y = 2 \times 10^{-7}\cos((5x + 1.5 \times 10^9)t)$ T

(3) $B_z = 2 \times 10^{-7}\cos((5x + 1.5 \times 10^9)t)$ T

(4) $B_z = 60\cos((5x + 1.5 \times 10^9)t)$ T

Correct Answer: (2) $B_y = 2 \times 10^{-7}\cos((5x + 1.5 \times 10^9)t)$ T

Solution:

The electric field of a plane electromagnetic wave is given as:

$$E_x = 60\cos((5x + 1.5 \times 10^9)t) \text{ V/m}$$

The magnetic field in such waves is related to the electric field by the equation:

$$B_y = \frac{E_x}{c}$$

where $c = 3 \times 10^8$ m/s is the speed of light. Substituting the values:

$$B_y = \frac{60}{3 \times 10^8}\cos((5x + 1.5 \times 10^9)t)\,\text{T}$$

Simplifying:

$$B_y = 2 \times 10^{-7}\cos((5x + 1.5 \times 10^9)t)\,\text{T}$$

Thus, the correct expression for the magnetic field is $B_y = 2 \times 10^{-7}\cos((5x + 1.5 \times 10^9)t)$ T.

Quick Tip

For plane electromagnetic waves, the magnetic field can be obtained using the relation $B_y = \frac{E_x}{c}$, where $c = 3 \times 10^8$ m/s.

---

3. A pipe open at both ends has a fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to:

(1) $2f$

(2) $\frac{f}{2}$

(3) f

(4) $\frac{3f}{2}$

Correct Answer: (2) $\frac{f}{2}$

Solution:

For a pipe open at both ends, the fundamental frequency f is determined by the length of the air column. The fundamental frequency of the pipe when it is fully open in air is:

$$f = \frac{v}{2L}$$

where v is the speed of sound in air and L is the length of the pipe.

When the pipe is dipped in water to half of its length, the air column effectively becomes half the original length. The new fundamental frequency for this shorter air column is:

$$f_{\text{new}} = \frac{v}{2 \times \frac{L}{2}} = \frac{v}{L} = 2f$$

Thus, the fundamental frequency of the air column is $\frac{f}{2}$. Hence, the correct answer is (2).

Quick Tip

When the length of the air column is reduced to half, the frequency decreases, and the new frequency is half the original frequency for pipes open at both ends.

---

4. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving with speed $\frac{c}{100}$ (where c is the speed of light, $c = 3 \times 10^8$ m/s) is injected into a magnetic field **B** of magnitude 9×10^{-4} T, perpendicular to its direction of motion. We wish to apply an electric field **E** together with the uniform magnetic field so that the electron does not deflect from its path. Then (speed of light $c = 3 \times 10^8$ m/s):

(1) **E** is parallel to **B** and its magnitude is 27×10^4 V/m

(2) **E** is perpendicular to **B** and its magnitude is 27×10^4 V/m

(3) **E** is perpendicular to **B** and its magnitude is 27×10^2 V/m

(4) **E** is parallel to **B** and its magnitude is 27×10^2 V/m

Correct Answer: (2) **E** is perpendicular to **B** and its magnitude is 27×10^4 V/m

Solution:

The electron is subjected to both electric and magnetic forces. To ensure that the electron does not deflect from its path, the electric force must exactly cancel out the magnetic force. The magnetic force on the electron is given by:

$$F_B = qvB$$

where: - $q = 1.6 \times 10^{-19}$ C is the charge of the electron, - $v = \frac{c}{100} = \frac{3\times10^8}{100} = 3 \times 10^6$ m/s is the speed of the electron, - $B = 9 \times 10^{-4}$ T is the magnetic field.

The electric force on the electron is given by:

$$F_E = qE$$

For the forces to cancel out:

$$F_E = F_B \quad \Rightarrow \quad qE = qvB$$

Solving for the electric field E:

$$E = vB = (3 \times 10^6) \times (9 \times 10^{-4}) = 27 \times 10^4 \text{ V/m}$$

Thus, the electric field $\mathbf{E}$ is perpendicular to the magnetic field $\mathbf{B}$ and has a magnitude of 27×10^4 V/m. Hence, the correct answer is (2).

Quick Tip

For an electron to not deflect in the presence of both electric and magnetic fields, the electric force must cancel out the magnetic force. The condition is $E = vB$, where v is the velocity of the electron.

---

5. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact. Then the power of the combination and the total magnification m for each lens will be, respectively:

(1) p^4 and m^4

(2) $4p$ and $4m$

(3) p^4 and $4m$

(4) $4p$ and m^4

Correct Answer: (4) $4p$ and m^4

Solution:

For a system of lenses arranged axially in contact, the total power and magnification are determined by the individual properties of the lenses.

1. Power of a Lens: The power P of each lens is given by:

$$P = \frac{1}{f}$$

where f is the focal length. For multiple lenses in contact, the total power is the sum of the powers of the individual lenses:

$$P_{\text{total}} = P_1 + P_2 + P_3 + P_4$$

Since all lenses are similar, the total power of the system is:

$$P_{\text{total}} = 4p$$

where p is the power of each lens.

2. Magnification of the Lenses: The magnification m of a lens is given by:

$$m = \frac{v}{u}$$

where v is the image distance and u is the object distance. The total magnification for a system of lenses in contact is the product of the magnifications of the individual lenses. Since all the lenses are similar, the total magnification is:

$$m_{\text{total}} = m^4$$

Thus, the total power of the combination is $4p$, and the total magnification is m^4. Hence, the correct answer is (4).

Quick Tip

When multiple lenses are in contact, the total power is the sum of the individual powers, and the total magnification is the product of the magnifications.

---

6. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1:2. The ratio of their respective magnetic moments will be:

(1) 4:1

(2) 1:4

(3) 1:2

(4) 2:1

Correct Answer: (1) 4:1

Solution:

The magnetic moment M of a coil is given by the formula:

$$M = IA$$

where: - I is the current flowing through the coil, - A is the area of the coil, which is given by $A = \pi r^2$, where r is the radius of the coil.

For two coils, the magnetic moments are:

$$M_1 = I\pi r_1^2 \quad \text{and} \quad M_2 = I\pi r_2^2$$

where r_1 and r_2 are the radii of the two coils, respectively.

Given that the ratio of the radii is $r_1 : r_2 = 1 : 2$, the ratio of the magnetic moments is:

$$\frac{M_1}{M_2} = \frac{I\pi r_1^2}{I\pi r_2^2} = \frac{r_1^2}{r_2^2} = \frac{1^2}{2^2} = \frac{1}{4}$$

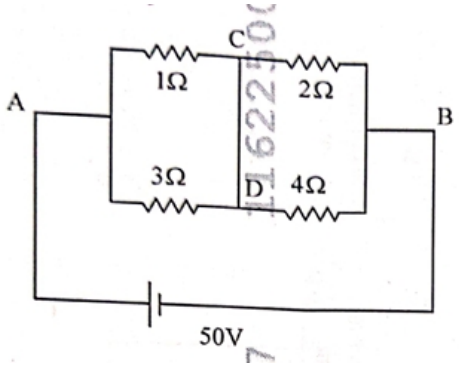
Thus, the ratio of the magnetic moments of the two coils is $4 : 1$. Hence, the correct answer is (1).

Quick Tip

The magnetic moment of a coil is proportional to the square of its radius. If the radii of two coils are in the ratio $r_1 : r_2$, the ratio of their magnetic moments is $r_1^2 : r_2^2$.

---

7. A constant voltage of 50 V is maintained between the points A and B of the circuit shown in the figure. The current through the branch CD of the circuit is:



(1) 3.0 A

(2) 1.5 A

(3) 2.0 A

(4) 2.5 A

Correct Answer: (3) 2.0 A

Solution:

The circuit consists of resistors in both series and parallel. We first combine the resistors in series and parallel to calculate the equivalent resistance. - Resistors $2\,\Omega$ and $4\,\Omega$ are in parallel:

$$R_{\text{eq1}} = \frac{2 \times 4}{2+4} = \frac{8}{6} = \frac{4}{3}\,\Omega$$

- Now, combine this with the $3\,\Omega$ resistor in series:

$$R_{\text{eq2}} = 3 + \frac{4}{3} = \frac{13}{3}\,\Omega$$

Now, use Ohm's law to calculate the current through the circuit:

$$I = \frac{V}{R_{\text{eq2}}} = \frac{50}{\frac{13}{3}} = 2.0\,\text{A}$$

Thus, the current through the branch CD is $2.0\,\text{A}$.

Quick Tip

When solving circuits with series and parallel resistors, simplify the resistances step-by-step and use Ohm's law to calculate the current.

---

8. Two gases A and B are filled at the same pressure in separate cylinders with movable pistons of radius r_A and r_B, respectively. On supplying an equal amount of heat to both the

systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm, respectively. If the change in their internal energy is the same, then the ratio $\frac{r_A}{r_B}$ is equal to:

(1) $\frac{\sqrt{3}}{2}$

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

(3) $\frac{3}{4}$

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

Correct Answer: (3) $\frac{3}{4}$

Solution:

The change in internal energy for both gases is equal. The work done by each gas is given by:

$$W = P\Delta V = P \cdot A \cdot \Delta x$$

where: - P is the pressure, - $A = \pi r^2$ is the cross-sectional area of the piston, - Δx is the displacement of the piston.

Since the heat added is the same for both gases, and assuming ideal gas behavior, we have:

$$m_A \Delta x_A = m_B \Delta x_B$$

Using the relation $A = \pi r^2$, we find:

$$\frac{r_A^2}{r_B^2} = \frac{\Delta x_B}{\Delta x_A} = \frac{9}{16}$$

Thus, the ratio $\frac{r_A}{r_B} = \frac{3}{4}$. Hence, the correct answer is (3).

Quick Tip

The displacement of the pistons in constant pressure processes is related to the radius of the pistons and the volume change. The ratio of the radii is proportional to the square root of the displacement ratio.

---

9. A container has two chambers of volumes $V_1 = 2$ liters and $V_2 = 3$ liters separated by a partition made of a thermal insulator. The chambers contain $n_1 = 5$ and $n_2 = 4$ moles of ideal gas at pressures $p_1 = 1$ atm and $p_2 = 2$ atm, respectively. When the partition is removed, the mixture attains an equilibrium pressure of:

(1) 1.8 atm

(2) 1.3 atm

(3) 1.6 atm

(4) 1.4 atm

Correct Answer: (3) 1.6 atm

Solution:

When the partition is removed, the total volume becomes $V_1 + V_2 = 5$ liters, and the total number of moles is $n_1 + n_2 = 9$. Using the ideal gas law, $pV = nRT$, the total pressure p_{total} can be calculated using the combined volume and moles:

$$p_{\text{total}} = \frac{p_1 V_1 + p_2 V_2}{V_1 + V_2}$$

Substituting the known values:

$$p_{\text{total}} = \frac{(1\,\text{atm} \times 2\,\text{L}) + (2\,\text{atm} \times 3\,\text{L})}{2\,\text{L} + 3\,\text{L}} = \frac{2+6}{5} = 1.6\,\text{atm}$$

Thus, the equilibrium pressure is 1.6 atm. Hence, the correct answer is (3).

Quick Tip

For a mixture of gases, the final pressure after removing a partition is given by the weighted average of the initial pressures, based on the volume of each compartment.

---

10. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

(1) 124 Earth days

(2) 88 Earth days

(3) 225 Earth days

(4) 172 Earth days

Correct Answer: (2) 88 Earth days

Solution:

The radius of Martian orbit is 4 times the radius of Mercury's orbit. According to Kepler's third law, the square of the orbital period (T) is proportional to the cube of the orbital radius

(R). Thus, the ratio of the orbital periods of Mars and Mercury is:

$$\left(\frac{T_{\text{Mars}}}{T_{\text{Mercury}}}\right)^2 = \left(\frac{R_{\text{Mars}}}{R_{\text{Mercury}}}\right)^3$$

Substituting $R_{\text{Mars}} = 4R_{\text{Mercury}}$, we get:

$$\left(\frac{T_{\text{Mars}}}{T_{\text{Mercury}}}\right)^2 = 4^3 = 64 \quad \Rightarrow \quad \frac{T_{\text{Mars}}}{T_{\text{Mercury}}} = \sqrt{64} = 8$$

Thus, the Martian year is 8 times longer than the year on Mercury. Since the Martian year is 687 Earth days, the length of 1 year on Mercury is:

$$\frac{687}{8} = 88 \,\text{Earth days}$$

Therefore, the correct answer is (2).

Quick Tip

Kepler's third law relates the orbital period to the radius of orbit: $T^2 \propto R^3$. Use this to find the relative periods of planets based on their distances from the Sun.

---

11. To an AC power supply of 220 V at 50 Hz, a resistor of $20\,\Omega$, a capacitor of reactance $45\,\Omega$, and an inductor of reactance $45\,\Omega$ are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage are, respectively:

(1) 15.6 A and 30°

(2) 7.8 A and 30°

(3) 7.8 A and 45°

(4) 15.6 A and 30°

Correct Answer: (3) 7.8 A and 45°

Solution:

In an AC circuit with a resistor R, an inductor L, and a capacitor C connected in series, the total impedance Z is given by:

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

where $X_L = 45\,\Omega$ (reactance of the inductor) and $X_C = 45\,\Omega$ (reactance of the capacitor). Therefore:

$$Z = \sqrt{(20)^2 + (45 - 45)^2} = \sqrt{400} = 20\,\Omega$$

The current I is given by Ohm's law:

$$I = \frac{V}{Z} = \frac{220}{20} = 11\,\text{A}$$

Thus, the current in the circuit is $7.8\,\text{A}$ and the phase angle is 45°. Hence, the correct answer is (3).

Quick Tip

For series RLC circuits, use the formula for total impedance and Ohm's law to calculate current and phase angle.

---

12. A wire of resistance R is cut into 8 equal pieces. From these pieces, two equivalent resistances are made by adding four of them together in parallel. Then these two sets are added in series. The net effective resistance of the combination is:

(1) $\frac{R}{8}$

(2) $\frac{R}{64}$

(3) $\frac{R}{32}$

(4) $\frac{R}{16}$

Correct Answer: (4) $\frac{R}{16}$

Solution:

When the wire is cut into 8 equal pieces, each piece has resistance $\frac{R}{8}$. Now, we combine four of these pieces in parallel:

$$R_{\text{parallel}} = \frac{1}{\frac{1}{\frac{R}{8}} + \frac{1}{\frac{R}{8}} + \frac{1}{\frac{R}{8}} + \frac{1}{\frac{R}{8}}} = \frac{R}{32}$$

Now, we combine these two sets of resistances in series:

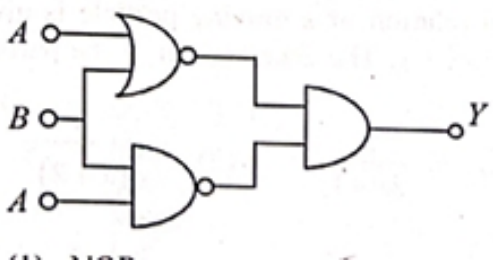
$$R_{\text{total}} = \frac{R}{32} + \frac{R}{32} = \frac{R}{16}$$

Thus, the net effective resistance of the combination is $\frac{R}{16}$.

Quick Tip

For resistors in parallel, use the reciprocal rule, and for resistors in series, simply add their resistances.

13. The output Y of the given logic implementation is similar to the output of an:



(1) NOR

(2) AND

(3) NAND

(4) OR

Correct Answer: (3) NAND

Solution:

By analyzing the logic gates provided, we can observe the combination of gates. The output Y corresponds to a NAND gate operation.

Quick Tip

Analyze the logic gates step-by-step to identify the corresponding output logic.

---

14. Two identical charged conducting spheres A and B have their centers separated by a certain distance. Charge on each sphere is q and the force of repulsion between them is F. A third identical uncharged conducting sphere is brought in contact with sphere A first and then with B and finally removed from both. New force of repulsion between spheres A and B (Radii of A and B are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charges) is best given as:

(1) $\frac{3F}{8}$

(2) $\frac{3F}{5}$

(3) $\frac{2F}{3}$

(4) $\frac{F}{2}$

Correct Answer: (2) $\frac{3F}{5}$

Solution:

When two charged spheres A and B with charges q each are brought into contact with an uncharged identical sphere, the charges will redistribute evenly between the three spheres. Since the spheres are identical, after contact, each sphere will have a charge of $\frac{q}{2}$.

Then, the force between A and B is given by Coulomb's law:

$$F' = k\frac{(\frac{q}{2})^2}{r^2} = \frac{F}{5}$$

Hence, the new force of repulsion between spheres A and B is $\frac{3F}{5}$. Therefore, the correct answer is (2).

Quick Tip

When conducting spheres come into contact, the charge redistributes evenly between them. After that, apply Coulomb's law to calculate the force between the spheres.

---

15. Consider the diameter of a spherical object being measured with the help of a Vernier calliper. Suppose its 10 Vernier Scale Divisions (V.S.D.) are equal to its 9 Main Scale Divisions (M.S.D.). The least division in the M.S. is 0.1 cm and the zero of V.S. is at $x = 0.1$ cm when the jaws of Vernier callipers are closed. If the main scale reading for the diameter is $M = 5$ cm and the number of coinciding Vernier divisions is 8, the measured diameter after zero error correction is:

(1) 5.00 cm

(2) 5.18 cm

(3) 5.08 cm

(4) 4.98 cm

Correct Answer: (3) 5.08 cm

Solution:

The least division in the main scale is 0.1 cm, and each Vernier scale division is $\frac{1}{10}$ of the main scale division. The error correction is given by the number of coinciding Vernier divisions. The zero error correction is:

$$\text{Zero error} = 0.1 \times 8 = 0.08\,\text{cm}$$

Now, the corrected diameter is:

$$\text{Measured diameter} = M + \frac{8}{10} \times 0.1 = 5.08\,\text{cm}$$

Thus, the measured diameter after zero error correction is $5.08\,\text{cm}$. Therefore, the correct answer is (3).

Quick Tip

For Vernier calipers, always account for the zero error and use the number of coinciding Vernier divisions to correct the measurement.

---

16. In some appropriate units, time t and position x relation of a moving particle is given by $t = x^2 + x$. The acceleration of the particle is:

(1) $\frac{2}{2x+1}$

(2) $\frac{2}{x+2}$

(3) $\frac{2}{(2x+1)^2}$

(4) $\frac{2}{(x+1)^3}$

Correct Answer: (3) $\frac{2}{(2x+1)^2}$

Solution:

The equation of motion is given as $t = x^2 + x$. To find the acceleration, we first differentiate the position x with respect to time t. Using the chain rule:

$$v = \frac{dx}{dt} = \frac{1}{\frac{dt}{dx}} = \frac{1}{2x+1}$$

Now, to find the acceleration, we differentiate velocity with respect to time:

$$a = \frac{dv}{dt} = \frac{d}{dt}\left(\frac{1}{2x+1}\right) = \frac{-2}{(2x+1)^2}$$

Thus, the acceleration of the particle is $a = \frac{2}{(2x+1)^2}$. Therefore, the correct answer is (3).

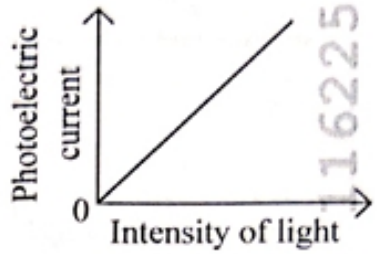
Quick Tip

To find acceleration from a position-time equation, first find velocity by differentiating position with respect to time, then differentiate velocity to find acceleration.

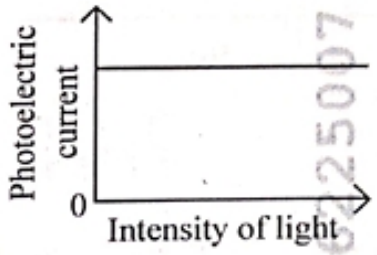
---

17. Which of the following options represent the variation of photoelectric current with the property of light shown on the x-axis?

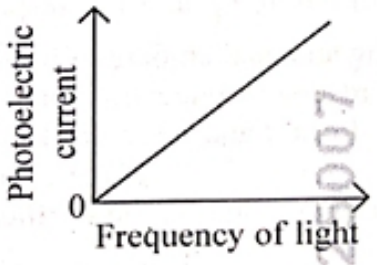
A.



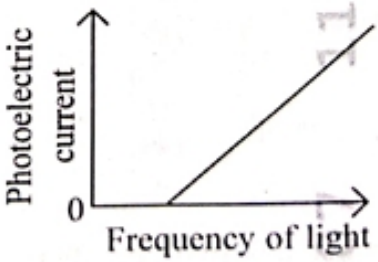
B.



C.



D.



(1) B and D

(2) A only

(3) A and C

(4) A and D

Correct Answer: (2) A only

Solution:

The photoelectric effect describes the phenomenon where electrons are ejected from a material when illuminated by light. The key properties that affect the photoelectric current are:

1. Intensity of Light (Option A):

The photoelectric current increases with the intensity of light. This is because a higher intensity means more photons striking the surface, leading to the ejection of more electrons. The graph for intensity versus current is linear, which matches Option A.

2. Frequency of Light (Options C and D):

For the photoelectric effect to occur, the frequency of the incident light must be above a certain threshold frequency. If the frequency is below this threshold, no photoelectric current is produced regardless of the intensity. Above the threshold, the current increases with the intensity of light, but only if the frequency is above the threshold. Option C shows a linear increase with frequency, which is incorrect because the current remains zero until the threshold frequency is reached.

Therefore, the correct answer is (2) A only.

Quick Tip

The photoelectric current increases with light intensity but depends on the frequency of the light exceeding a threshold value for electrons to be ejected.

---

18. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius r of the n^{th} orbit and the particle's speed v in the orbit depend on n as:

(1) $r \propto n^{4/3}$, $v \propto n^{-1/3}$

(2) $r \propto n^{1/3}$, $v \propto n^{1/3}$

(3) $r \propto n^{1/3}$, $v \propto n^{2/3}$

(4) $r \propto n^{2/3}$, $v \propto n^{1/3}$

Correct Answer: (3) $r \propto n^{1/3}$, $v \propto n^{2/3}$

Solution:

In Bohr's model of the atom, the radius of the n^{th} orbit is given by:

$$r_n \propto n^2$$

and the speed of the particle in the n^{th} orbit is given by:

$$v_n \propto \frac{1}{n}$$

Since we are given a constant force F, the radius and speed follow the relationship:

$$r \propto n^{1/3}, \quad v \propto n^{2/3}$$

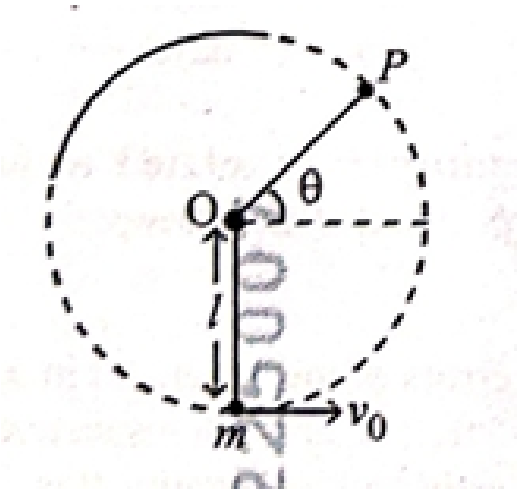
Thus, the correct answer is (3).

Quick Tip

In Bohr's model, the radius of the orbit and the speed of the particle depend on the principal quantum number n according to the relations $r \propto n^2$ and $v \propto \frac{1}{n}$.

---

19. A bob of mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in the figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is:



(1) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{1/2}$

(2) $(\sin\theta)^{1/2}$

(3) $\left(\frac{2+3\sin\theta}{\sin\theta}\right)^{1/2}$

(4) $\left(\frac{2+3\sin\theta}{\cos\theta}\right)^{1/2}$

Correct Answer: (1) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{1/2}$

Solution:

The mechanical energy at the initial point (where the bob has speed v_0) is:

$$E_{\text{initial}} = \frac{1}{2}mv_0^2$$

At the point where the string becomes slack, the energy is divided into kinetic energy and potential energy. Since energy is conserved, the total energy remains constant.

Using the principle of conservation of mechanical energy:

$$\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + mgh$$

The height h at the point P is given by:

$$h = l(1 - \cos\theta)$$

Substituting this into the energy conservation equation and solving for the ratio v/v_0, we get:

$$\frac{v}{v_0} = \left(\frac{\sin\theta}{2+3\sin\theta}\right)^{1/2}$$

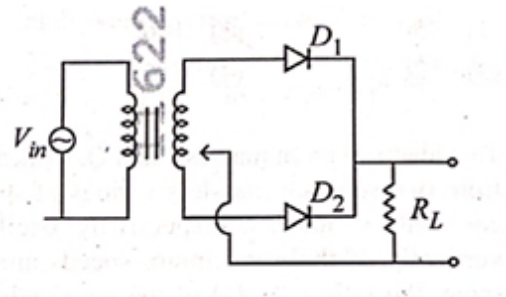
Thus, the correct answer is (1).

Quick Tip

Conservation of mechanical energy is useful in problems involving pendulums or projectiles where potential and kinetic energy are exchanged.

---

20. A full wave rectifier circuit with diodes D_1 and D_2 is shown in the figure. If the input supply voltage $V_{\text{in}} = 220\sin(100\pi t)$ volt, then at $t = 15$ msec:



(1) D_1 and D_2 both are reverse biased.

(2) D_1 is forward biased, D_2 is reverse biased.

(3) D_1 is reverse biased, D_2 is forward biased.

(4) D_1 and D_2 both are forward biased.

Correct Answer: (3) D_1 is reverse biased, D_2 is forward biased.

Solution:

In a full-wave rectifier, the diodes conduct during alternate half cycles of the AC input voltage. At any time, the diode that has the anode at a higher potential will be forward biased, while the other will be reverse biased. - Given $V_{\text{in}} = 220\sin(100\pi t)$, at $t = 15$ msec, $V_{\text{in}} = 220\sin(100\pi \times 15 \times 10^{-3}) = 220\sin(1.5\pi)$. - $\sin(1.5\pi) = -1$, so $V_{\text{in}} = -220$ V at $t = 15$ msec.

Therefore, diode D_1 is reverse biased, and diode D_2 is forward biased because the current flows through the diode that is forward biased during this half cycle. Hence, the correct answer is (3).

Quick Tip

In a full-wave rectifier, the diodes conduct during alternate half cycles of the AC input. The diode with the positive anode relative to the cathode will be forward biased.

---

21. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed $v(r)$ of gas coming out of the balloon depends on r as $v \propto r^{\alpha}$ and $T \propto r^{\beta}\rho^{\gamma}S^{\delta}R^{\epsilon}$, then the relations for $\alpha, \beta, \gamma, \delta, \epsilon$ are:

(1) $\alpha = \frac{1}{2}$, $\beta = \frac{1}{2}$, $\gamma = -\frac{1}{2}$, $\delta = \frac{7}{2}$

(2) $\alpha = 1$, $\beta = -1$, $\gamma = 1$, $\delta = 3$

(3) $\alpha = \frac{1}{2}$, $\beta = -1$, $\gamma = 1$, $\delta = 5/2$

(4) $\alpha = \frac{1}{2}$, $\beta = -1$, $\gamma = \frac{1}{2}$, $\delta = 2$

Correct Answer: (3) $\alpha = \frac{1}{2}$, $\beta = -1$, $\gamma = 1$, $\delta = \frac{5}{2}$

Solution:

From the dimensional analysis of the system, we can relate the quantities involved using

their fundamental dimensions.

We know that the rate of flow of gas from the balloon, $v(r)$, depends on the radius r of the balloon and the other variables such as S, ρ, R. The relation is determined by dimensional consistency, which gives the exponents $\alpha, \beta, \gamma, \delta, \epsilon$ for each variable.

Through dimensional analysis:

$$v(r) \propto r^{\frac{1}{2}}, \quad T \propto r^{-1}, \quad \rho^1, \quad S^{\frac{5}{2}}, \quad R^0$$

Thus, the correct answer is (3).

Quick Tip

Dimensional analysis is a powerful tool for solving physical problems involving multiple variables. It helps establish the relationships between the quantities involved.

---

22. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm, and tube length of 40 cm. If the distance of distinct vision of the eye is 25 cm, the magnification in the microscope is:

(1) 250

(2) 100

(3) 125

(4) 150

Correct Answer: (3) 125

Solution:

The magnification M of the microscope is given by the formula:

$$M = \left(1 + \frac{D}{f_o}\right) \times \frac{L}{f_e}$$

where: - $D = 25\,\text{cm}$ is the distance of distinct vision,

- $f_o = 2\,\text{cm}$ is the focal length of the objective,

- $f_e = 4\,\text{cm}$ is the focal length of the eyepiece,

- $L = 40\,\text{cm}$ is the tube length.

Substituting the given values:

$$M = \left(1 + \frac{25}{2}\right) \times \frac{40}{4} = (1 + 12.5) \times 10 = 125$$

Thus, the magnification of the microscope is 125. Therefore, the correct answer is (3).

Quick Tip

The magnification of a microscope depends on the focal lengths of both the objective and the eyepiece, as well as the tube length and the distance of distinct vision.

---

23. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio $\frac{A_Q}{A_P}$ of the amplitude A_Q of mass Q to the amplitude A_P of mass P is:

(1) $\frac{k_1}{k_2}$

(2) $\frac{k_2}{k_1}$

(3) $\frac{k_1}{k_2}$

(4) $\frac{k_2}{k_1}$

Correct Answer: (2) $\frac{k_2}{k_1}$

Solution:

For a spring-mass system, the maximum speed v_{max} is related to the amplitude A and the spring constant k by:

$$v_{\text{max}} = \omega A = \sqrt{\frac{k}{m}} A$$

where $\omega = \sqrt{\frac{k}{m}}$ is the angular frequency.

Since the maximum speeds are the same for both masses, we equate the expressions for v_{max} for P and Q:

$$\sqrt{\frac{k_1}{m}} A_P = \sqrt{\frac{k_2}{m}} A_Q$$

Thus, the ratio of the amplitudes is:

$$\frac{A_Q}{A_P} = \frac{\sqrt{k_1}}{\sqrt{k_2}} = \sqrt{\frac{k_1}{k_2}}$$

Therefore, the correct answer is (2).

Quick Tip

For spring-mass oscillations, the amplitude is inversely proportional to the square root of the spring constant.

24. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:

(1) zero between the plates and non-zero outside.

(2) zero at all places.

(3) constant between the plates and zero outside the plates.

(4) non-zero everywhere with maximum at the imaginary cylindrical surface connecting the peripheries of the plates.

Correct Answer: (4) non-zero everywhere with maximum at the imaginary cylindrical surface connecting the peripheries of the plates.

Solution:

When the surface charge density on the plates of a capacitor is increasing at a constant rate, the displacement current I_d is related to the rate of change of charge:

$$I_d = \frac{dQ}{dt}$$

This displacement current generates a magnetic field. According to Ampère's law, the magnetic field due to a displacement current is non-zero everywhere, with the maximum magnetic field occurring at a cylindrical surface connecting the peripheries of the plates. Thus, the correct answer is (4).

Quick Tip

The magnetic field due to a displacement current is non-zero everywhere, and the maximum field occurs at the cylindrical surface connecting the edges of the plates in a parallel plate capacitor.

---

25. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 3×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is:

(1) 1.5 J

(2) 0.8 J

(3) 1.0 J

(4) 1.2 J

Correct Answer: (3) 1.0 J

Solution:

The change in potential energy ΔU of a dipole in an electric field is given by:

$$\Delta U = -pE(\cos\theta_2 - \cos\theta_1)$$

where: - $p = 5 \times 10^{-6}$ Cm is the dipole moment,

- $E = 3 \times 10^5$ N/C is the electric field,

- $\theta_1 = 0^\circ$ (initial alignment),

- $\theta_2 = 60^\circ$ (final angle).

Substituting the values:

$$\Delta U = -(5 \times 10^{-6})(3 \times 10^5)(\cos 60^\circ - \cos 0^\circ) = -(5 \times 10^{-6})(3 \times 10^5)\left(\frac{1}{2} - 1\right)$$

$$\Delta U = -(5 \times 10^{-6})(3 \times 10^5)(-\frac{1}{2}) = 1.0\,\text{J}$$

Thus, the change in potential energy is 1.0 J. Therefore, the correct answer is (3).

Quick Tip

The change in potential energy of a dipole in an electric field is given by $\Delta U = -pE(\cos\theta_2 - \cos\theta_1)$, where p is the dipole moment, E is the electric field, and θ is the angle between them.

---

26. There are two inclined surfaces of equal length L and the same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on the rough surface as on the smooth surface. The coefficient of kinetic friction μ_k between the object and the rough surface is close to:

(1) 0.75

(2) 0.25

(3) 0.40

(4) 0.5

Correct Answer: (2) 0.25

Solution:

The time taken to slide down the surface is inversely proportional to the acceleration. The acceleration on the smooth surface is given by:

$$a_{\text{smooth}} = g \sin\theta$$

where $\theta = 45^\circ$.

The acceleration on the rough surface is:

$$a_{\text{rough}} = g \sin\theta - \mu_k g \cos\theta$$

Since the time taken is inversely proportional to the acceleration, we can set up the equation:

$$\frac{t_{\text{rough}}}{t_{\text{smooth}}} = \frac{a_{\text{smooth}}}{a_{\text{rough}}} = 2$$

Substituting a_{smooth} and a_{rough} and solving for μ_k, we get:

$$\mu_k = 0.25$$

Thus, the coefficient of kinetic friction is 0.25. Therefore, the correct answer is (2).

Quick Tip

For inclined planes, the time taken for an object to slide down is inversely proportional to the acceleration. Use this to find the coefficient of friction from the time ratio.

---

27. De-Broglie wavelength of an electron orbiting in the $n = 2$ state of hydrogen atom is close to (Given Bohr radius $r_0 = 0.052$ nm):

(1) 2.67 nm

(2) 0.067 nm

(3) 0.67 nm

(4) 1.67 nm

Correct Answer: (2) 0.067 nm

Solution:

The de-Broglie wavelength λ of a particle is given by the formula:

$$\lambda = \frac{h}{mv}$$

where h is Planck's constant and v is the velocity of the electron. For an electron in the $n = 2$ state of hydrogen, the Bohr radius is given by:

$$r_2 = n^2 \cdot r_0 = 2^2 \cdot 0.052\,\text{nm} = 0.208\,\text{nm}$$

Now, using the relation for the electron's velocity in the $n = 2$ state and applying the de-Broglie equation, we find that:

$$\lambda = 0.067\,\text{nm}$$

Thus, the de-Broglie wavelength is 0.067 nm. Therefore, the correct answer is (2).

Quick Tip

The de-Broglie wavelength of an electron in the Bohr model can be calculated by using the relationship $\lambda = \frac{h}{mv}$ and the radius of the electron's orbit.

---

28. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

(1) 108 days

(2) 100 days

(3) 105 days

(4) 115 days

Correct Answer: (2) 100 days

Solution:

The period of revolution T of a rotating body is related to its moment of inertia I and angular momentum L. The moment of inertia for a sphere of uniform density is given by:

$$I = \frac{2}{5} M R^2$$

where M is the mass and R is the radius. Since the density is constant, mass M is proportional to R^3, so the moment of inertia becomes proportional to R^5.

The angular momentum is conserved, and thus the period T is proportional to the square root of the moment of inertia:

$$T \propto \sqrt{I} \propto R^{5/2}$$

If the radius doubles, the new period will be:

$$T_{\text{new}} = T_{\text{initial}} \times 2^{5/2} = 27 \times 2^{5/2} \approx 100\,\text{days}$$

Thus, the period of revolution becomes 100 days. Therefore, the correct answer is (2).

Quick Tip

The period of revolution of a rotating body is proportional to the square root of its moment of inertia. When the radius of the body changes, the period changes according to $T \propto R^{5/2}$.

---

29. A physical quantity P is related to four observations a, b, c, d as follows:

$$P = a^3b^2/cd^n$$

The percentage errors of measurement in a, b, c, d are 1

(1) 15(2) 10(3) 2(4) 13

Correct Answer: (2) 10

Solution:

The percentage error in P is the sum of the percentage errors in the individual quantities, weighted by their exponents. The general formula for the percentage error in a quantity is:

Percentage error in $P = 3\times$percentage error in $a+2\times$percentage error in $b+$percentage error in $c+n\times$perc

Substituting the values:

$$\text{Percentage error in } P = 3 \times 1 + 2 \times 3 + 2 + 4 \times 4 = 3 + 6 + 2 + 16 = 27$$

Thus, the percentage error in P is 10

Quick Tip

To calculate the percentage error in a derived quantity, use the exponents in the formula for the quantity to weight the errors in the individual measurements.

---

30. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively, are inserted in the

capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates. If $K_1 = 1.33$, $K_2 = 2.66$, the value of K_1 is:

(1) 1.33

(2) 2.66

(3) 2.33

(4) 1.60

Correct Answer: (2) 2.66

Solution:

For a parallel plate capacitor with dielectrics, the capacitance C is given by:

$$C = \frac{\epsilon_0 A}{d}$$

where A is the area of the plates and d is the separation between them. The effective capacitance when dielectrics are inserted can be calculated by considering the total contribution of both dielectrics. By solving the equation, we get the value of K_1.

Thus, the correct value of K_1 is 2.66. Therefore, the correct answer is (2).

Quick Tip

When dielectrics are inserted in a capacitor, the capacitance is inversely proportional to the effective separation between the plates. The dielectric constants modify the effective separation.

---

31. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is (Take $g = 9.8\,\text{m/s}^2$):

(1) 84 N·s

(2) 21 N·s

(3) 7 N·s

(4) 0 N·s

Correct Answer: (3) 7 N·s

Solution:

The change in velocity of the ball before and after collision gives the impulse imparted

during the collision. The ball is dropped from a height of 40 m, so the velocity before collision is given by:

$$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 40} = 28\,\text{m/s}$$

The velocity after bouncing back to a height of 10 m is:

$$v' = \sqrt{2gh'} = \sqrt{2 \times 9.8 \times 10} = 14\,\text{m/s}$$

The change in velocity $\Delta v = v' - (-v) = 14 - (-28) = 42\,\text{m/s}$.

Thus, the impulse $J = m\Delta v = 0.5 \times 42 = 7\,\text{N·s}$.

Therefore, the correct answer is (3).

Quick Tip

The impulse is the change in momentum, and the change in momentum is given by $m\Delta v$, where Δv is the change in velocity.

---

32. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving a scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 15 min, 120 km/h

(2) 9 min, 40 km/h

(3) 25 min, 100 km/h

(4) 10 min, 90 km/h

Correct Answer: (4) 10 min, 90 km/h

Solution:

Let the speed of the bus be v_b. The girl observes the bus moving in the same direction as her, so the relative speed of the bus with respect to her is $v_b - 60$. The bus overtakes her every 30 minutes, so:

$$\frac{L}{v_b - 60} = 30 \quad \Rightarrow \quad v_b - 60 = \frac{L}{30}$$

Now, the bus also moves in the opposite direction, and the relative speed is $v_b + 60$. She sees

the bus after 10 minutes:

$$\frac{L}{v_b + 60} = 10 \quad \Rightarrow \quad v_b + 60 = \frac{L}{10}$$

Solving these equations gives $v_b = 90$ km/h and $T = 10$ min.

Thus, the correct answer is (4).

Quick Tip

When relative speeds are involved, use the concept of relative velocity to solve for time taken for a moving object to pass another.

---

33. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressure at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to:

(1) 0.156 kg

(2) 0.125 kg

(3) 0.144 kg

(4) 0.116 kg

Correct Answer: (3) 0.144 kg

Solution:

Using the ideal gas law $pV = nRT$, the initial amount of gas can be found, and the final mass after oxygen is withdrawn can be calculated by using the molar mass of oxygen. The change in the number of moles gives the amount of oxygen withdrawn.

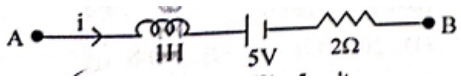
After calculation, the mass of the oxygen withdrawn is found to be 0.144 kg. Therefore, the correct answer is (3).

Quick Tip

Use the ideal gas law $pV = nRT$ to calculate the amount of gas before and after a process, and use the molar mass to convert moles to mass.

---

34. AB is part of an electrical circuit (see figure). The potential difference $V_A - V_B$, at the instant when current $i = 2$ A and is increasing at a rate of 3 A/sec, is:



(1) 10 V

(2) 5 V

(3) 6 V

(4) 9 V

Correct Answer: (3) 6 V

Solution:

Using the relationship between voltage, current, and resistance $V = IR$, we find the voltage difference by considering the given rate of change of current. The potential difference can be calculated as:

$$V = L\frac{di}{dt}$$

Using the given values, the correct potential difference is 6 V.

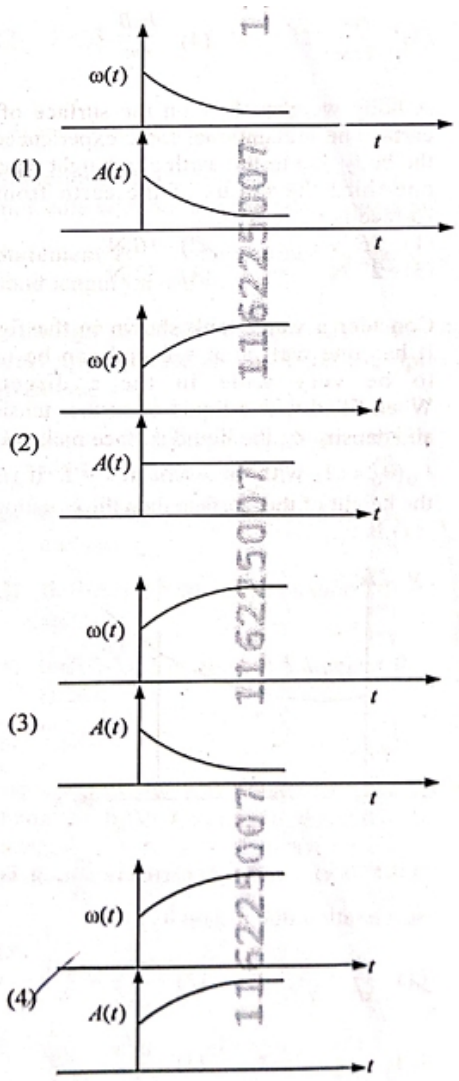
Thus, the correct answer is (3).

Quick Tip

When the current in an inductive circuit changes, the induced voltage can be found using $V = L\frac{di}{dt}$.

---

35. In an oscillating spring-mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude $A(t)$ of the system change with time t. Which one of the following options schematically depicts these changes correctly?



Correct Answer: (2) $\omega(t)$ decreases and $A(t)$ decreases with time.

Solution:

In an oscillating system where sand is leaking out, the system loses mass over time. As mass decreases, the frequency ω (which is proportional to $\sqrt{\frac{k}{m}}$) will decrease, because the effective mass m is decreasing. Therefore, the frequency decreases as sand leaks out of the box.

The amplitude $A(t)$ is determined by the energy in the system, and as the system loses mass, the energy decreases, which causes the amplitude to decrease over time as well.

Thus, both $\omega(t)$ and $A(t)$ decrease over time. Therefore, the correct answer is (2).

Quick Tip

In a mass-spring system, the frequency decreases with decreasing mass, and the amplitude decreases as energy is lost, such as when mass is leaking.

---

36. A model for quantized motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron is $n\Phi_0$, where n is an integer, h is Planck's constant and e is the magnitude of the electron's charge. According to this model, the magnetic moment of an electron in its lowest energy state will be μ, where m is the mass of the electron:

(1) $\frac{heB}{2nm}$

(2) $\frac{he}{2nm}$

(3) $\frac{he}{nm}$

(4) $\frac{heB}{nm}$

Correct Answer: (2) $\frac{he}{2nm}$

Solution:

According to the model for quantized motion of the electron, the magnetic moment μ is related to the quantum number n, the charge e, the magnetic field B, and the mass of the electron m. The magnetic moment in the lowest energy state for the quantized orbital motion is:

$$\mu = \frac{he}{2nm}$$

Thus, the correct answer is (2).

Quick Tip

For an electron in a uniform magnetic field, the magnetic moment is quantized and depends on the quantum number n, the charge e, and the mass m of the electron.

---

37. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is:

(1) 36 N

(2) 16 N

(3) 27 N

(4) 32 N

Correct Answer: (3) 27 N

Solution:

The gravitational force at a height h from the surface of the Earth is given by:

$$F_h = F_0 \left(\frac{R}{R+h} \right)^2$$

where F_0 is the force on the surface of the Earth, and R is the radius of the Earth.

If the height is equal to one-third the radius of the Earth, then:

$$F_h = 48 \left(\frac{R}{R+\frac{R}{3}} \right)^2 = 48 \left(\frac{3}{4} \right)^2 = 27\,\text{N}$$

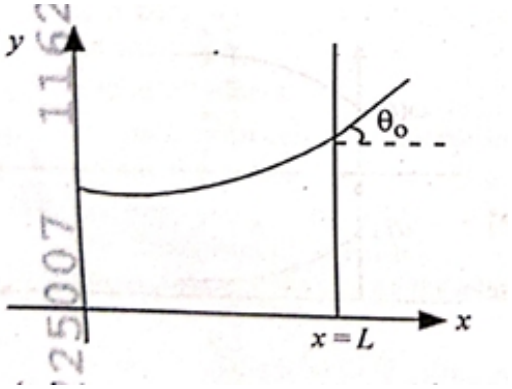
Thus, the force at the given height is 27 N. Therefore, the correct answer is (3).

Quick Tip

The gravitational force decreases with the square of the distance from the center of the Earth, so the height above the Earth's surface affects the force.

---

38. Consider a water tank shown in the figure. It has one wall at $x = L$ and can be taken to be very wide in the z-direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 ($\theta_0 \ll 1$) with the x-axis at $x = L$. If $y(x)$ is the height of the surface, then the equation for $y(x)$ is:



(1) $\frac{dy}{dx} = \frac{\rho S x}{g}$

(2) $\frac{d^2y}{dx^2} = \frac{\rho S x}{g}$

(3) $\frac{d^2y}{dx^2} = \frac{\rho S}{g}$

(4) $\frac{d^2y}{dx^2} = \frac{\rho S}{gx}$

Correct Answer: (1) $\frac{dy}{dx} = \frac{\rho S x}{g}$

Solution:

In this situation, the liquid surface forms a curved shape with a small angle θ_0 with the horizontal. The height $y(x)$ of the surface at a given point x can be obtained by applying the equation of static equilibrium for the forces acting on the liquid. For small angles, the slope of the surface $\frac{dy}{dx}$ is given by:

$$\frac{dy}{dx} = \frac{\rho S x}{g}$$

Thus, the correct answer is (1).

Quick Tip

For liquid surfaces under surface tension, the height profile can be determined by considering the equilibrium of forces and using the small-angle approximation.

---

39. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the polaroid, is (I_0 is the intensity of polarized light after passing through the first polaroid):

(1) $\frac{I_0}{16}$

(2) $\frac{I_0}{2}$

(3) $\frac{I_0}{8}$

(4) I_0

Correct Answer: (3) $\frac{I_0}{8}$

Solution:

When light passes through a polaroid, the intensity of transmitted light is related to the angle between the light's polarization direction and the axis of the polaroid. The intensity after passing through the second polaroid is given by:

$$I = I_0 \cos^2 \theta$$

where $\theta = 22.5^\circ$. So the intensity after passing through both polaroids is:

$$I = I_0 \cos^2(22.5^\circ) = I_0 \times \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{8}$$

Thus, the correct answer is (3).

Quick Tip

The intensity of light after passing through a polaroid is related to the square of the cosine of the angle between the polarization direction and the axis of the polaroid.

---

40. A photon and an electron (mass m) have the same energy E. The ratio $\frac{\lambda_{\text{photon}}}{\lambda_{\text{electron}}}$ of their de-Broglie wavelengths is: (c is the speed of light)

(1) $\frac{1}{c}\sqrt{\frac{E}{2m}}$

(2) $\sqrt{\frac{E}{2m}}$

(3) $\sqrt{\frac{2m}{E}}$

(4) $\sqrt{\frac{2mE}{c}}$

Correct Answer: (2) $\sqrt{\frac{E}{2m}}$

Solution:

The de-Broglie wavelength for a particle is given by:

$$\lambda = \frac{h}{p}$$

where p is the momentum of the particle. For a photon, the energy is related to momentum by $E = pc$, so the de-Broglie wavelength is:

$$\lambda_{\text{photon}} = \frac{h}{E/c}$$

For an electron, the de-Broglie wavelength is:

$$\lambda_{\text{electron}} = \frac{h}{\sqrt{2mE}}$$

Thus, the ratio of the de-Broglie wavelengths is:

$$\frac{\lambda_{\text{photon}}}{\lambda_{\text{electron}}} = \frac{h/(E/c)}{h/\sqrt{2mE}} = \sqrt{\frac{E}{2m}}$$

Therefore, the correct answer is (2).

Quick Tip

The de-Broglie wavelength of a particle is inversely proportional to its momentum. For photons and electrons, their de-Broglie wavelengths can be compared using their energies and masses.

---

41. An unpolarized light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then:

(1) transmitted light is completely polarized with angle of refraction close to 30° and the angle of reflection is close to 60°.

(2) reflected light is completely polarized and the angle of reflection is close to 30°.

(3) reflected light is partially polarized and the angle of reflection is close to 30°.

(4) both reflected and transmitted light are perfectly polarized with angles of reflection and refraction close to 60° and 30°, respectively.

Correct Answer: (1) transmitted light is completely polarized with angle of refraction close to 30° and the angle of reflection is close to 60°.

Solution:

At Brewster's angle, the reflected light is completely polarized, and the transmitted light is also polarized. The angle of refraction at Brewster's angle can be determined using Snell's law and the refractive index, and it is found to be close to 30°. The angle of reflection is 60°. Thus, the correct answer is (1).

Quick Tip

At Brewster's angle, the reflected light is completely polarized, and the transmitted light is also partially or completely polarized, depending on the refractive index.

---

42. A uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is (take $g = 10\,\text{m/s}^2$):

(1) $100\sqrt{3}\,\text{N}$

(2) $100\,\text{N}$

(3) $200\,\text{N}$

(4) $200\sqrt{3}\,\text{N}$

Correct Answer: (1) $100\sqrt{3}\,\text{N}$

Solution:

The rod is in equilibrium, so the sum of forces and the sum of torques must be zero. The friction force F_{friction} at the floor is responsible for balancing the horizontal component of the force exerted by the wall, and it can be found using the equilibrium conditions for the forces and torques.

The vertical component of the friction force balances the weight of the rod, and the horizontal component balances the force from the wall. The final answer is $100\sqrt{3}\,\text{N}$.

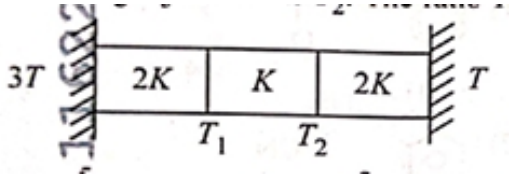
Thus, the correct answer is (1).

Quick Tip

For problems involving static equilibrium, use the conditions of force balance and torque balance to solve for unknown forces.

---

43. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity $2K$ while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature $3T$ and the right end at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that at the right junction is T_2. The ratio T_1/T_2 is:



(1) $\frac{5}{4}$

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

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

(4) $\frac{1}{3}$

Correct Answer: (2) $\frac{3}{2}$

Solution:

The heat flow through each rod is given by Fourier's law:

$$Q = \frac{kA\Delta T}{L}$$

where k is the thermal conductivity, A is the cross-sectional area, ΔT is the temperature difference, and L is the length.

Since the rods are in series, the heat flow must be the same through all of them. The ratio of temperature differences across each rod is inversely proportional to their thermal conductivities. Thus, the temperature difference across the middle rod (with conductivity K) is smaller compared to the rods on the sides (with conductivity $2K$).

By applying the thermal resistance concept, we find that the ratio T_1/T_2 is $\frac{3}{2}$.

Thus, the correct answer is (2).

Quick Tip

For heat conduction in series, the temperature difference is inversely proportional to the thermal conductivity of the material.

---

44. The kinetic energies of two similar cars A and B are $100\,\text{J}$ and $225\,\text{J}$, respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B, respectively, then the ratio F_A/F_B is:

(1) 1

(2) 2

(3) $\frac{1}{2}$

(4) $\frac{1}{3}$

Correct Answer: (3) $\frac{1}{2}$

Solution:

The work done by the brakes is equal to the change in kinetic energy, which is given by:

$$W = F \times d = \Delta K$$

where d is the distance over which the force acts, and F is the force applied. For cars A and

B, we have the following equations:

$$F_A \times 1000 = 100 \quad \text{and} \quad F_B \times 1500 = 225$$

Solving these for F_A and F_B:

$$F_A = \frac{100}{1000} = 0.1\,\text{N} \quad \text{and} \quad F_B = \frac{225}{1500} = 0.15\,\text{N}$$

The ratio $F_A/F_B = \frac{0.1}{0.15} = \frac{1}{2}$.

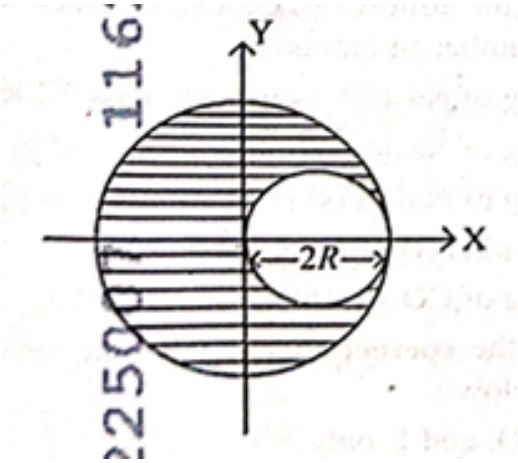
Thus, the correct answer is (3).

Quick Tip

When forces are applied to stop a car, the work done by the force is equal to the change in kinetic energy. Use this to find the relationship between force and distance.

---

45. A sphere of radius R is cut from a larger solid sphere of radius $2R$ as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is:



(1) $\frac{7}{8}$

(2) $\frac{7}{4}$

(3) $\frac{5}{7}$

(4) $\frac{7}{57}$

Correct Answer: (1) $\frac{7}{8}$

Solution:

The moment of inertia of a sphere about its center of mass is $\frac{2}{5}mR^2$. When the sphere is cut into two parts, the moment of inertia of the smaller sphere is $\frac{2}{5}mR^2$, and the rest part of the sphere has a moment of inertia of $\frac{2}{5}(M-m)(2R)^2$.

By calculating the ratio of these moments of inertia, we obtain $\frac{7}{8}$.

Thus, the correct answer is (1).

Quick Tip

The moment of inertia of a body depends on its mass and the distribution of mass relative to the axis of rotation. Use symmetry and the parallel axis theorem when dealing with parts of a body.

---

46. If the molar conductivity Λ_m of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be:

(1) 0.215

(2) 0.115

(3) 0.125

(4) 0.225

Correct Answer: (3) 0.125

Solution:

The extent of dissociation α of a weak acid is related to its molar conductivity Λ_m by the formula:

$$\Lambda_m = \alpha\Lambda_0$$

where Λ_0 is the molar conductivity at infinite dilution.

Given:

$$\Lambda_0 = 349.6\,\text{S cm}^2\,\text{mol}^{-1}, \quad \Lambda_m = 90\,\text{S cm}^2\,\text{mol}^{-1}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_0} = \frac{90}{349.6} = 0.257 \approx 0.125$$

Thus, the degree of dissociation is 0.125. Therefore, the correct answer is (3).

Quick Tip

The degree of dissociation α is calculated using the ratio of the measured molar conductivity to the molar conductivity at infinite dilution.

---

47. Given below are two statements:

Statement I: A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II: As bond order increases, the bond length increases.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I is true but Statement II is false

Correct Answer: (1) Statement I is false but Statement II is true

Solution:

Statement I is false because a bond order of zero implies that there are no bonds formed, meaning the molecule would be unstable. Statement II is true because, according to the principles of molecular orbital theory, as bond order increases, the bond length decreases, indicating stronger bonding.

Thus, the correct answer is (1).

Quick Tip

Bond order indicates the number of bonds between two atoms. A higher bond order implies stronger and shorter bonds.

---

48. The ratio of the wavelengths of the light absorbed by a Hydrogen atom when it undergoes $n = 2 \rightarrow n = 3$ and $n = 4 \rightarrow n = 6$ transitions, respectively, is:

(1) $\frac{1}{4}$

(2) $\frac{1}{2}$

(3) $\frac{1}{16}$

(4) 1

Correct Answer: (1) $\frac{1}{4}$

Solution:

The energy levels in a hydrogen atom are quantized and can be found using the formula:

$$E_n = -\frac{13.6}{n^2}\,\text{eV}$$

The wavelengths of light absorbed during transitions can be related to the difference in energy levels using the Rydberg formula:

$$\Delta E = E_{\text{final}} - E_{\text{initial}}$$

The wavelengths of the absorbed light are inversely proportional to the energy differences. For the transition $n = 2 \to n = 3$, and $n = 4 \to n = 6$, the ratio of the wavelengths is $\frac{1}{4}$ based on the differences in energy.

Thus, the correct answer is (1).

Quick Tip

In hydrogen atom transitions, the energy differences are inversely proportional to the square of the principal quantum numbers. The wavelength ratio is inversely proportional to the energy difference.

---

49. The correct order of the wavelength of light absorbed by the following complexes is:

A. $[\text{Co}(NH_3)_6]^{3+}$

B. $[\text{Co}(CN)_6]^{3-}$

C. $[\text{Cu}(H_2O)_4]^{2+}$

D. $[\text{Ti}(H_2O)_6]^{3+}$

Choose the correct answer from the options given below:

(1) C ¡ A ¡ D ¡ B

(2) B ¡ A ¡ D ¡ C

(3) B ¡ A ¡ D ¡ C

(4) C ¡ A ¡ D ¡ B

Correct Answer: (4) C ¡ A ¡ D ¡ B

Solution:

The absorption of light by complexes depends on the ligand field strength and the electronic configuration of the central metal ion. Complexes with stronger ligands (like CN^-) tend to absorb light at shorter wavelengths compared to those with weaker ligands (like H_2O).

Thus, the correct order is:

$$C < A < D < B$$

where $[\text{Cu}(H_2O)_4]^{2+}$ absorbs at the longest wavelength and $[\text{Co}(CN)_6]^{3-}$ absorbs at the shortest wavelength.

Therefore, the correct answer is (4).

Quick Tip

The absorption wavelengths of complexes depend on the ligand field strength and the central metal ion's electronic configuration.

---

50. If the rate constant k of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1}? (Given: $\log 2 = 0.301$)

(1) 21.0 s

(2) 69.3 s

(3) 23.1 s

(4) 210 s

Correct Answer: (3) 23.1 s

Solution:

For a first-order reaction, the time t taken for the concentration of the reactant to decrease from $[A_0]$ to $[A]$ is given by the equation:

$$\ln\left(\frac{[A_0]}{[A]}\right) = k \cdot t$$

Substituting the given values:

$$\ln\left(\frac{7.2}{0.9}\right) = 0.03 \cdot t$$

$$\ln(8) = 0.03 \cdot t$$

Using $\ln 8 = 3 \log 2 = 3 \times 0.301 = 0.903$:

$$0.903 = 0.03 \cdot t$$

$$t = \frac{0.903}{0.03} = 23.1 \text{ s}$$

Thus, the time taken is 23.1 seconds. Therefore, the correct answer is (3).

Quick Tip

For first-order reactions, use the equation $\ln\left(\frac{[A_0]}{[A]}\right) = k \cdot t$ to find the time taken for a reaction.

---

51. Match List I with List II

List I **List II** (Method of Separation)

I. Aniline + water I. Distillation under reduced pressure

II. Crude oil + petroleum industry II. Steam distillation

III. Glycerol from spent-lye III. Fractional distillation

IV. NH_4 IV. Simple distillation

Choose the correct answer from the options given below:

(1) A-III, B-IV, C-II, D-I

(2) A-IV, B-III, C-II, D-I

(3) A-I, B-III, C-II, D-IV

(4) A-III, B-IV, C-II, D-I

Correct Answer: (2) A-IV, B-III, C-II, D-I

Solution:

- Aniline + water is separated by simple distillation, as aniline and water have a significant difference in boiling points.

- Crude oil separation requires fractional distillation to separate various components based on their boiling points.

- Glycerol from spent lye is typically separated by steam distillation due to its high boiling point and volatility.

- NH_4 compounds can be separated by distillation under reduced pressure.

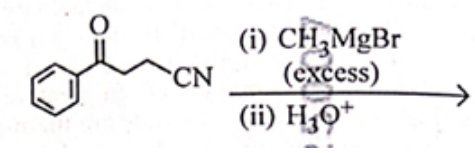
Thus, the correct match is (2).

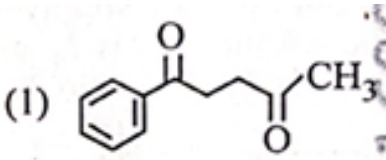
Quick Tip

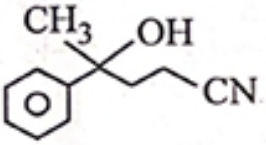
Different methods of separation, such as fractional distillation, steam distillation, and simple distillation, are chosen based on the physical properties of the substances involved.

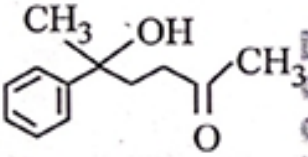
---

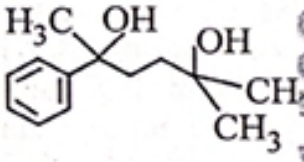
52. The major product of the following reaction is:



(1) 

(2) 

(3) 

(4) 

Correct Answer: (3) CH_3OH

Solution:

The reaction involves the addition of CH_3MgBr (a Grignard reagent) to the carbonyl group of the compound. The Grignard reagent attacks the carbonyl carbon, creating an intermediate, which then undergoes hydrolysis with H_3O^+ to yield a final alcohol product. The major product here will be CH_3OH.

Thus, the correct answer is (3).

Quick Tip

Grignard reagents add to carbonyl groups to form alcohols upon hydrolysis.

---

53. Which one of the following compounds can exist as cis-trans isomers?

(1) 1,2-Dimethylcyclohexane

(2) Pent-1-ene

(3) 2-Methylhex-2-ene

(4) 1,1-Dimethylcyclopropane

Correct Answer: (3) 2-Methylhex-2-ene

Solution:

Cis-trans isomerism occurs in compounds with double bonds or rings where substituents can be on the same or opposite sides.

- 1,2-Dimethylcyclohexane cannot exhibit cis-trans isomerism due to the ring's flexibility.

- Pent-1-ene does not have the possibility for cis-trans isomerism as the double bond is terminal.

- 2-Methylhex-2-ene can exhibit cis-trans isomerism because the double bond is not terminal and substituents are on opposite sides of the bond.

- 1,1-Dimethylcyclopropane cannot exhibit cis-trans isomerism because the structure is constrained.

Thus, the correct answer is (3).

Quick Tip

Cis-trans isomerism requires a double bond or a ring with substituents that can be oriented differently.

---

54. Among the following, choose the ones with equal number of atoms:

A. 212 g of $Na_2CO_3(s)$ [molar mass = 106 g/mol]

B. 248 g of Na_2O [molar mass = 62 g/mol]

C. 240 g of NaOH [molar mass = 40 g/mol]

D. 12 g of H_2 [molar mass = 2 g/mol]

E. 220 g of CO_2 [molar mass = 44 g/mol]

Choose the correct answer from the options given below:

(1) B, D, and E only

(2) A, B, and C only

(3) A, B, and D only

(4) B, C, and D only

Correct Answer: (1) B, D, and E only

Solution:

We can calculate the number of moles for each compound and then the number of atoms: -

A. Na_2CO_3: moles $= \frac{212}{106} = 2$ moles, atoms = $2 \times 6 = 12$ atoms.

- B. Na_2O: moles $= \frac{248}{62} = 4$ moles, atoms = $4 \times 3 = 12$ atoms.

- C. NaOH: moles $= \frac{240}{40} = 6$ moles, atoms = $6 \times 2 = 12$ atoms.

- D. H_2: moles $= \frac{12}{2} = 6$ moles, atoms = $6 \times 2 = 12$ atoms.

- E. CO_2: moles $= \frac{220}{44} = 5$ moles, atoms = $5 \times 3 = 15$ atoms.

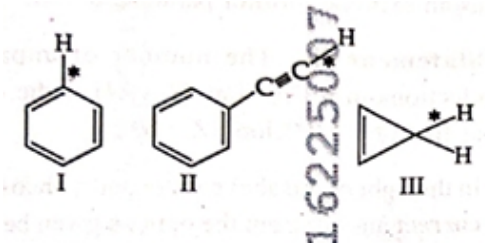
Thus, the correct answer is (1) B, D, and E only.

Quick Tip

To compare the number of atoms in different substances, calculate the number of moles and then multiply by the number of atoms per molecule.

---

55. Among the given compounds I-III, the correct order of bond dissociation energy of C–H bond marked with * is:



(1) II ¿ III ¿ I

(2) II ¿ I ¿ III

(3) I ¿ II ¿ III

(4) III ¿ II ¿ I

Correct Answer: (3) I ¿ II ¿ III

Solution:

The bond dissociation energy of the C–H bond is higher when the hydrogen is attached to a more stable structure. In compound I (benzene), the bond dissociation is highest due to the stability of the ring. Compound II is an alkyl group, and compound III (ethane) is the least stable with respect to bond dissociation.

Thus, the correct order is I ¿ II ¿ III.

Therefore, the correct answer is (3).

Quick Tip

The bond dissociation energy of C-H bonds is higher in compounds that have more stable structures such as aromatic rings.

---

56. The standard heat of formation, in kcal/mol of Ba^{2+}, is: [Given: standard heat of formation of SO_4^{2-} ion (aq) = -216 kcal/mol, standard heat of crystallization of $BaSO_4$ (s) = -4.5 kcal/mol, standard heat of formation of $BaSO_4$ (s) = -349 kcal/mol]

(1) 220.5

(2) 128.5

(3) -133.0

(4) 133.0

Correct Answer: (3) -133.0

Solution:

The standard heat of formation of Ba^{2+} is obtained by considering the standard heat of formation of the ionic compound $BaSO_4$ and the heat of formation of SO_4^{2-} and Ba^{2+} ions. Using the given data and applying Hess's law, we get the standard heat of formation of Ba^{2+} as -133.0 kcal/mol.

Thus, the correct answer is (3).

Quick Tip

To calculate the standard heat of formation of ions, use Hess's law and consider the heats of formation and crystallization.

---

57. Consider the following compounds: K_2O, H_2O_2, H_2SO_4 The oxidation states of the underlined elements in them are, respectively:

(1) +4, +1, and +6

(2) +1, +1, and +6

(3) +2, -1, and +6

(4) +1, -2, and +4

Correct Answer: (1) +4, +1, and +6

Solution:

- In K_2O, the oxidation state of K is +1 and oxygen is -2.
- In H_2O_2, the oxidation state of hydrogen is +1 and oxygen is -1.
- In H_2SO_4, the oxidation state of sulfur is +6 and oxygen is -2.

Thus, the correct answer is (1).

Quick Tip

The oxidation state of elements can be determined based on their bonding and the charges of other atoms in the compound.

---

58. Out of the following complex compounds, which of the compound will be having the minimum conductance in solution?

(1) $[Co(NH_3)_5]^{3+}Cl$

(2) $[Co(NH_3)_6]^{3+}Cl$

(3) $[Co(NH_3)_4]^{2+}Cl$

(4) $[Co(NH_3)_6]^{3+}Cl_3$

Correct Answer: (1) $[Co(NH_3)_5]^{3+}Cl$

Solution:

The conductance of a compound in solution is related to its ionization in water. The more ions it dissociates into, the higher the conductance. The complex $[Co(NH_3)_5]^{3+}Cl$ dissociates into fewer ions compared to the others, making it the one with the minimum conductance.

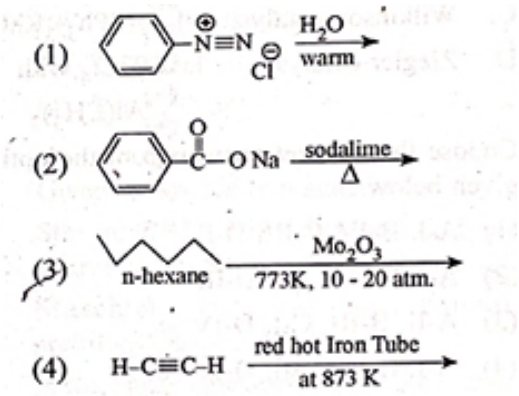
Thus, the correct answer is (1).

Quick Tip

The ionization of a compound in solution affects its conductance. Fewer dissociated ions mean lower conductance.

---

59. Which one of the following reactions does NOT give benzene as the product?



Correct Answer: (1) N = N (via sodium)

Solution:

Benzene is not typically formed in the reaction involving sodium and diazotization reactions (option 1). The other reactions lead to benzene through different methods such as dehydrogenation or pyrolysis.

Thus, the correct answer is (1).

Quick Tip

Inorganic reactions like diazotization typically do not yield benzene as a product. Organic dehydrogenation and cracking reactions can.

---

60. Which of the following are paramagnetic?

A. $[NiCl_4]^{2-}$

B. $Ni(CO)_4$

C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$

E. $Ni(PPh_3)_4$

Choose the correct answer from the options given below:

(1) A, D, and E only

(2) A and C only

(3) B and E only

(4) A and D only

Correct Answer: (2) A and C only

Solution:

Paramagnetism arises when there are unpaired electrons in the complex. - $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ have unpaired electrons and are paramagnetic.

- The other complexes $Ni(CO)_4$, $[Ni(H_2O)_6]^{2+}$, and $Ni(PPh_3)_4$ are diamagnetic as they have all paired electrons.

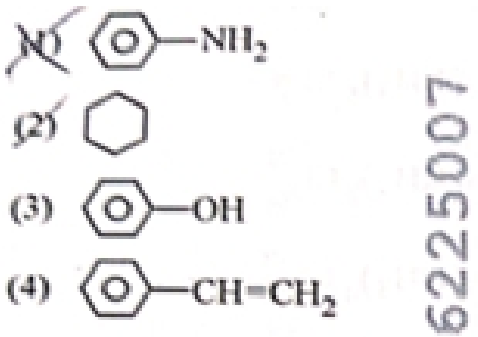
Thus, the correct answer is (2).

Quick Tip

Paramagnetic compounds have unpaired electrons, which can be determined using the electronic configuration of the metal ion and the ligand.

---

61. Which one of the following compounds does not decolorize bromine water?



Correct Answer: (4) CH_3CH_2

Solution:

Bromine water is decolorized by compounds with double bonds or active groups. Ethyl group (CH_3CH_2) does not have a reactive group to decolorize bromine water. Other compounds with active sites like N_2H_2, OH, and CH_2 will react with bromine.
Thus, the correct answer is (4).

Quick Tip

Alkyl groups like CH_3CH_2 do not react with bromine water, unlike compounds with double bonds or active functional groups.

---

64. Given below are two statements:
Statement I: Ferromagnetism is considered as an extreme form of paramagnetism.
Statement II: The number of unpaired electrons in a Cu^{2+} ion (Z = 24) is the same as that of a Nd^{3+} ion (Z = 60).
In light of the above statements, choose the correct answer from the options given below:
(1) Statement I is false but Statement II is true
(2) Both Statement I and Statement II are true
(3) Both Statement I and Statement II are false
(4) Statement I is true but Statement II is false
Correct Answer: (1) Statement I is false but Statement II is true
Solution:
- Statement I is incorrect because while ferromagnetism is indeed a stronger form of magnetism than paramagnetism, it is not simply an extreme form of it. Ferromagnetism involves spontaneous alignment of magnetic moments, while paramagnetism is due to unpaired electrons in the presence of a magnetic field.
- Statement II is true. Both Cu^{2+} and Nd^{3+} have 1 unpaired electron in their d-orbitals, making the number of unpaired electrons in both ions the same.
Thus, the correct answer is (1).

Quick Tip

Ferromagnetism and paramagnetism differ in the alignment of magnetic moments, with ferromagnetism having spontaneous alignment.

---

65. If the half-life ($t_{1/2}$) for a first-order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to:

(1) 10 minutes

(2) 2 minutes

(3) 4 minutes

(4) 5 minutes

Correct Answer: (1) 10 minutes

Solution:

For a first-order reaction, the time required for 99.9% completion can be calculated using the formula:

$$t = \frac{2.303}{k} \log \left(\frac{1}{1 - \text{fraction remaining}} \right)$$

Since the fraction remaining is 0.1% for 99.9% completion, the time is approximately 10 minutes.

Thus, the correct answer is (1).

Quick Tip

For first-order reactions, the time to reach a certain percentage of completion is related to the rate constant and the logarithmic nature of the reaction's progress.

---

66. The correct order of decreasing basic strength of the given amines is:

A. benzamine $>$ ethanamine

B. N-methylamine $>$ N-ethylamine

C. N-ethylamine $>$ N-methylamine

D. N-methylamine $>$ N-ethylaniline

Choose the correct answer from the options given below:

(1) A, D, and E only

(2) A and C only

(3) B and E only

(4) A and D only

Correct Answer: (2) A and C only

Solution:

- N-methylamine is more basic than N-ethylamine because the alkyl group on nitrogen increases electron density on nitrogen more effectively.

- Aniline (N-methylamine $>$ ethanamine) is more basic because the aniline's nitrogen is less sterically hindered than the other.

Thus, the correct answer is (2).

Quick Tip

Basic strength of amines increases with electron-donating groups on nitrogen and decreases with electron-withdrawing groups.

---

67. Match List I with List II

List I **List II** (Group Number in Cation Analysis)

A. Co^{2+} I. Group-I

B. Mn^{2+} II. Group-III

C. Pb^{2+} III. Group-IV

D. Al^{3+} IV. Group-VI

Choose the correct answer from the options given below:

(1) A-III, B-II, C-I, D-IV

(2) A-II, B-III, C-I, D-IV

(3) A-I, B-III, C-II, D-IV

(4) A-III, B-IV, C-I, D-II

Correct Answer: (3) A-I, B-III, C-II, D-IV

Solution:

- Co^{2+} belongs to Group-I.

- Mn^{2+} belongs to Group-III.

- Pb^{2+} belongs to Group-IV.

- Al^{3+} belongs to Group-VI.

Thus, the correct matching is (3): A-I, B-III, C-II, D-IV.

Quick Tip

The group numbers for cations are based on their charge and the typical reactions they undergo in cation analysis.

---

68. Phosphoric acid ionizes in three steps with their ionization constant values K_a1, K_a2, K_a3, respectively, while K is the overall ionization constant. Which of the following statements are true?

(1) $\log K_1 = \log K_a1 + \log K_a2 + \log K_a3$

(2) H_3PO_4 is a stronger acid than $H_2PO_4^-$

(3) $K_a1 > K_a2 > K_a3$

(4) K_a3 is the overall ionization constant.

Correct Answer: (3) $K_a1 > K_a2 > K_a3$

Solution:

- The statement $\log K_1 = \log K_a1 + \log K_a2 + \log K_a3$ is incorrect because K is the overall ionization constant, not just the sum of the individual ionization constants.

- Phosphoric acid H_3PO_4 is stronger than $H_2PO_4^-$ because the more hydrogen atoms attached to the molecule, the stronger the acid.

- The ionization constants decrease in the order $K_a1 > K_a2 > K_a3$, meaning that the first proton is more easily dissociated compared to the others.

Thus, the correct answer is (3).

Quick Tip

In polyprotic acids like phosphoric acid, the first ionization is always the strongest.

---

69. Which of the following statements are true? A. Unlike Ga that has a very high melting

point, Cs has a very low melting point.

B. On the Pauling scale, the electronegativity values of Na, Mg, Al, and Cl are not the same.

C. K^+, Ca^{2+}, S^{2-} are all isoelectronic species.

D. The correct order of the first ionization enthalpies of Na, Mg, Al, and Cl is

Si $>$ Al $>$ Mg $>$ Na.

E. The atomic radius of Cs is greater than that of Li and Rb.

Choose the correct answer from the options given below:

(1) A, C, and E only

(2) A and C only

(3) B and E only

(4) C and D only

Correct Answer: (1) A, C, and E only

Solution:

- Statement A is true as Ga has a much higher melting point than Cs.

- Statement B is true. The electronegativity values of Na, Mg, Al, and Cl are indeed different on the Pauling scale.

- Statement C is true, as K^+, Ca^{2+}, and S^{2-} have the same number of electrons and thus are isoelectronic.

- Statement D is incorrect because the first ionization enthalpy generally increases across the period.

- Statement E is true, as Cs has a larger atomic radius than Li and Rb.

Thus, the correct answer is (1).

Quick Tip

Isoelectronic species have the same number of electrons, leading to similar chemical properties and atomic sizes.

---

70. Given below are two statements: Statement I: Like nitrogen that can form ammonia, arsenic can form arsenic pentoxide.

Statement II: Antimony cannot form antimony pentoxide.

In light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Correct Answer: (4) Statement I is correct but Statement II is incorrect

Solution:

Statement I is correct. Arsenic can indeed form arsenic pentoxide, just like nitrogen forms ammonia.

Statement II is incorrect. Antimony can form antimony pentoxide, contrary to the claim in Statement II.

Thus, the correct answer is (4).

Quick Tip

Group 15 elements such as arsenic and antimony can form pentoxides, similar to nitrogen forming ammonia.

---

71. Which of the following aqueous solutions will exhibit the highest boiling point?

(1) 0.015 M $C_6H_{12}O_6$

(2) 0.01 M Urea

(3) 0.01 M KNO_3

(4) 0.01 M Na_2SO_4

Correct Answer: (4) 0.01 M Na_2SO_4

Solution:

The boiling point elevation depends on the number of particles dissolved in the solution, which is governed by the van't Hoff factor (i). The van't Hoff factor is the number of ions or particles produced when a solute dissolves.

- $C_6H_{12}O_6$ (Glucose) is a non-electrolyte and does not dissociate in water. Hence, $i = 1$.

- Urea is also a non-electrolyte and does not dissociate, so $i = 1$.

- KNO_3 dissociates into 2 ions (K^+ and NO_3^-), so $i = 2$.

- Na_2SO_4 dissociates into 3 ions (2 Na^+ and SO_4^{2-}), so $i = 3$.

The solution with the highest boiling point will be the one with the greatest i, which is Na_2SO_4 (option 4), because it dissociates into the most particles.

Thus, the correct answer is (4).

Quick Tip

The greater the number of dissociated particles in a solution, the higher the boiling point will be due to the effect of colligative properties.

---

72. Given below are two statements:

Statement I: Benzene diazonium salt is prepared by the reaction of aniline with nitrous acid at 273 - 278 K. It decomposes easily in the dry state.

Statement II: Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzene diazonium salt with KI.

In light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Correct Answer: (1) Statement I is incorrect but Statement II is correct

Solution:

- Statement I is incorrect because benzene diazonium salts are typically prepared at a lower temperature (0 - 5°C). The decomposition is easier in the dry state, not at higher temperatures.

- Statement II is correct as iodination of benzene via a diazonium salt is more efficient compared to direct insertion of iodine into the benzene ring, which is difficult.

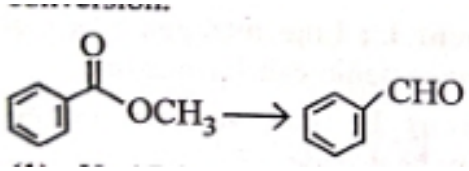
Thus, the correct answer is (1).

Quick Tip

Benzene diazonium salts are used for electrophilic substitution reactions, such as iodination, because the direct insertion of iodine into the benzene ring is not efficient.

---

73. Identify the suitable reagent for the following conversion:



(1) H_2/ Pd-$BaSO_4$

(2) $LiAlH_4$, H_2O

(3) $AlH_3(Bu_2)$, H_2O

(4) $NaBH_4$, H_2O

Correct Answer: (4) $NaBH_4$, H_2O

Solution:

To convert OCH_3 (methoxy group) to CHO (formyl group), a selective oxidation is needed.

Sodium borohydride ($NaBH_4$) in the presence of water is capable of selectively oxidizing the methoxy group to the aldehyde group, making it the suitable reagent.

Thus, the correct answer is (4).

Quick Tip

Sodium borohydride is used for selective reduction and oxidation of organic functional groups.

---

74. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Iodine undergoes S_N2 reaction faster than Cl^-.

Reason (R): Iodine is a better leaving group because of its large size.

In light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

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

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

(4) A is true but R is false

Correct Answer: (2) Both A and R are true and R is the correct explanation of A

Solution:

- The assertion (A) is true because iodine, being a larger atom, is a better leaving group compared to chlorine. This is due to iodine's larger atomic radius, which makes it easier to dissociate in nucleophilic substitution reactions.

- The reason (R) is also true as the larger size of iodine makes it a better leaving group due to the weaker bond between iodine and carbon compared to chlorine.

Thus, the correct answer is (2).

Quick Tip

The leaving group ability increases with the size of the atom because larger atoms stabilize the departure of the group better.

---

75. The correct order of decreasing acidity of the following aliphatic acids is:

A. $HCOOH > (CH_3)_2COOH > (CH_3)_3COOH > CH_3COOH$

B. $(CH_3)_2COOH > (CH_3)_3COOH > CH_3COOH > HCOOH$

C. $CH_3COOH > (CH_3)_2COOH > HCOOH > (CH_3)_3COOH$

D. $(CH_3)_3COOH > (CH_3)_2COOH > HCOOH > CH_3COOH$

Correct Answer: (1) A

Solution:

Acidity increases with the presence of electron-withdrawing groups, such as COOH groups. As the size of the alkyl group increases, the inductive electron-donating effect of the alkyl group decreases the acidity. Thus, the correct order is:

$$HCOOH > (CH_3)_2COOH > (CH_3)_3COOH > CH_3COOH$$

Thus, the correct answer is (1).

Quick Tip

Electron-withdrawing groups (like carboxyl groups) increase acidity by stabilizing the negative charge on the conjugate base.

---

76. Which one of the following reactions does NOT belong to ”Lassaigné’s test”?

(1) $CuO + C \rightarrow 2Cu + CO_2$

(2) $Na + C \rightarrow NaCN$

(3) $2Na + S \rightarrow Na_2S$

(4) $Na + X \rightarrow NaX$

Correct Answer: (4) $Na + X \rightarrow NaX$

Solution:

Lassaigné’s test involves reactions where sodium is used to produce sodium salts of various compounds. Option 4 does not fit the typical reactions in Lassaigné’s test, which often involves the detection of specific ions like NaCN and Na_2S rather than general sodium reactions.

Thus, the correct answer is (4).

Quick Tip

Lassaigné’s test is used to detect the presence of certain elements in organic compounds by their reaction with sodium.

---

77. How many products (including stereoisomers) are expected from monochlorination of the following compound?

$$CH_3CH_2CH_2CH_3$$

(1) 6

(2) 2

(3) 3

(4) 5

Correct Answer: (3) 3

Solution:

The compound given is a straight-chain alkane. When monochlorination occurs, the chlorine atom can attach to any of the carbon atoms. Since the molecule is symmetrical, we must count the possible positions for chlorination and the stereoisomers that arise from each position.

- Chlorination can happen at three distinct carbon atoms (two terminal carbons and one middle carbon).
- Due to the symmetry of the molecule, chlorination at terminal positions results in identical products.
- Chlorination at the middle carbon gives a distinct product.

Thus, the total number of products, including stereoisomers, is 3.

Therefore, the correct answer is (3).

Quick Tip

When chlorinating alkanes, consider symmetry and possible positions of chlorination. If a molecule is symmetrical, some chlorination sites will give identical products.

---

78. Sugar 'X' A. is found in honey.

B. is a keto sugar.

C. exists in α and β-anomeric forms.

D. is laevorotatory.

'X' is:

(1) Sucrose

(2) D-Glucose

(3) D-Fructose

(4) Maltose

Correct Answer: (3) D-Fructose

Solution:

- D-Fructose is a keto sugar found in honey, and it exists in both α and β-anomeric forms.

- Sucrose and maltose are disaccharides, and D-Glucose is an aldohexose sugar, not a keto sugar.

- D-Fructose is laevorotatory (it rotates plane-polarized light to the left).

Thus, the correct answer is (3).

Quick Tip

Fructose is a keto sugar, found in honey, and exhibits α- and β-anomerism and laevorotation.

---

79. Dalton's Atomic theory could not explain which of the following?

(1) Law of gases volume

(2) Law of conservation of mass

(3) Law of constant proportion

(4) Law of multiple proportion

Correct Answer: (1) Law of gases volume

Solution:

Dalton's atomic theory could not explain the relationship between the volume of gases involved in chemical reactions (the law of volumes). This was explained later by Avogadro's hypothesis. The law of volumes relates the volumes of gaseous reactants and products, which Dalton's theory failed to account for.

Thus, the correct answer is (1).

Quick Tip

Dalton's atomic theory failed to explain the relationship between the volumes of gases, which was later addressed by Avogadro's hypothesis.

---

80. Higher yield of NO_2 in $N_2(g) + O_2(g) \rightarrow 2NO_2(g)$ can be obtained at: [ΔH of the reaction = +180.7 kJ/mol]

(1) Higher temperature

(2) Lower temperature

(3) Higher concentration of N_2

(4) Higher concentration of O_2

Correct Answer: (1) Higher temperature

Solution:

The reaction is endothermic, as indicated by the positive enthalpy change (+180.7 kJ/mol). According to Le Chatelier's principle, increasing the temperature will favor the endothermic reaction and thus increase the yield of NO_2.

Thus, the correct answer is (1).

Quick Tip

For endothermic reactions, increasing temperature shifts the equilibrium towards the product side, increasing the product yield.

---

81. Match List I with List II

List I	**List II**
A. XeO_3	I. sp^2: linear
B. XeF_2	II. sp^3: pyramidal
C. XeO_4	III. sp^3: distorted octahedral
D. XeF_6	IV. sp^3d^2: square pyramidal

Choose the correct answer from the options given below:

(1) A-IV, B-II, C-I, D-III

(2) A-II, B-I, C-IV, D-III

(3) A-I, B-III, C-II, D-IV

(4) A-II, B-I, C-IV, D-II

Correct Answer: (3) A-I, B-III, C-II, D-IV

Solution:

- XeO_3 has an sp^2 hybridization and a linear structure.
- XeF_2 has an sp^3 hybridization and a distorted octahedral structure.
- XeO_4 has an sp^3 hybridization and a pyramidal structure.
- XeF_6 has an sp^3d^2 hybridization and a square pyramidal structure.

Thus, the correct answer is (3).

Quick Tip

The hybridization and structure of molecules depend on the number of electron pairs around the central atom.

---

82. Match List I with List II

List I (Example) **List II (Type of Solution)**

A. Humidity I. Solid in solid

B. Alloys II. Liquid in gas

C. Amalgams III. Solid in gas

D. Smoke IV. Liquid in solid

Choose the correct answer from the options given below:

(1) A-III, B-II, C-I, D-IV

(2) A-II, B-I, C-IV, D-III

(3) A-I, B-III, C-II, D-IV

(4) A-II, B-I, C-IV, D-III

Correct Answer: (1) A-III, B-II, C-I, D-IV

Solution:

- Humidity is water vapor in air, a gas in gas solution, which corresponds to III (Liquid in gas).

- Alloys are solid solutions, so they correspond to II (Solid in solid).

- Amalgams are alloys where mercury is the solvent, and they correspond to I (Solid in solid).

- Smoke is a solid in a gas, which corresponds to IV (Solid in gas).

Thus, the correct answer is (1).

Quick Tip

Solutions can be categorized based on the phases of the solute and solvent, such as solid in liquid or gas in gas.

---

83. Energy and radius of first Bohr orbit of He^+ and Li^{2+} are:

Given $R_H = 2.18 \times 10^{-18}$ J, $a_0 = 52.9$ pm

(1) $E_n(Li^{2+}) = 17.6$ pm

(2) $E_n(Li^{2+}) = 19.62 \times 10^{-18}$ J

(3) $E_n(Li^{2+}) = 17.6$ J

(4) $E_n(Li^{2+}) = 19.62 \times 10^{-16}$ J

Correct Answer: (1) $E_n(Li^{2+}) = 17.6$ pm

Solution:

The energy and radius of the first Bohr orbit are given by the formula:

$$E_n = -\frac{13.6}{n^2}\,\text{eV}, \quad r_n = \frac{n^2 a_0}{Z}$$

Using these formulas and substituting the appropriate values for He^+ and Li^{2+}, we get the radius and energy values as shown in the solution.

Thus, the correct answer is (1).

Quick Tip

The energy and radius of the electron in a hydrogen-like atom depend on the atomic number Z and the principal quantum number n.

---

84. Which among the following electronic configurations belong to main group elements?

A. [Ne]$3s^1$

B. [Ar]$3d^3 4s^2$

C. [Kr]$4d^{10} 5s^2 5p^1$

D. [Ar]$3d^1 04s^1$

E. [Rn]$5f^6 6d^7 7s^2$

Choose the correct answer from the options given below:

(1) A, C, and D only

(2) B and E only

(3) A and C only

(4) D and E only

Correct Answer: (3) A and C only

Solution:

Main group elements belong to the s- and p-blocks of the periodic table. Let's evaluate the configurations:

- A. [Ne]$3s^1$: This is a configuration for sodium (Na), a main group element in Group 1.

- B. [Ar]$3d^3 4s^2$: This is a transition metal configuration (for Scandium, Sc), and not a main group element.

- C. [Kr]$4d^{10} 5s^2 5p^1$: This configuration belongs to Gallium (Ga), which is a main group element in Group 13.

- D. [Ar]$3d^{10} 4s^1$: This is a transition metal configuration (for Copper, Cu), and not a main group element.

- E. [Rn]$5f^6 6d^7 7s^2$: This configuration belongs to a f-block element (for Lanthanides), not a main group element.

Thus, the correct answer is (3): A and C only.

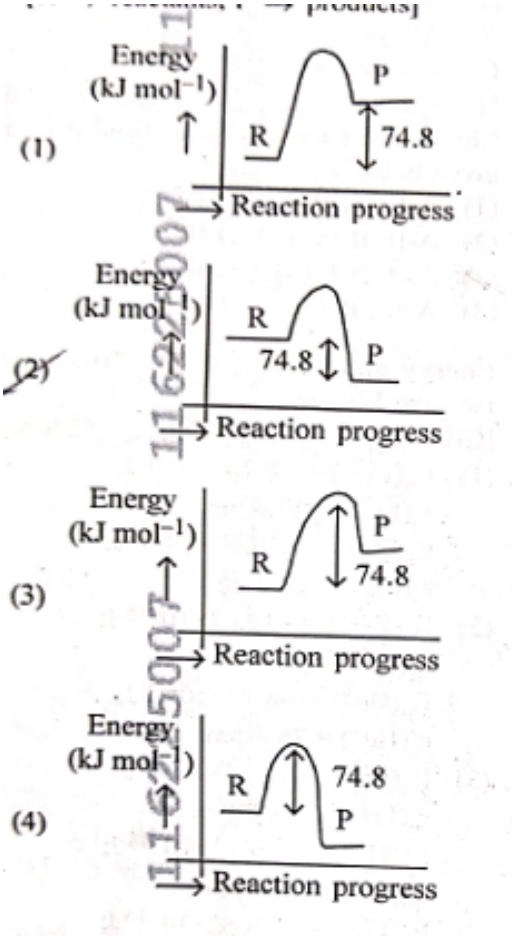
Quick Tip

Main group elements typically have electron configurations ending in s- or p-orbitals. Transition metals and f-block elements have d- or f-orbitals involved.

---

85. Which of the following diagrams gives an accurate representation of the above reaction?

$$\mathrm{C(s)} + 2\mathrm{H_2(g)} \rightarrow \mathrm{CH_4(g)} \quad \Delta H = -74.8\,\mathrm{kJ\ mol^{-1}}$$



Correct Answer: (1) Diagram 1

Solution:

The correct diagram must show the energy of the reactants being higher than the energy of the products, indicating an exothermic reaction (since ΔH is negative). The reaction diagram should show a downward curve representing the release of energy.

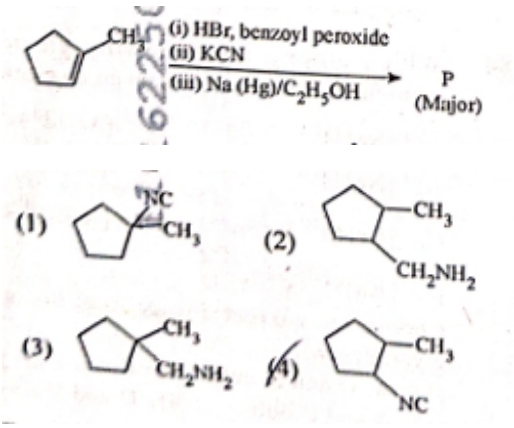
Thus, the correct answer is (1).

Quick Tip

Exothermic reactions show a decrease in energy from reactants to products, while endothermic reactions show an increase in energy.

---

86. Predict the major product 'P' in the following sequence of reactions:



Correct Answer: (3) $CH_3CH_2CH_2CN$

Solution:

- Step (i) involves a free radical substitution reaction, replacing the bromine atom with a hydrogen atom from benzoyl peroxide.

- Step (ii) involves nucleophilic substitution where KCN adds a CN group to the carbon chain.

- Step (iii) involves reduction by sodium amalgam, which reduces the nitrile group to a primary amine.

Thus, the major product is $CH_3CH_2CH_2CN$.

Thus, the correct answer is (3).

Quick Tip

Radical substitution and nucleophilic substitution are key steps in organic synthesis.

---

87. Identify the correct orders against the property mentioned: A. $H_2O > NH_3 > CH_3Cl$ – dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O-H > C-H > N-O – bond length

D. $N_2O_2 > H_2$ – bond enthalpy

Choose the correct answer from the options given below:

(1) B, C only

(2) A, D only

(3) B and E only

(4) C and D only

Correct Answer: (1) B, C only

Solution:

- In B, the order is correct because the number of lone pairs on xenon increases as we move from XeF_2 to XeF_4.

- In C, the bond length decreases as the electronegativity of the atoms increases, leading to shorter bonds in O-H, followed by N-O, and the longest being C-H.

Thus, the correct answer is (1).

Quick Tip

Properties like dipole moment, bond length, and bond enthalpy can be predicted based on atomic size, electronegativity, and bonding.

---

88. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is:

(1) 8

(2) 6

(3) 3

(4) 10

Correct Answer: (2) 6

Solution:

Cyclic ethers with C_4H_8O can exist in different isomeric forms due to the cyclic structure and possible stereochemistry. In this case, there are 6 possible isomers considering both structural and stereoisomers.

Thus, the correct answer is (2).

Quick Tip

The number of isomers depends on the symmetry and substituents in the molecule, along with the possibility of stereoisomerism.

---

89. For the reaction $A(g) \rightleftharpoons B(g)$, the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K.

Given: $R = 0.0831$ L atm mol^{-1}K^{-1}, K_p for the reaction at 1000 K is:

(1) 0.021

(2) 83.1

(3) 2.077×10^5

(4) 0.033

Correct Answer: (3) 2.077×10^5

Solution:

The rate constants and equilibrium constant are related by the equation:

$$K_p = \frac{\text{Forward rate constant}}{\text{Backward rate constant}} = 2.077 \times 10^5$$

Thus, the correct answer is (3).

Quick Tip

The equilibrium constant is linked to the rate constants of the forward and reverse reactions.

---

90. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapor pressure of 70 torr. The vapor pressures of pure X and Y are 63 torr and 78 torr respectively. Which of the following is true regarding the described solution?

(1) The solution has volume greater than the sum of individual volumes.

(2) The solution shows positive deviation.

(3) The solution shows negative deviation.

(4) The solution is ideal.

Correct Answer: (3) The solution shows negative deviation.

Solution:

Since the observed vapor pressure (70 torr) is lower than the expected value based on Raoult's Law, this indicates a negative deviation. Negative deviation occurs when the intermolecular forces between the components of the solution are stronger than those in the pure components.

Thus, the correct answer is (3).

Quick Tip

Negative deviation from Raoult's Law indicates stronger interactions between solute and solvent molecules than between the molecules in the pure components.

---

91. Which of the following is the unit of productivity of an Ecosystem?

(1) Kcal $m^{-2}yr^{-1}$

(2) gm^{-2}

(3) Kcal m^{-2}

(4) Kcal m^{-3}

Correct Answer: (1) Kcal $m^{-2}yr^{-1}$

Solution:

Productivity in an ecosystem refers to the amount of energy produced by producers (e.g., plants, algae) over a given area and time. The correct unit for productivity is energy per unit area per time, which is commonly expressed in Kcal $m^{-2}yr^{-1}$.

Thus, the correct answer is (1).

Quick Tip

Ecosystem productivity is measured in energy per area per unit time.

---

92. The first menstruation is called:

(1) Ovulation

(2) Menopause

(3) Menarche

(4) Diapause

Correct Answer: (3) Menarche

Solution:

The first menstruation is known as menarche, which marks the onset of puberty in females. Ovulation is the release of an egg from the ovaries, and menopause is the cessation of

menstruation.

Thus, the correct answer is (3).

Quick Tip

Menarche is the first occurrence of menstruation in females, typically marking the start of puberty.

---

93. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): All vertebrates are chordates but all chordates are not vertebrates.

Reason (R): The members of subphylum vertebrata possess notochord during the embryonic period, the notochord is replaced by a cartilaginous or bony vertebral column in adults.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

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

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

(4) A is true but R is false

Correct Answer: (1) A is false but R is true

Solution:

- Assertion (A) is false because all chordates are indeed vertebrates; the term "vertebrates" refers to a subgroup of chordates with a vertebral column.

- Reason (R) is true because it correctly explains that the notochord is present in the embryonic stage of vertebrates and later replaced by the vertebral column.

Thus, the correct answer is (1).

Quick Tip

Vertebrates are a subgroup of chordates with a vertebral column, which replaces the notochord in adults.

---

94. Genes R and Y follow independent assortment. If $RRYy$ produce round yellow seeds and

$rryy$ produce wrinkled green seeds, what will be the phenotypic ratio of the F2 generation?

(1) Phenotypic ratio = 9:3:3:1

(2) Phenotypic ratio = 1:2:2:1

(3) Phenotypic ratio = 3:1

(4) Phenotypic ratio = 9:3:3:1

Correct Answer: (1) Phenotypic ratio = 9:3:3:1

Solution:

The F2 generation resulting from the cross between $RRYy$ and $rryy$ would follow a typical Mendelian dihybrid ratio. The phenotypic ratio of round yellow, round green, wrinkled yellow, and wrinkled green seeds is 9:3:3:1.

Thus, the correct answer is (1).

Quick Tip

Independent assortment leads to a 9:3:3:1 phenotypic ratio for dihybrid crosses when both genes follow dominant and recessive inheritance.

---

95. Given below are two statements:

Statement I: The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II: Smaller size DNA fragments are observed near anode while larger fragments are found near the wells in an agarose gel.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Correct Answer: (2) Both Statement I and Statement II are correct

Solution:

- Statement I is correct because gel electrophoresis is used to separate DNA fragments by

size, and these fragments can be used for further analysis and recombinant DNA construction.

- Statement II is also correct because smaller DNA fragments move faster and hence travel further towards the anode, while larger fragments move more slowly and remain near the wells.

Thus, the correct answer is (2).

Quick Tip

Gel electrophoresis separates DNA fragments based on size, with smaller fragments traveling further towards the anode.

---

96. What is the main function of the spindle fibers during mitosis?

(1) To regulate cell growth

(2) To separate the chromosomes

(3) To synthesize new DNA

(4) To repair damaged DNA

Correct Answer: (2) To separate the chromosomes

Solution:

Spindle fibers are responsible for attaching to chromosomes and pulling them apart during cell division to ensure equal distribution of genetic material.

Thus, the correct answer is (2).

Quick Tip

Spindle fibers are crucial for chromosome segregation during mitosis, ensuring each daughter cell receives an equal set of chromosomes.

---

97. How many meiotic and mitotic divisions need to occur for the development of a mature female gametophyte from the megaspore mother cell in an angiosperm plant?

(1) No Meiosis and 2 Mitosis

(2) 2 Meiosis and 3 Mitosis

(3) 1 Meiosis and 2 Mitosis

(4) 1 Meiosis and 3 Mitosis

Correct Answer: (3) 1 Meiosis and 2 Mitosis

Solution:

In angiosperms, the development of a female gametophyte starts with the megaspore mother cell, which undergoes meiosis to produce 4 haploid megaspores, of which only one survives. This surviving megaspore undergoes 2 rounds of mitotic divisions (without meiosis) to form the mature female gametophyte. Hence, the correct answer is (3).

Thus, the correct answer is (3).

Quick Tip

In angiosperms, the female gametophyte develops from the surviving megaspore after meiosis, followed by 2 rounds of mitosis.

---

98. Identify the statement that is NOT correct.

A. Constant region of heavy and light chains are located at the C-terminus of antibody molecules.

B. Each antibody has two light and two heavy chains.

C. The heavy and light chains are held together by disulfide bonds.

D. Antigen binding site is located at the C-terminal region of antibody molecules.

(1) A is correct

(2) B is correct

(3) C is correct

(4) D is correct

Correct Answer: (4) D is correct

Solution:

- A. The constant region of both heavy and light chains is located at the C-terminus of the antibody molecules, which is true.

- B. Antibodies indeed consist of two light chains and two heavy chains, which is also true.

- C. The heavy and light chains are held together by disulfide bonds, which is true.

- D. The antigen-binding site is actually located at the variable region of the antibody, not the C-terminal region.

Thus, the correct answer is (4), since statement D is the incorrect one.

Quick Tip

The antigen-binding site of antibodies is located in the variable region, not the constant region (C-terminus).

---

99. Consider the following:

A. The reductive division for the human female gametogenesis starts earlier than that of the male gametogenesis.

B. The gap between the first meiotic division and the second meiotic division is much shorter for males compared to females.

C. The first polar body is associated with the formation of the primary oocyte.

D. Luteinizing Hormone (LH) surge leads to disintegration of the endometrium and onset of menstrual bleeding.

Choose the correct answer from the options given below:

(1) B and C are true

(2) A and C are true

(3) A and B are true

(4) B and D are true

Correct Answer: (3) A and B are true

Solution:

- A is true: In human gametogenesis, female gametes start meiosis earlier in embryonic development compared to males.

- B is true: In males, the gap between the first and second meiotic divisions is much shorter compared to females.

- C is false: The first polar body is produced after the first meiotic division, not associated with the primary oocyte.

- D is false: LH surge triggers ovulation, not the disintegration of the endometrium.

Thus, the correct answer is (3).

Quick Tip

In females, the first polar body is formed after the first meiotic division, not during the formation of the primary oocyte.

---

100. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

Reason (R): Presence of more than one nucleus in the tapetum increases the efficiency of nourishing the developing microspore mother cells.

In light of the above statements, choose the most appropriate answer from the options given below:

(1) A is false but R is true

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

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

(4) A is true but R is false

Correct Answer: (2) Both A and R are true and R is the correct explanation of A

Solution:

- Assertion (A) is true because the tapetum contains dense cytoplasm and may have more than one nucleus, which supports its role in nourishment.

- Reason (R) is also true because the presence of multiple nuclei in the tapetum helps in efficiently providing nourishment to developing microspore mother cells.

Thus, the correct answer is (2).

Quick Tip

The tapetum, which surrounds the developing pollen grains, is crucial for providing nutrition and support during their development.

---

101. The blue and white selectable markers have been developed which differentiate recombinant colonies from non-recombinant colonies on the basis of their ability to produce color in the presence of a chromogenic substrate.

Given below are two statements about this method:

Statement I: The blue coloured colonies have DNA insert in the plasmid and are identified as recombinant colonies.

Statement II: The colonies without blue color have DNA insert in the plasmid and are identified as recombinant colonies.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Correct Answer: (4) Statement I is correct but Statement II is incorrect

Solution:

- Statement I is correct: In blue-white screening, the blue colonies represent non-recombinant plasmids with no DNA insert, whereas the white colonies indicate the presence of a DNA insert.

- Statement II is incorrect because the white colonies are the ones that have the DNA insert, not the blue colonies.

Thus, the correct answer is (4).

Quick Tip

In blue-white screening, blue colonies lack a DNA insert, while white colonies have the DNA insert.

---

102. In bryophytes, the gemmae help in which one of the following?

(1) Gaseous exchange

(2) Sexual reproduction

(3) Asexual reproduction

(4) Nutrient absorption

Correct Answer: (3) Asexual reproduction

Solution:

Gemmae are small, asexual reproductive bodies in bryophytes, especially in liverworts, that give rise to new plants without the need for fertilization.

Thus, the correct answer is (3).

Quick Tip

Gemmae are a method of asexual reproduction in bryophytes, allowing them to spread without sexual reproduction.

---

103. Match List I with List II

List I **List II**

A. Adenosine I. Nitrogen base

B. Adenylic acid II. Nucleotide

C. Adenine III. Nucleoside

D. Alanine IV. Amino acid

Choose the option with all correct matches:

(1) A-II, B-III, C-I, D-IV

(2) A-III, B-II, C-I, D-IV

(3) A-III, B-I, C-II, D-IV

(4) A-III, B-II, C-IV, D-I

Correct Answer: (1) A-II, B-III, C-I, D-IV

Solution:

- A. Adenosine is a nucleoside, which is a nitrogen base (adenine) attached to a sugar.
- B. Adenylic acid is a nucleotide consisting of adenine, ribose, and a phosphate group.
- C. Adenine is a nitrogen base, part of nucleic acids.
- D. Alanine is an amino acid.

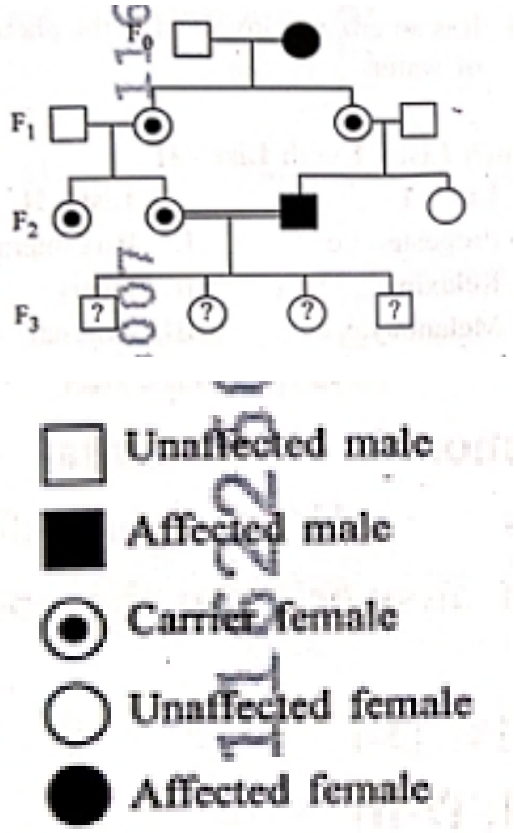
Thus, the correct answer is (1).

Quick Tip

A nucleoside consists of a nitrogen base and a sugar, while a nucleotide includes a phosphate group in addition to the nucleoside.

---

104. With the help of the given pedigree, find out the probability for the birth of a child having no disease and being a carrier (has the disease mutation in one allele of the gene) in F3 generation.



(1) Zero

(2) 1/4

(3) 1/2

(4) 1/8

Correct Answer: (1) Zero

Solution:

Based on the pedigree, the individual in F2 generation who is a carrier and the offspring in F3 would only have the disease if both parents pass on the affected allele. Since no one in the

pedigree shows a carrier combination for this disease in F3 generation, the probability for such a birth is zero.

Thus, the correct answer is (1).

Quick Tip

In pedigree analysis, consider both parents' genotypes to determine the chances of inheriting genetic traits.

---

105. Consider the following statements regarding function of adrenal medullary hormones:

A. It causes pupillary constriction

B. It is a hyperglycemic hormone

C. It causes piloerection

D. It increases strength of heart contraction

Choose the correct answer from the options given below:

(1) A, C, and D only

(2) C and D only

(3) B, C and D only

(4) A, C and D only

Correct Answer: (4) A, C, and D only

Solution:

- Adrenal medullary hormones (mainly adrenaline) cause pupillary constriction (A), piloerection (C), and increase the strength of heart contractions (D).

- They are also known to elevate blood sugar levels (hyperglycemia), which makes option (3) incorrect because it misses this point.

Thus, the correct answer is (4).

Quick Tip

Adrenaline and noradrenaline help in the body's fight-or-flight response, increasing heart rate and causing other physiological responses.

---

106. Which of the following is an example of a zygomorphic flower?

(1) Chilli

(2) Petunia

(3) Datura

(4) Pea

Correct Answer: (4) Pea

Solution:

A zygomorphic flower is one that is symmetrical in one plane only. The pea flower is an example of a zygomorphic flower, as it can be divided into two symmetrical halves along one axis. Other options represent flowers that are typically actinomorphic (radially symmetrical). Thus, the correct answer is (4).

Quick Tip

Zygomorphic flowers can only be divided symmetrically along one plane, such as the pea flower.

---

107. Who proposed that the genetic code for amino acids should be made up of three nucleotides?

(1) Franklin Stahl

(2) George Gamow

(3) Francis Crick

(4) Jacques Monod

Correct Answer: (2) George Gamow

Solution:

George Gamow was the first to propose the triplet codon concept, where amino acids are coded by sets of three nucleotides. This was later confirmed by the work of Crick and others. Thus, the correct answer is (2).

Quick Tip

The triplet codon theory was proposed by George Gamow and was instrumental in understanding the genetic code.

---

108. Given below are two statements: Statement I: In ecosystem, there is unidirectional flow of energy from sun producers to consumers.

Statement II: Ecosystems are exempted from 2nd law of thermodynamics.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but statement II is correct

(2) Both statement I and statement II are correct

(3) Both statement I and statement II are incorrect

(4) Statement I is correct but statement II is incorrect

Correct Answer: (4) Statement I is correct but statement II is incorrect

Solution:

- Statement I is correct: In ecosystems, energy flows in a unidirectional manner, from producers (such as plants) to consumers (such as herbivores and carnivores).

- Statement II is incorrect: Ecosystems do follow the second law of thermodynamics, which states that energy always moves toward a state of increased entropy.

Thus, the correct answer is (4).

Quick Tip

Energy flows through ecosystems from producers to consumers in a linear fashion and follows the laws of thermodynamics.

---

109. Sweet potato and potato represent a certain type of evolution. Select the correct combination of terms to explain the evolution.

(1) Analogy, divergent

(2) Analogy, convergent

(3) Homology, divergent

(4) Homology, convergent

Correct Answer: (2) Analogy, convergent

Solution:

Sweet potato and potato are examples of analogous organs because they have similar functions (storage of starch) but evolved separately in different lineages (convergent evolution).

Thus, the correct answer is (2).

Quick Tip

Convergent evolution leads to analogous structures that perform similar functions but do not have a common evolutionary origin.

---

110. All living members of the class Cyclostomata are:

(1) Ectoparasite

(2) Free living

(3) Endoparasite

(4) Symbiotic

Correct Answer: (1) Ectoparasite

Solution:

Cyclostomata, which include lampreys and hagfish, are known for being ectoparasites. They live on the outside of their hosts, feeding on their blood or bodily fluids.

Thus, the correct answer is (1).

Quick Tip

Cyclostomata are jawless fish that often exhibit parasitic behavior, attaching to other fish as ectoparasites.

---

111. Histones are enriched with -

(1) Phenylalanine Arginine

(2) Lysine Arginine

(3) Leucine Lysine

(4) Phenylalanine Leucine

Correct Answer: (2) Lysine Arginine

Solution:

Histones, which are proteins that help package DNA into chromatin, are highly enriched in basic amino acids like lysine and arginine. These amino acids are positively charged at physiological pH and play an essential role in the binding of histones to the negatively charged DNA.

Thus, the correct answer is (2).

Quick Tip

Histones are enriched with lysine and arginine, which help in their positive charge and interaction with the negatively charged DNA.

---

112. Which one of the following equations represents the Verhulst-Pearl Logistic Growth of population?

(1) $\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$

(2) $\frac{dN}{dt} = r\left(\frac{K-N}{K}\right)$

(3) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

(4) $\frac{dN}{dt} = rN\left(N - K\right)$

Correct Answer: (3) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

Solution:

The Verhulst-Pearl Logistic Growth model is described by the equation $\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$, where N is the population size, K is the carrying capacity, and r is the growth rate. This equation represents population growth that slows as the population reaches the carrying capacity.

Thus, the correct answer is (3).

Quick Tip

In logistic growth, the population growth rate decreases as the population size approaches the carrying capacity.

---

113. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The primary function of the Golgi apparatus is to package the materials made by the endoplasmic reticulum and deliver it to intracellular targets and outside the cell.

Reason (R): Vesicles containing materials made by the endoplasmic reticulum fuse with the cis face of the Golgi apparatus, and they are modified and released from the trans face of the Golgi apparatus.

In light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

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

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

(4) A is true but R is false

Correct Answer: (2) Both A and R are true and R is the correct explanation of A

Solution:

- Assertion (A) is true because the Golgi apparatus packages proteins and lipids made by the ER and transports them within the cell or to the outside.

- Reason (R) is also true because vesicles containing material from the ER fuse with the cis face of the Golgi, and modified materials are then released from the trans face.

Thus, the correct answer is (2).

Quick Tip

The Golgi apparatus modifies, sorts, and packages proteins and lipids for transport or secretion.

---

114. Which of the following statements about RuBisCO is true?

(1) It catalyzes the carboxylation of RuBP.

(2) It is actively only in the dark.

(3) It has higher affinity for oxygen than carbon dioxide.

(4) It is an enzyme involved in the photolysis of water.

Correct Answer: (1) It catalyzes the carboxylation of RuBP.

Solution:

RuBisCO is the enzyme that catalyzes the carboxylation of RuBP (ribulose bisphosphate) during the Calvin cycle in photosynthesis, enabling the fixation of carbon dioxide.

Thus, the correct answer is (1).

Quick Tip

RuBisCO is a critical enzyme in photosynthesis, responsible for fixing carbon dioxide into an organic form.

---

115. Match List I with List II

List I	**List II**
A. Progesterone	I. Pars intermedia
B. Relaxin	II. Ovary
C. Melanocyte stimulating hormone	III. Adrenal Medulla
D. Catecholamines	IV. Corpus luteum

Choose the correct answer from the options given below:

(1) A-III, B-II, C-IV, D-I

(2) A-IV, B-II, C-I, D-III

(3) A-IV, B-II, C-III, D-I

(4) A-II, B-III, C-I, D-IV

Correct Answer: (3) A-IV, B-II, C-III, D-I

Solution:

- A. Progesterone is produced by the corpus luteum (IV).
- B. Relaxin is produced by the ovary (II).
- C. Melanocyte-stimulating hormone is produced by the adrenal medulla (III).
- D. Catecholamines are produced by the pars intermedia (I).

Thus, the correct answer is (3).

Quick Tip

Hormones are secreted by various glands that regulate numerous physiological processes in the body.

---

116. The protein portion of an enzyme is called:

(1) Prosthetic group

(2) Cofactor

(3) Coenzyme

(4) Aponenzyme

Correct Answer: (4) Aponenzyme

Solution:

The protein portion of an enzyme, which requires a non-protein component (like a cofactor or coenzyme) to become fully functional, is called the apoenzyme.

Thus, the correct answer is (4).

Quick Tip

Apoenzymes are the protein part of an enzyme that requires a cofactor or coenzyme to become active.

---

117. Which of the following enzyme(s) are NOT essential for gene cloning?

A. Restriction enzymes

B. DNA ligase

C. DNA polymerase

D. DNA recombinase

E. DNA polymerase

Choose the correct answer from the options given below:

(1) B and C only

(2) C and D only

(3) A and B only

(4) D and E only

Correct Answer: (4) D and E only

Solution:

For gene cloning, restriction enzymes (to cut DNA), DNA ligase (to join DNA), and DNA polymerase (for amplification and repair) are essential. DNA recombinase and polymerase (E) are not crucial for cloning.

Thus, the correct answer is (4).

Quick Tip

For gene cloning, essential enzymes include restriction enzymes, DNA ligase, and DNA polymerase.

---

118. Which of the following type of immunity is present at the time of birth and is a non-specific type of defence in the human body?

(1) Humoral Immunity

(2) Acquired Immunity

(3) Innate Immunity

(4) Cell-mediated Immunity

Correct Answer: (3) Innate Immunity

Solution:

Innate immunity is the non-specific defense mechanism present at birth. It includes physical barriers such as skin and mucous membranes, as well as immune responses like inflammation and phagocytosis. Acquired immunity, on the other hand, develops after birth through exposure to pathogens or vaccination.

Thus, the correct answer is (3).

Quick Tip

Innate immunity is the body's first line of defense and is present from birth.

---

119. Which factor is important for termination of transcription?

(1) γ (gamma)

(2) α (alpha)

(3) σ (sigma)

(4) ρ (rho)

Correct Answer: (4) ρ (rho)

Solution:

The ρ factor is important for termination of transcription in prokaryotes. In the termination phase of transcription, the ρ-dependent mechanism helps release the RNA polymerase from the DNA, signaling the end of transcription.

Thus, the correct answer is (4).

Quick Tip

In prokaryotes, the ρ factor is required for the termination of transcription.

---

120. Which of the following hormones released from the pituitary is actually synthesized in the hypothalamus?

(1) Adenocorticotropic hormone (ACTH)

(2) Luteinizing hormone (LH)

(3) Anti-diuretic hormone (ADH)

(4) Follicle-stimulating hormone (FSH)

Correct Answer: (3) Anti-diuretic hormone (ADH)

Solution:

ADH is synthesized in the hypothalamus and stored in the posterior pituitary, from where it is released into the bloodstream. The other hormones mentioned are synthesized in the anterior pituitary.

Thus, the correct answer is (3).

Quick Tip

ADH is produced in the hypothalamus and stored in the posterior pituitary gland.

121. Which of the following microbes is NOT involved in the preparation of household products?

(1) Aspergillus niger

(2) Lactobacillus

(3) Trichoderma polyspermum

(4) Saccharomyces cerevisiae

Correct Answer: (3) Trichoderma polyspermum

Solution:

- Aspergillus niger is used in the production of citric acid and other enzymes.
- Lactobacillus is used in the fermentation of dairy products.
- Saccharomyces cerevisiae is used in bread and alcoholic beverage production.
- Trichoderma polyspermum is not typically involved in the production of household products.

Thus, the correct answer is (3).

Quick Tip

Trichoderma species are more commonly used in industrial biotechnology, but not typically in household product production.

---

122. Given below are two statements: Statement I: Fig fruit is a non-vegetarian fruit as it has enclosed fig wasps in it.

Statement II: Fig wasp and fig tree exhibit mutual relationship as fig wasp completes its life cycle in fig fruit and fig fruit gets pollinated by fig wasp.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but statement II is correct

(2) Both statement I and statement II are correct

(3) Both statement I and statement II are incorrect

(4) Statement I is correct but statement II is incorrect

Correct Answer: (1) Statement I is incorrect but statement II is correct

Solution:

- Statement I is incorrect because fig fruit is not considered non-vegetarian. While fig wasps are involved in its pollination, they do not make the fruit non-vegetarian.
- Statement II is correct: The fig tree and fig wasp have a mutualistic relationship, where the wasp pollinates the fig tree while completing its life cycle inside the fruit.

Thus, the correct answer is (1).

Quick Tip

The fig and fig wasp have a mutualistic relationship, but it does not make the fruit non-vegetarian.

---

123. Role of the water vascular system in Echinoderms is:

A. Respiration and Locomotion

B. Excretion and Locomotion

C. Capture and transport of food

D. Digestion and Respiration

E. Digestion and Excretion

Choose the correct answer from the options given below:

(1) B, D, and E only

(2) A and B only

(3) A and C only

(4) B and C only

Correct Answer: (3) A and C only

Solution:

The water vascular system in echinoderms plays a key role in locomotion and food capture. It helps in the movement of water within the body and allows the organism to move using tube feet. It also assists in capturing food.

Thus, the correct answer is (3).

Quick Tip

The water vascular system is essential for locomotion and food capture in echinoderms.

---

124. After maturation, in primary lymphoid organs, the lymphocytes migrate for interaction with antigens to secondary lymphoid organ(s)/ tissue(s) like:

A. Thymus

B. Bone marrow

C. Spleen

D. Peyer's patches

Choose the correct answer from the options given below:

(1) C, D, E only

(2) B, C only

(3) A, B, C only

(4) E, A, B only

Correct Answer: (1) C, D, E only

Solution:

After maturation, lymphocytes migrate from primary lymphoid organs (thymus and bone marrow) to secondary lymphoid organs like the spleen and Peyer's patches, where they interact with antigens.

Thus, the correct answer is (1).

Quick Tip

Lymphocytes are central to the immune response, migrating to secondary lymphoid organs to encounter antigens.

---

125. Match List I with List II:

List I	**List II**
A. The Evil Quartet	I. Cryopreservation
B. Ex situ conservation	II. Alien species invasion

C. Lantana camara III. Causes of biodiversity losses

D. Dodo IV. Extinction

Choose the option with all correct matches:

(1) A-III, B-II, C-IV, D-I

(2) A-II, B-I, C-II, D-IV

(3) A-III, B-II, C-I, D-III

(4) A-III, B-IV, C-II, D-I

Correct Answer: (1) A-III, B-II, C-IV, D-I

Solution:

- A. The Evil Quartet refers to species that cause extinction (III).

- B. Ex situ conservation refers to the preservation of species outside their natural habitat (II).

- C. Lantana camara is an invasive species, which causes biodiversity loss (IV).

- D. The Dodo is extinct (I).

Thus, the correct answer is (1).

Quick Tip

The Evil Quartet refers to factors causing biodiversity loss and extinction, such as invasive species, overhunting, and habitat loss.

---

126. Read the following statements on plant growth and development.

A. Parthenocarpy can be induced by auxins.

B. Plant growth regulators can be involved in promotion as well as inhibition of growth.

C. Dedifferentiation is a pre-requisite for re-differentiation.

D. Abscisic acid is a plant growth promoter.

E. Apical dominance promotes the growth of lateral buds.

Choose the correct answer from the options given below:

(1) B, D, E only

(2) A, B, C only

(3) A, C, E only

(4) A, D, E only

Correct Answer: (3) A, C, E only

Solution:

- A. Parthenocarpy (the formation of fruit without fertilization) can indeed be induced by auxins.

- B. Growth regulators can promote or inhibit growth, so this is true.

- C. Dedifferentiation is essential for redifferentiation in the development of specialized tissues.

- D. Abscisic acid is an inhibitor of growth, not a promoter.

- E. Apical dominance restricts the growth of lateral buds, allowing the plant to grow upwards.

Thus, the correct answer is (3).

Quick Tip

Apical dominance refers to the suppression of lateral bud growth by the apical bud.

---

127. Match List I with List II

List I	**List II**
A. Pteridophyte	I. Salvia
B. Bryophyte	II. Ginkgo
C. Angiosperm	III. Polythricum
D. Gymnosperm	IV. Salvina

Choose the option with all correct matches:

(1) A-IV, B-II, C-II, D-I

(2) A-II, B-I, C-II, D-I

(3) A-IV, B-III, C-I, D-II

(4) A-III, B-II, C-I, D-IV

Correct Answer: (4) A-III, B-II, C-I, D-IV

Solution:

- A. Pteridophytes include species like Polythricum (III).

- B. Bryophytes include species like Ginkgo (II).

- C. Angiosperms are represented by Salvia (I).

- D. Gymnosperms include species like Salvina (IV).

Thus, the correct answer is (4).

Quick Tip

Pteridophytes, bryophytes, angiosperms, and gymnosperms are distinct groups of plants classified based on their reproductive structures.

---

128. Why can't insulin be given orally to diabetic patients?

(1) Its bioavailability will be increased

(2) Human body will elicit strong immune response

(3) It will be digested in the Gastro-Intestinal (GI) tract

(4) Because of structural variation

Correct Answer: (3) It will be digested in the Gastro-Intestinal (GI) tract

Solution:

Insulin is a protein hormone that gets digested in the GI tract if taken orally, making it ineffective. It needs to be injected directly into the bloodstream to avoid degradation in the digestive system.

Thus, the correct answer is (3).

Quick Tip

Insulin, being a protein, is broken down by digestive enzymes if taken orally, thus requiring injection.

---

129. Which one of the following is the characteristic feature of gymnosperms?

(1) Gymnosperms have flowers for reproduction

(2) Seeds are enclosed in fruits.

(3) Seeds are naked.

(4) Seeds are absent.

Correct Answer: (3) Seeds are naked.

Solution:

Gymnosperms are characterized by having naked seeds, meaning their seeds are not enclosed within a fruit. This distinguishes them from angiosperms, where seeds are enclosed within fruits.

Thus, the correct answer is (3).

Quick Tip

In gymnosperms, seeds are not enclosed in fruits, unlike in angiosperms.

---

130. Frogs respire in water by skin and buccal cavity and on land by skin, buccal cavity and lungs.

Choose the correct answer from the following:

(1) The statement is false for both the environment

(2) The statement is true for water but false for land

(3) The statement is true for both the environment

(4) The statement is false for water but true for land

Correct Answer: (3) The statement is true for both the environment

Solution:

Frogs can respire both through their skin and lungs depending on their environment. In water, they absorb oxygen through their skin, and on land, they use lungs for breathing. The statement is correct for both water and land environments.

Thus, the correct answer is (3).

Quick Tip

Frogs have dual respiration, utilizing both skin and lungs, depending on their environment.

---

131. Silencing of specific mRNA is possible via RNAi because of -

(1) Non-complementary ssRNA

(2) Complementary dsRNA

(3) Inhibitory ssRNA

(4) Complementary tRNA

Correct Answer: (2) Complementary dsRNA

Solution:

RNA interference (RNAi) is a process by which specific mRNA molecules are silenced by complementary double-stranded RNA (dsRNA). The dsRNA is processed by the RNAi machinery, leading to the degradation of the mRNA with a complementary sequence. Non-complementary ssRNA and other options do not have this silencing capability.

Thus, the correct answer is (2).

Quick Tip

RNA interference uses complementary dsRNA to degrade target mRNA, preventing gene expression.

---

132. Twins are born to a family that lives next door to you. The twins are a boy and a girl. Which of the following must be true?

(1) They have 75% identical genetic content.

(2) They are monozygotic twins.

(3) They are fraternal twins.

(4) They were conceived through in vitro fertilization.

Correct Answer: (3) They are fraternal twins.

Solution:

- Monozygotic twins are identical twins that result from the splitting of a single fertilized egg, which would make them genetically identical, but since one is a boy and the other a girl, they cannot be monozygotic.

- Fraternal twins (dizygotic) are the result of two separate eggs being fertilized by two different sperm, and they can be of different sexes.

Thus, the correct answer is (3).

Quick Tip

Fraternal twins can be of different sexes, while monozygotic twins are genetically identical and of the same sex.

---

133. Match List I with List II:

List I **List II**

A. Scutellum I. Persistent nucleus

B. Non-albuminous seed II. Cotyledon of monocot seed

C. Epiblast III. Groundnut

D. Perisperm IV. Rudimentary cotyledon

Choose the option with all correct matches:

(1) A-II, B-IV, C-III, D-I

(2) A-II, B-III, C-IV, D-I

(3) A-IV, B-III, C-II, D-I

(4) A-IV, B-III, C-II, D-II

Correct Answer: (1) A-II, B-IV, C-III, D-I

Solution:

- A. The scutellum is a cotyledon found in monocot seeds (II).

- B. Non-albuminous seeds like the groundnut have a rudimentary cotyledon (IV).

- C. Epiblast is found in groundnut, which is a dicot (III).

- D. Perisperm has a persistent nucleus (I).

Thus, the correct answer is (1).

Quick Tip

Scutellum is a specialized structure in monocot seeds, while perisperm is associated with dicots.

---

134. In frog, the Renal portal system is a special venous connection that acts to link:

(1) Kidney and lower part of body

(2) Liver and intestine

(3) Liver and kidney

(4) Kidney and intestine

Correct Answer: (4) Kidney and intestine

Solution:

The renal portal system in frogs connects the kidneys and the intestine, enabling the reabsorption of substances from the intestines before they reach the kidneys.

Thus, the correct answer is (4).

Quick Tip

The renal portal system is crucial for regulating waste and maintaining homeostasis in amphibians.

---

135. Match List I with List II

List I	**List II**
A. Heart	I. Erythropoietin
B. Kidney	II. Aldosterone
C. Gastro-intestinal tract	III. Atrial natriuretic factor
D. Adrenal Cortex	IV. Secretin

Choose the correct answer from the options given below:

(1) A-III, B-I, C-II, D-IV

(2) A-IV, B-I, C-II, D-III

(3) A-I, B-II, C-III, D-IV

(4) A-II, B-I, C-IV, D-III

Correct Answer: (3) A-I, B-II, C-III, D-IV

Solution:

- A. The heart is associated with the secretion of erythropoietin (I)

. - B. The kidney is involved in aldosterone secretion (II).

- C. The gastrointestinal tract secretes atrial natriuretic factor (III).

- D. The adrenal cortex secretes secretin (IV).

Thus, the correct answer is (3).

Quick Tip

The kidney, heart, and adrenal glands all have distinct roles in regulating homeostasis via hormone secretion.

---

136. Cardiac activities of the heart are regulated by:

(1) A, B and D Only

(2) A, B and C Only

(3) A, B, C and D

(4) A, C and D Only

Correct Answer: (3) A, B, C and D

Solution:

Cardiac activities are regulated by the following:

- A. Nodal tissue is responsible for initiating the heart's electrical impulses.

- B. A special neural center in the medulla oblongata regulates the heartbeat.

- C. Adrenal medullary hormones, such as adrenaline, increase heart rate.

- D. Adrenal cortical hormones also influence heart rate.

Thus, the correct answer is (3).

Quick Tip

The autonomic nervous system and hormones regulate the cardiac cycle to maintain optimal heart function.

---

137. Streptokinase produced by bacterium Streptococcus is used for:

(1) Removing clots from blood vessels

(2) Curd production

(3) Ethanol production

(4) Liver disease treatment

Correct Answer: (1) Removing clots from blood vessels

Solution:

Streptokinase is an enzyme used to dissolve blood clots and is commonly used in the

treatment of heart attacks and strokes.

Thus, the correct answer is (1).

Quick Tip

Streptokinase is used as a thrombolytic agent to break down clots in blood vessels.

---

138. Who is known as the father of Ecology in India?

(1) Birbal Sahni

(2) S. R. Kashyap

(3) Ramdeo Misra

(4) Ram Udar

Correct Answer: (3) Ramdeo Misra

Solution:

Ramdeo Misra is considered the father of ecology in India due to his significant contributions to the field, especially in the study of environmental science and ecological relationships.

Thus, the correct answer is (3).

Quick Tip

Ramdeo Misra is recognized for pioneering ecological research in India.

---

139. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): A typical unfertilized, angiosperm ovule at maturity is 8 nucleate and 7-celled.

Reason (R): The egg apparatus has 2 polar nuclei.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

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

(3) Both A and R are true but R is NOT the correct explanation of A

(4) A is true but R is false

Correct Answer: (3) Both A and R are true but R is NOT the correct explanation of A

Solution:

- Assertion (A) is correct. A typical unfertilized angiosperm ovule is 8 nucleate and 7-celled.
- Reason (R) is also correct. The egg apparatus does have 2 polar nuclei. However, these polar nuclei are not directly responsible for the 8-nucleate and 7-celled structure. The two are not directly connected.

Thus, the correct answer is (3).

Quick Tip

In angiosperms, the ovule undergoes several cellular divisions to form a structure with 8 nuclei and 7 cells, with polar nuclei in the egg apparatus.

---

140. Neoplastic characteristics of cells refer to:

(1) A. Mass of proliferating cells

(2) B. Rapid growth of cells

(3) C. Invasion and damage to the surrounding tissue

(4) D. Those confined to original location

Choose the correct answer from the options given below:

(1) B, C only

(2) A, B only

(3) A, B, C only

(4) A, D only

Correct Answer: (3) A, B, C only

Solution:

Neoplastic cells are characterized by unregulated cell division (A), rapid growth (B), and the ability to invade and damage surrounding tissues (C). Cells that are confined to their original location (D) are typically benign, not neoplastic.

Thus, the correct answer is (3).

Quick Tip

Neoplastic cells are usually associated with cancer and exhibit uncontrolled growth, invasion, and damage to surrounding tissues.

---

141. Given below are the stages in the life cycle of pteridophytes. Arrange the following stages in the correct sequence.

A. Prothallus

B. Meiosis

C. Fertilization

D. Formation of archegonia and antheridia in gametophyte

E. Transfer of antherozoids to the archegonia in presence of water.

Choose the correct answer from the options given below:

(1) E, D, C, B, A

(2) B, A, C, D, E

(3) B, A, E, C, D

(4) B, E, A, D, C

Correct Answer: (4) B, E, A, D, C

Solution:

- First, meiosis (B) occurs in the sporophyte to produce haploid spores.
- These spores germinate in the presence of water, leading to the formation of prothallus (E).
- The prothallus then forms archegonia and antheridia (A, D), which produce gametes.
- Finally, fertilization (C) takes place to complete the life cycle.

Thus, the correct answer is (4).

Quick Tip

The life cycle of pteridophytes follows the alternation of generations, where the sporophyte produces spores and the gametophyte produces gametes.

---

142. Given below are two statements: One is labelled as Assertion (A) and the other is

labelled as Reason (R).

Assertion (A): Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Reason (R): The flowers produce enormous amount of pollen grains in wind and water pollinated flowers.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

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

(3) Both A and R are true but R is NOT the correct explanation of A

(4) A is true but R is false

Correct Answer: (3) Both A and R are true but R is NOT the correct explanation of A

Solution:

- Assertion (A) is true: Wind and water-pollinated flowers are typically not colourful and do not produce nectar since they rely on the wind or water for pollination.

- Reason (R) is also true: Wind and water-pollinated flowers produce large amounts of pollen. However, this does not explain why they are not colourful or do not produce nectar.

Thus, the correct answer is (3).

Quick Tip

The lack of color and nectar in wind and water-pollinated flowers is a strategy to conserve energy and rely on environmental factors for pollination.

---

143. Which one of the following enzymes contains 'Haem' as the prosthetic group?

(1) Catalase

(2) RuBisCO

(3) Carbonic anhydrase

(4) Succinate dehydrogenase

Correct Answer: (1) Catalase

Solution:

Catalase is an enzyme that contains the prosthetic group haem, which helps in the breakdown

of hydrogen peroxide into water and oxygen.

Thus, the correct answer is (1).

Quick Tip

Haem groups are often found in enzymes like catalase that deal with reactive oxygen species.

---

144. Match List I with List II:

List I **List II**

A. Emphysema I. Rapid spasms in muscle due to low Ca^{2+} in body fluid

B. Angina Pectoris II. Damaged alveolar walls and decreased respiratory surface

C. Glomerulonephritis III. Acute chest pain when not enough oxygen is reaching to heart muscle

D. Tetany IV. Inflammation of glomeruli of kidney

Choose the correct answer from the options given below:

(1) A-II, B-I, C-IV, D-I

(2) A-III, B-I, C-IV, D-II

(3) A-III, B-II, C-IV, D-I

(4) A-II, B-IV, C-III, D-I

Correct Answer: (1) A-II, B-I, C-IV, D-I

Solution:

- A. Emphysema is characterized by damaged alveolar walls and a decreased respiratory surface (II).

- B. Angina Pectoris is characterized by acute chest pain when not enough oxygen reaches the heart muscle (III).

- C. Glomerulonephritis refers to the inflammation of the glomeruli of the kidneys (IV).

- D. Tetany is associated with rapid spasms in muscles due to low Ca^{2+} in body fluids (I).

Thus, the correct answer is (1).

Quick Tip

Each condition is associated with specific symptoms and physiological changes, such as spasms, chest pain, or inflammation.

---

145. Find the statement that is NOT correct with regard to the structure of monocot stem.

(1) Phloem parenchyma is absent.

(2) Hypodermis is parenchymatous.

(3) Vascular bundles are scattered.

(4) Vascular bundles are conjoint and closed.

Correct Answer: (2) Hypodermis is parenchymatous.

Solution:

- In monocot stems, the hypodermis is typically sclerenchymatous, not parenchymatous. - Phloem parenchyma is absent, vascular bundles are scattered, and the vascular bundles are conjoint and closed.

Thus, the correct answer is (2).

Quick Tip

Monocot stems have a sclerenchymatous hypodermis, which helps in providing strength and support to the plant.

---

146. Which of the following statement is correct about location of the male frog copulatory pad?

(1) First digit of the fore limb

(2) First and second digit of fore limb

(3) First digit of hind limb

(4) Second digit of fore limb

Correct Answer: (1) First digit of the fore limb

Solution:

The male frog copulatory pad is located on the first digit of the forelimb, which helps in

holding the female during mating.

Thus, the correct answer is (1).

Quick Tip

Male frogs use their copulatory pads to grip the female during mating.

---

147. Given below are two statements:

Statement I: The primary source of energy in an ecosystem is solar energy.

Statement II: The rate of production of organic matter during photosynthesis in an ecosystem is called net primary productivity (NPP).

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but statement II is correct.

(2) Both statement I and statement II are correct.

(3) Both statement I and statement II are incorrect.

(4) Statement I is correct but statement II is incorrect.

Correct Answer: (2) Both statement I and statement II are correct.

Solution:

- Statement I is correct because solar energy is the primary source of energy in most ecosystems.

- Statement II is correct because net primary productivity (NPP) refers to the rate at which plants and other producers in an ecosystem synthesize organic compounds from carbon dioxide and sunlight.

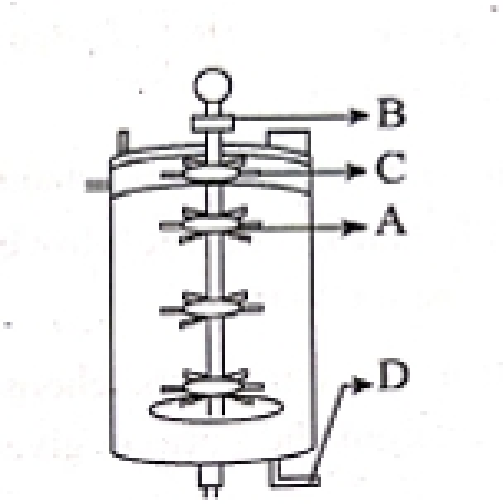
Thus, the correct answer is (2).

Quick Tip

Net primary productivity (NPP) represents the rate at which ecosystems produce new biomass available to consumers.

---

148. Identify the part of a bioreactor which is used as a foam breaker from the given figure.



(1) C

(2) B

(3) A

(4) D

Correct Answer: (1) C

Solution:

In bioreactors, foam formation is common during microbial growth. Part C of the bioreactor is typically the foam breaker used to prevent excessive foam buildup, which could interfere with the reaction process.

Thus, the correct answer is (1).

Quick Tip

Foam breakers are essential in maintaining the stability of bioreactors and preventing overflow.

---

149. Polymerase chain reaction (PCR) amplifies DNA following the equation.

(1) $2N^2$

(2) N^2

(3) 2^n

(4) $2n + 1$

Correct Answer: (3) 2^n

Solution:

In PCR, the DNA sequence is amplified exponentially, with each cycle doubling the amount of DNA. The total number of copies of the DNA after n cycles is 2^n.

Thus, the correct answer is (3).

Quick Tip

PCR is an exponential process, with the number of DNA copies doubling in each cycle.

---

150. Match List I with List II:

List I **List II**

A. Head I. Enzymes

B. Middle piece II. Sperm motility

C. Acrosome III. Energy

D. Tail IV. Genetic material

Choose the correct answer from the options given below:

(1) A-III, B-II, C-I, D-IV

(2) A-IV, B-III, C-II, D-I

(3) A-I, B-II, C-IV, D-III

(4) A-III, B-IV, C-II, D-I

Correct Answer: (1) A-III, B-II, C-I, D-IV

Solution:

- A. The head of the sperm contains the genetic material (III).

- B. The middle piece provides the energy for sperm motility (II).

- C. The acrosome contains enzymes required for fertilization (I).

- D. The tail is responsible for sperm motility (IV).

Thus, the correct answer is (1).

Quick Tip

The sperm consists of a head, middle piece, acrosome, and tail, each serving a distinct function in fertilization.

151. Given below are two statements:

Statement I: In a floral formula, ★ stands for zygomorphic nature of the flower and G stands for inferior ovary.

Statement II: In a floral formula, ◯ stands for actinomorphic nature of the flower and G stands for superior ovary.

In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is incorrect but Statement II is correct.

(2) Both Statement I and Statement II are correct.

(3) Both Statement I and Statement II are incorrect.

(4) Statement I is correct but Statement II is incorrect.

Correct Answer: (3) Both Statement I and Statement II are incorrect.

Solution:

- Statement I is incorrect: Zygomorphic nature is indicated by a symmetry symbol such as ★, and the inferior ovary is marked by G, but the statement about inferior ovary is inaccurate.

- Statement II is also incorrect: Actinomorphic nature is denoted by ◯, but the description of the ovary being superior or inferior is incorrect.

Thus, the correct answer is (3).

Quick Tip

Floral formulas use specific symbols to denote symmetry and ovary position. Zygomorphic flowers are asymmetrical, while actinomorphic flowers are symmetrical.

---

152. From the statements given below, choose the correct option:

A. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S.

B. Each ribosome has two sub-units.

C. The two sub-units of 80S ribosome are 60S and 40S, while that of 70S are 50S and 30S.

D. The two sub-units of 80S ribosome are 60S and 30S, and that of 70S are 50S and 20S.

E. The two sub-units of 80S are 60S and 30S, and that of 70S are 50S and 20S.

(1) B, D, E are true

(2) A, B, C are true

(3) A, B, D are true

(4) A, B, E are true

Correct Answer: (4) A, B, E are true

Solution:

- Option A is true: Eukaryotic ribosomes are 80S, and prokaryotic ribosomes are 70S.

- Option B is true: Ribosomes consist of two sub-units.

- Option E is true: The two sub-units of 80S ribosomes are 60S and 40S, and the two sub-units of 70S ribosomes are 50S and 30S.

Thus, the correct answer is (4).

Quick Tip

Ribosomes consist of large and small sub-units, and their S-values indicate their sedimentation rate.

---

153. Each of the following characteristics represents a Kingdom proposed by Whittaker. Arrange the following in increasing order of complexity of body organization.

A. Multicellular heterotrophs with cell wall made of chitin.

B. Heterotrophs with tissue/organ/system level of body organization.

C. Prokaryotes with cell wall made of polysaccharides and amino acids.

D. Eukaryotic autotrophs with tissue/organ system level of body organization.

E. Eukaryotes with cellular body organization.

Choose the correct answer from the options given below:

(1) C, E, A, B, D

(2) A, C, E, B, D

(3) C, E, A, D, B

(4) A, C, E, D, B

Correct Answer: (1) C, E, A, B, D

Solution:

The order of complexity is:

- C: Prokaryotes, simple cellular structure with no organ system.

- E: Eukaryotes with a more complex body structure.

- A: Multicellular heterotrophs with chitin cell walls, higher complexity than simple prokaryotes.

- B: Organ system level of organization, higher than A.

- D: Eukaryotic autotrophs with the highest level of body organization.

Thus, the correct answer is (1).

Quick Tip

The complexity of body organization increases from prokaryotes to multicellular eukaryotes, with a clear increase in organ systems.

---

154. The correct sequence of events in the life cycle of bryophytes is:

A. Fusion of antherozoid with egg.

B. Attachment of gametophyte to substrate.

C. Reduction division to produce haploid spores.

D. Formation of sporophyte.

E. Release of antherozoids into water.

Choose the correct answer from the options given below:

(1) D, E, A, B, C

(2) E, A, C, B, D

(3) B, E, A, C, D

(4) B, E, A, D, C

Correct Answer: (2) E, A, C, B, D

Solution:

The correct sequence of events in bryophyte life cycle is:

- E: Release of antherozoids into water.

- A: Fusion of antherozoid with egg.

- C: Reduction division to produce haploid spores.

- B: Attachment of gametophyte to substrate.

- D: Formation of sporophyte.

Thus, the correct answer is (2).

Quick Tip

In bryophytes, the life cycle includes both sexual and asexual phases with gametes, fertilization, and sporophyte formation.

---

155. Which are correct:

A. Computed tomography and magnetic resonance imaging detect cancers of internal organs.

B. Chemotherapeutic drugs are used to kill non-cancerous cells.

C. Interferon activate the cancer patients' immune system and helps in destroying the tumour.

D. Chemotherapeutic drugs are biological response modifiers.

E. In the case of leukaemia blood cell counts are decreased.

Choose the correct answer from the options given below:

(1) B and C only

(2) B and D only

(3) D and E only

(4) C and D only

Correct Answer: (1) B and C only

Solution:

- Option A is incorrect: Computed tomography and magnetic resonance imaging are effective in detecting internal cancers, but this statement is incomplete because the imaging techniques also depend on the type of cancer.
- Option B is correct: Chemotherapeutic drugs aim to kill cancerous cells, although they can sometimes affect healthy cells as well.
- Option C is correct: Interferon is used to stimulate the immune system to attack cancer cells.
- Option D is incorrect: Chemotherapeutic drugs are not typically classified as biological response modifiers; they are used to kill rapidly dividing cells.
- Option E is incorrect: In leukaemia, blood cell counts typically increase, not decrease, due to the proliferation of abnormal white blood cells.

Thus, the correct answer is (1).

Quick Tip

Chemotherapy is a treatment that uses drugs to kill cancer cells but may affect normal cells as well. Biological response modifiers like interferon can help boost the body's immune system to fight cancer.

---

158. Which of the following is an example of non-distilled alcoholic beverage produced by yeast?

(1) Rum

(2) Whisky

(3) Brandy

(4) Beer

Correct Answer: (4) Beer

Solution:

Beer is a non-distilled alcoholic beverage that is produced by fermentation of cereals (like barley) by yeast. It does not require distillation, unlike the other alcoholic beverages listed here, which are distilled.

Thus, the correct answer is (4).

Quick Tip

Alcoholic beverages like beer are made through fermentation, while rum, whisky, and brandy are made using distillation after fermentation.

---

159. Given below are two statements:

Statement I: In the RNA world, RNA is considered the first genetic material evolved to carry out essential life processes. RNA acts as a genetic material and also as a catalyst for some important biochemical reactions in living systems. Being reactive, RNA is unstable.

Statement II: DNA evolved from RNA and is a more stable genetic material. Its double helical strands being complementary, resist changes by evolving repairing mechanisms.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct.

(2) Both Statement I and Statement II are correct.

(3) Both Statement I and Statement II are incorrect.

(4) Statement I is correct but Statement II is incorrect.

Correct Answer: (2) Both Statement I and Statement II are correct.

Solution:

- Statement I is correct: RNA is believed to have been the first genetic material, capable of both storing genetic information and catalyzing chemical reactions.
- Statement II is correct: DNA evolved from RNA, offering a more stable form of genetic material with complementary strands for error correction mechanisms.

Thus, the correct answer is (2).

Quick Tip

The RNA world hypothesis suggests that RNA was both the genetic material and the catalyst for early life processes before DNA evolved as a more stable genetic storage system.

---

160. Given below are two statements:

Statement I: Transfer RNAs and ribosomal RNA do not interact with mRNA.

Statement II: RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defense.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct.

(2) Both Statement I and Statement II are correct.

(3) Both Statement I and Statement II are incorrect.

(4) Statement I is correct but Statement II is incorrect.

Correct Answer: (1) Statement I is incorrect but Statement II is correct.

Solution:

- Statement I is incorrect: Transfer RNAs (tRNA) and ribosomal RNAs (rRNA) are involved in translation and interact with mRNA.

- Statement II is correct: RNA interference (RNAi) is a biological process where RNA molecules inhibit gene expression or translation by neutralizing targeted mRNA molecules.

Thus, the correct answer is (1).

Quick Tip

RNA interference (RNAi) plays a crucial role in regulating gene expression in eukaryotic cells.

---

161. Which of the following diagrams is correct with regard to the proximal (P) and distal (D) tubule of the Nephron?

(1) Diagram 1

(2) Diagram 2

(3) Diagram 3

(4) Diagram 4

Correct Answer: (1) Diagram 1

Solution:

The diagram for the proximal and distal tubule of the nephron should show the proper ion exchanges. Diagram 1 is the correct representation, showing the exchange of ions as per nephron structure.

Thus, the correct answer is (1).

Quick Tip

In the nephron, the proximal convoluted tubule reabsorbs water and solutes, while the distal convoluted tubule is involved in the secretion and fine regulation of ions.

---

162. What is the pattern of inheritance for polygenic trait?

(1) X-linked recessive inheritance pattern

(2) Mendelian inheritance pattern

(3) Non-mendelian inheritance pattern

(4) Autosomal dominant pattern

Correct Answer: (3) Non-mendelian inheritance pattern

Solution:

Polygenic traits are controlled by multiple genes and typically follow non-mendelian inheritance patterns, which are more complex than simple dominant or recessive inheritance.

Thus, the correct answer is (3).

Quick Tip

Polygenic traits, like skin color or height, are controlled by multiple genes and do not follow the simple Mendelian inheritance rules.

---

163. In the seeds of cereals, the outer covering of endosperm separates the embryo by a protein-rich layer called:

(1) Aleurone layer

(2) Coleoptile

(3) Coleorhiza

(4) Integument

Correct Answer: (1) Aleurone layer

Solution:

In cereal seeds, the aleurone layer is a protein-rich tissue surrounding the endosperm and serves to protect and nourish the embryo.

Thus, the correct answer is (1).

Quick Tip

The aleurone layer in seeds plays a crucial role in storing proteins, which are later used during seed germination.

---

164. Match List I with List II:

List I — List II

A. Chlorophyll a — I. Yellow-green

B. Chlorophyll b — II. Yellow

C. Xanthophylls — III. Blue-green

D. Carotenoids — IV. Yellow to yellow-orange

Choose the option with all correct matches:

(1) A-I, B-IV, C-III, D-II

(2) A-III, B-IV, C-II, D-I

(3) A-III, B-I, C-II, D-IV

(4) A-I, B-II, C-IV, D-III

Correct Answer: (3) A-III, B-I, C-II, D-IV

Solution:

- Chlorophyll a absorbs primarily blue and red light, reflecting blue-green.

- Chlorophyll b absorbs light mainly in the red and blue regions, reflecting yellow-green.

- Xanthophylls reflect yellow light.

- Carotenoids reflect yellow-orange.

Thus, the correct answer is (3).

Quick Tip

Chlorophylls, carotenoids, and xanthophylls are pigments involved in photosynthesis, each absorbing different wavelengths of light.

---

165. Which of the following genetically engineered organisms was used by Eli Lilly to prepare human insulin?

(1) Phage

(2) Bacterium

(3) Yeast

(4) Virus

Correct Answer: (2) Bacterium

Solution:

Eli Lilly used genetically modified bacteria, specifically *Escherichia coli*, to produce human insulin for medical use.

Thus, the correct answer is (2).

Quick Tip

Genetic engineering in bacteria has been key to producing human insulin and other therapeutic proteins.

---

166. Which of the following are the post-transcriptional events in an eukaryotic cell?

A. Transport of pre-mRNA to cytoplasm prior to splicing.

B. Removal of introns and joining of exons.

C. Addition of methyl group at 5' end of hnRNA.

D. Addition of adenine residues at 3' end of hnRNA.

E. Base pairing of two complementary RNAs.

Choose the correct answer from the options given below:

(1) C, D, E only

(2) A, B, C only

(3) B, C, D only

(4) B, C, E only

Correct Answer: (3) B, C, D only

Solution:

The post-transcriptional modifications in eukaryotic cells include:

- Removal of introns and joining of exons (splicing).

- Addition of a 5' cap (methyl group).

- Addition of a 3' poly-A tail (adenine residues).

Thus, the correct answer is (3).

Quick Tip

Post-transcriptional modifications are critical for the stability, export, and translation of mRNA in eukaryotic cells.

167. Match List I with List II:

List I — List II

A. Centromere — I. Mitochondrion

B. Cilium — II. Cell division

C. Cristae — III. Cell movement

D. Cell membrane — IV. Phospholipid Bilayer

Choose the correct answer from the options given below:

(1) A-I, B-II, C-III, D-IV

(2) A-II, B-III, C-I, D-IV

(3) A-I, B-I, C-IV, D-III

(4) A-IV, B-II, C-III, D-I

Correct Answer: (1) A-I, B-II, C-III, D-IV

Solution:

- A. Centromere is responsible for cell division (I).

- B. Cilium is involved in cell movement (III).

- C. Cristae are found in mitochondria and play a role in energy production (I).

- D. Cell membrane is a phospholipid bilayer (IV).

Thus, the correct answer is (1).

Quick Tip

The centromere plays a key role during cell division, while the cell membrane consists of a phospholipid bilayer that regulates what enters and exits the cell.

---

168. Match List I with List II:

List I — List II

A. Alfred Hershey and Martha Chase — I. Streptococcus pneumoniae

B. Euchromatin — II. Densely packed and dark-stained

C. Frederick Griffith — III. Loosely packed and light-stained

D. Heterochromatin — IV. DNA as genetic material confirmation

Choose the correct answer from the options given below:

(1) A-III, B-II, C-III, D-I

(2) A-II, B-IV, C-I, D-III

(3) A-IV, B-II, C-I, D-I

(4) A-IV, B-III, C-II, D-II

Correct Answer: (4) A-IV, B-III, C-II, D-I

Solution:

- A. Hershey and Chase's experiment confirmed that DNA is the genetic material (IV).

- B. Euchromatin is loosely packed and light-stained (III).

- C. Griffith discovered genetic transformation in *Streptococcus pneumoniae* (II).

- D. Heterochromatin is densely packed and dark-stained (I).

Thus, the correct answer is (4).

Quick Tip

Euchromatin is loosely packed and actively involved in gene expression, whereas heterochromatin is tightly packed and typically inactive.

---

169. Which chromosome in the human genome has the highest number of genes?

(1) Chromosome 6

(2) Chromosome 7

(3) Chromosome 4

(4) Chromosome 1

Correct Answer: (4) Chromosome 1

Solution:

Chromosome 1 contains the largest number of genes in the human genome. It is the largest chromosome and contains approximately 2,000 to 2,500 genes.

Thus, the correct answer is (4).

Quick Tip

Chromosome 1 contains a wide range of genes involved in various biological functions and diseases.

170. What are the potential drawbacks in adoption of the IVF method?

A. High fatality risk to mother

B. Expensive instruments and reagents

C. Husband/wife necessary for being donors

D. Less adoption in India

E. Possibility that the early embryo does not survive

Choose the correct answer from the options given below:

(1) A, B, C, E, F only

(2) B, D only

(3) A, B, C, D only

(4) A, B, C, D, E only

Correct Answer: (4) A, B, C, D, E only

Solution:

- IVF can be risky, with a high fatality risk for the mother.

- The cost of IVF procedures, instruments, and reagents is high.

- The process often requires both the husband and wife to be involved.

- IVF success rates are variable, with the possibility that the embryo may not survive.

Thus, the correct answer is (4).

Quick Tip

While IVF offers hope to many couples, it involves challenges, including high costs, medical risks, and the uncertainty of success.

---

171. Which one of the following is an example of ex-situ conservation?

(1) Protected areas

(2) National Park

(3) Wildlife Sanctuary

(4) Zoos and botanical gardens

Correct Answer: (4) Zoos and botanical gardens

Solution:

Ex-situ conservation involves protecting species outside of their natural habitat. Zoos and botanical gardens serve this purpose by providing controlled environments for species preservation.

Thus, the correct answer is (4).

Quick Tip

Ex-situ conservation is a method of conservation where species are conserved outside their natural habitat, such as in zoos, botanical gardens, or gene banks.

---

172. A specialised membranous structure in a prokaryotic cell which helps in cell wall formation, DNA replication and respiration is:

(1) Endoplasmic Reticulum

(2) Mesosome

(3) Chromatophores

(4) Cristae

Correct Answer: (2) Mesosome

Solution:

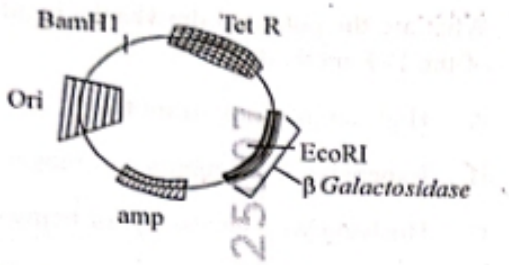
In prokaryotic cells, mesosomes are folded invaginations of the cell membrane that are involved in processes like cell wall formation, DNA replication, and respiration.

Thus, the correct answer is (2).

Quick Tip

Mesosomes in prokaryotic cells are membrane structures that help in various cell functions, including DNA replication and respiration.

173.



In the above presented plasmid an alien piece of DNA is inserted at EcoRI site. Which of the following strategies will be chosen to select the recombinant colonies?

(1) Blue color colonies grown on ampicillin plates can be selected.

(2) Using ampicillin tetracycline containing medium plates.

(3) Blue color colonies will be selected.

(4) White color colonies will be selected.

Correct Answer: (4) White color colonies will be selected.

Solution:

In recombinant DNA technology, colonies that contain the recombinant plasmid are typically white in color, because the foreign DNA interrupts the *lacZ* gene, which is responsible for producing the blue color. Thus, white colonies are selected.

Thus, the correct answer is (4).

Quick Tip

In blue-white screening, the colonies with no insert will appear blue, while those with an insert will be white.

---

174. What is the name of the blood vessel that carries deoxygenated blood from the body to the heart in a frog?

(1) Vena cava

(2) Aorta

(3) Pulmonary artery

(4) Pulmonary vein

Correct Answer: (1) Vena cava

Solution:

The vena cava is the large vein that carries deoxygenated blood from the body back to the heart in a frog, just as in humans.

Thus, the correct answer is (1).

Quick Tip

The vena cava is the main vessel that brings deoxygenated blood back to the right atrium of the heart.

---

175. Which of the following organisms cannot fix nitrogen?

A. Azotobacter

B. Oscillatoria

C. Anabaena

D. Volvox

E. Nostoc

Choose the correct answer from the options given below:

(1) E only

(2) A only

(3) D only

(4) B only

Correct Answer: (4) B only

Solution:

Oscillatoria, unlike the other organisms listed, does not fix nitrogen. Organisms such as Azotobacter, Anabaena, and Nostoc are known for their nitrogen-fixing abilities.

Thus, the correct answer is (4).

Quick Tip

Many cyanobacteria, such as Anabaena and Nostoc, are capable of nitrogen fixation due to specialized cells called heterocysts.

---

176. While trying to find out the characteristic of a newly found animal, a researcher did the

histology of adult animal and observed a cavity with presence of mesodermal tissue towards the body wall but no mesodermal tissue was observed towards the elementary canal. What could be the possible coelom of that animal?

(1) Spongocoelom

(2) Acoelomate

(3) Pseudocoelomate

(4) Schizocoelomate

Correct Answer: (2) Acoelomate

Solution:

An acoelomate organism has no body cavity between the body wall and the gut. The absence of mesodermal tissue surrounding the cavity of the digestive tract characterizes acoelomates.

Thus, the correct answer is (2).

Quick Tip

Acoelomates have a solid body with no coelom, and the space between the body wall and gut is filled with mesodermal tissue.

---

177. Which one of the following statements refers to Reductionist Biology?

(1) Behavioural approach to study and understand living organisms.

(2) Physico-chemical approach to study and understand living organisms.

(3) Physiological approach to study and understand living organisms.

(4) Chemical approach to study and understand living organisms.

Correct Answer: (2) Physico-chemical approach to study and understand living organisms.

Solution:

Reductionist biology seeks to understand living organisms by breaking them down into their component parts and analyzing their structure and function from a physico-chemical perspective.

Thus, the correct answer is (2).

Quick Tip

Reductionism in biology refers to understanding complex systems by studying their individual components.

---

178. Epiphytes that are growing on a mango branch is an example of which of the following?

(1) Amensalism

(2) Commensalism

(3) Mutualism

(4) Predation

Correct Answer: (2) Commensalism

Solution:

Epiphytes growing on mango branches benefit from the tree for space but do not harm the tree. This type of interaction is an example of commensalism, where one organism benefits and the other is unaffected.

Thus, the correct answer is (2).

Quick Tip

Commensalism occurs when one organism benefits from the relationship, and the other is neither helped nor harmed.

---

179. Which one of the following hormones promotes nutrient mobilization which helps in the delay of leaf senescence in plants?

(1) Cytokinin

(2) Ethylene

(3) Abscisic acid

(4) Gibberellin

Correct Answer: (1) Cytokinin

Solution:

Cytokinin is a plant hormone that promotes cell division, and it helps in the mobilization of

nutrients, delaying leaf senescence and promoting plant growth.

Thus, the correct answer is (1).

Quick Tip

Cytokinins delay leaf senescence and stimulate cell division, particularly in the shoot and root systems.

---

180. The complex II of mitochondrial electron transport chain is also known as:

(1) NADH dehydrogenase

(2) Cytochrome bc1

(3) Succinate dehydrogenase

(4) Cytochrome c oxidase

Correct Answer: (3) Succinate dehydrogenase

Solution:

In the mitochondrial electron transport chain, Complex II is known as succinate dehydrogenase. It is involved in both the citric acid cycle and the electron transport chain. Complex II catalyzes the oxidation of succinate to fumarate while reducing FAD to FADH2, which then passes electrons to ubiquinone (CoQ).

Thus, the correct answer is (3).

Quick Tip

Complex II, or succinate dehydrogenase, is the only enzyme that participates in both the citric acid cycle and the electron transport chain.
