NEET UG 2024 R6 Question Paper with Solutions

Time Allowed :200 minutes	**Maximum Marks :**720	**Total questions :**200

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours 20 minutes duration.
2. The question paper consists of 200 questions out of which 180 MCQs must be answered. The maximum marks are 720.
3. There are four parts in the question paper consisting of Biology, Physics, Chemistry and Mathematics.
4. Each subject will be divided into two sections, A and B which will have 35 and 15 questions respectively. Candidates will have to answer only 10 questions in Section B.
5. 4 marks are awarded for each correct answer and 1 mark is deducted for each wrong answer

Physics

Section A

1. In an ideal transformer, the turns ratio is $\frac{N_P}{N_S} = \frac{1}{2}$. The ratio $V_S : V_P$ is equal to (the symbols carry their usual meaning):

(A) $2 : 1$

(B) $1 : 1$

(C) $1 : 4$

(D) $1 : 2$

Correct Answer: (1) $2 : 1$

Solution:

Step 1: Understanding Transformer Voltage Ratio

- In an ideal transformer, the voltage ratio is given by:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

- Given that $\frac{N_P}{N_S} = \frac{1}{2}$, we can rewrite this as:

$$N_S = 2N_P$$

Step 2: Applying the Formula

- Substituting in the transformer equation:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} = 2$$

- This implies that $V_S : V_P = 2 : 1$.

Conclusion:

Since the voltage ratio is $\mathbf{2 : 1}$, the correct answer is $(\mathbf{1})$.

Quick Tip

For an ideal transformer, the voltage ratio is directly proportional to the turns ratio:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

Thus, if the number of secondary turns increases, the secondary voltage also increases proportionally.

2. A tightly wound 100 turns coil of radius 10 cm carries a current of 7 A. The magnitude of the magnetic field at the centre of the coil is (Take permeability of free space as $4\pi \times 10^{-7}$ SI units):

(A) $4.4\,T$

(B) $4.4\,mT$

(C) $44\,T$

(D) $44\,mT$

Correct Answer: (2) $4.4\,mT$

Solution:

Step 1: Using the Formula for Magnetic Field at the Centre of a Circular Coil

- The magnetic field at the centre of a circular coil with N turns is given by:

$$B = \frac{\mu_0 N I}{2R}$$

where:

  - $\mu_0 = 4\pi \times 10^{-7}$ Tm/A (permeability of free space),
  - $N = 100$ (number of turns),
  - $I = 7$ A (current),
  - $R = 10$ cm $= 0.1$ m (radius of coil).

Step 2: Substituting the Values

$$B = \frac{(4\pi \times 10^{-7}) \times (100) \times (7)}{2 \times (0.1)}$$

$$B = \frac{28\pi \times 10^{-7}}{2 \times 10^{-1}}$$

$$B = \frac{28\pi \times 10^{-7}}{2 \times 10^{-1}} = \frac{28\pi}{2} \times 10^{-6}$$

$$B = 14\pi \times 10^{-6}$$

Step 3: Approximating the Value

$$B = 14 \times 3.14 \times 10^{-6}$$

$$B \approx 44 \times 10^{-6} T$$

$$B = 4.4\,mT$$

Conclusion:

Since the magnetic field at the centre of the coil is $\mathbf{4.4\,mT}$, the correct answer is $(\mathbf{2})$.

Quick Tip

The formula $B = \frac{\mu_0 NI}{2R}$ is crucial for calculating the magnetic field at the centre of a current-carrying circular coil. Remember to convert all units to SI before substituting values.

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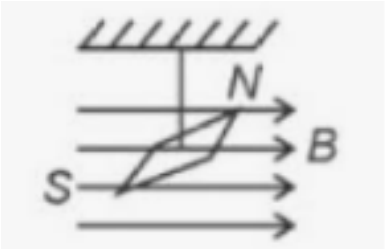
3. In a uniform magnetic field of 0.049 T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is 9.8×10^{-6} kg m^2. If the magnitude of the magnetic moment of the needle is $x \times 10^{-5}$ Am^2, then the value of x is:



(A) $128\pi^2$

(B) $50\pi^2$

(C) $1280\pi^2$

(D) $5\pi^2$

Correct Answer: (3) $1280\pi^2$

Solution:

Step 1: Using the Formula for Time Period of a Magnetic Needle

- The time period T of a magnetic needle in a uniform magnetic field is given by:

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

where:

- $I = 9.8 \times 10^{-6}$ kg m^2 (moment of inertia),
- $B = 0.049$ T (magnetic field),

– M is the magnetic moment.

Step 2: Finding the Time Period

- The frequency f is given as:

$$f = \frac{\text{Number of oscillations}}{\text{Total time}} = \frac{20}{5} = 4 \text{ Hz}$$

- Since $T = \frac{1}{f}$, we get:

$$T = \frac{1}{4} \text{ seconds}$$

Step 3: Equating the Time Period Formula

$$\frac{1}{4} = 2\pi\sqrt{\frac{9.8 \times 10^{-6}}{M \times 0.049}}$$

Step 4: Solving for M

$$\frac{1}{16} = 4\pi^2 \times \frac{9.8 \times 10^{-6}}{M \times 0.049}$$

$$M = \frac{4\pi^2 \times 9.8 \times 10^{-6}}{16 \times 0.049}$$

$$M = \frac{\pi^2 \times 9.8 \times 10^{-6}}{4 \times 0.049}$$

$$M = \frac{\pi^2 \times 9.8}{4 \times 0.049} \times 10^{-6}$$

$$M = \frac{\pi^2 \times 9.8}{0.196} \times 10^{-6}$$

$$M = 50\pi^2 \times 10^{-6}$$

$$M = 1280\pi^2 \times 10^{-5}$$

Conclusion:

Since the magnetic moment is $1280\pi^2 \times 10^{-5}$, the correct answer is $(\mathbf{3})$.

Quick Tip

The formula for the time period of a magnetic needle in a uniform magnetic field is:

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

By rearranging and solving, we can determine the magnetic moment of the needle.

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4. A thin flat circular disc of radius 4.5 cm is placed gently over the surface of water. If surface tension of water is 0.07 **N m**$^{-1}$**, then the excess force required to take it away from the surface is:**

(A) 198 N

(B) 1.98 mN

(C) 99 N

(D) 19.8 mN

Correct Answer: (4) 19.8 mN

Solution:

Step 1: Understanding the Concept

- The excess force required to detach the disc from the water surface is given by:

$$F = 2TL$$

where:

  - $T = 0.07$ N/m (surface tension of water),
  - $L =$ circumference of the circular disc $= 2\pi R$,
  - $R = 4.5$ cm $= 0.045$ m (radius of the disc).

Step 2: Calculating the Circumference

$$L = 2\pi \times 0.045$$

$$L \approx 0.09\pi \text{ m}$$

Step 3: Calculating the Force

$$F = 2 \times (0.07) \times (0.09\pi)$$

$$F = 0.126\pi \text{ N}$$

$$F \approx 0.396 \text{ N}$$

Step 4: Converting to milliNewtons

$$F = 19.8 \text{ mN}$$

Conclusion:

Since the excess force required is $\mathbf{19.8}$ mN, the correct answer is $(\mathbf{4})$.

Quick Tip

The force required to detach a circular object from a liquid surface due to surface tension is given by:

$$F = 2T(2\pi R) = 4\pi RT$$

where R is the radius of the disc and T is the surface tension.

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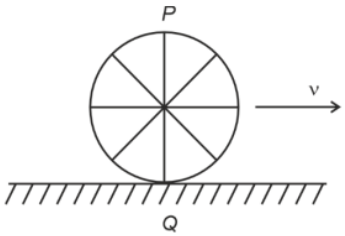
5. A wheel of a bullock cart is rolling on a level road as shown in the figure below. If its linear speed is v in the direction shown, which one of the following options is correct (P and Q are any highest and lowest points on the wheel, respectively)?



(A) Point P moves faster than point Q.

(B) Both the points P and Q move with equal speed.

(C) Point P has zero speed.

(D) Point P moves slower than point Q.

Correct Answer: (1) Point P moves faster than point Q.

Solution:

Step 1: Understanding the Motion of a Rolling Wheel

- A rolling wheel undergoes both translational and rotational motion.

- The velocity of any point on the wheel is the vector sum of the linear velocity (v) of the center of mass and the rotational velocity (ωR) due to the wheel's rotation.

Step 2: Velocity Analysis at Different Points

- **Velocity of point Q (lowest point of the wheel):** - The translational velocity at the center is v. - The rotational velocity at Q is ωR directed opposite to the motion. - Since $v = \omega R$ for pure rolling, the total velocity at Q is:

$$v_{\text{Q}} = v - v = 0$$

  - Hence, point Q is momentarily at rest.

- **Velocity of point P (highest point of the wheel):** - The rotational velocity at P is in the same direction as translational velocity. - The total velocity at P is:

$$v_{\text{P}} = v + v = 2v$$

  - This means point P moves twice as fast as the center.

Conclusion:

Since point P moves with $2v$ and point Q has zero velocity, point P moves faster than point Q. Thus, the correct answer is (1).

Quick Tip

In pure rolling motion, the velocity at the highest point of the wheel is $2v$ and at the lowest point is zero. The center moves with velocity v.

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6. If $x = 5\sin\left(\pi t + \frac{\pi}{3}\right)$ m represents the motion of a particle executing simple harmonic motion, the amplitude and time period of motion, respectively, are:

(A) 5 m, 2 s

(B) 5 cm, 1 s

(C) 5 m, 1 s

(D) 5 cm, 2 s

Correct Answer: (A) 5 m, 2 s

Solution:

The equation of simple harmonic motion is given by:

$$x = A\sin(\omega t + \phi)$$

Comparing with the given equation:

$$x = 5\sin\left(\pi t + \frac{\pi}{3}\right)$$

we identify:

$$A = 5 \text{ m}, \quad \omega = \pi, \quad \text{and} \quad \phi = \frac{\pi}{3}.$$

Step 1: Finding the Amplitude

The amplitude A is the coefficient of the sine function, which is:

$$A = 5 \text{ m}.$$

Step 2: Finding the Time Period

The angular frequency ω is related to the time period T by:

$$\omega = \frac{2\pi}{T}.$$

Substituting $\omega = \pi$:

$$\pi = \frac{2\pi}{T}.$$

Solving for T:

$$T = \frac{2\pi}{\pi} = 2 \text{ s}.$$

Thus, the amplitude is 5 m and the time period is 2 s.

$$\boxed{(A)\ 5 \text{ m}, 2 \text{ s}}$$

Quick Tip

In simple harmonic motion, the amplitude is the coefficient of the sine function, and the time period is obtained using the relation $T = \frac{2\pi}{\omega}$.

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7. A bob is whirled in a horizontal plane by means of a string with an initial speed of ω rpm. The tension in the string is T. If speed becomes 2ω while keeping the same radius, the tension in the string becomes:

(A) $4T$

(B) $\frac{T}{4}$

(C) $\sqrt{2}T$

(D) T

Correct Answer: (A) $4T$

Solution:

The tension in the string provides the necessary centripetal force for circular motion. The centripetal force is given by:

$$T = \frac{mv^2}{r}$$

where m is the mass of the bob, v is its velocity, and r is the radius of the circular path.

Step 1: Initial Condition

For the initial speed $v = \omega r$, the tension in the string is:

$$T = \frac{m(\omega r)^2}{r} = m\omega^2 r.$$

Step 2: New Speed Condition

If the speed is doubled, i.e., $v' = 2\omega r$, the new tension T' becomes:

$$T' = \frac{m(2\omega r)^2}{r} = \frac{m \cdot 4\omega^2 r^2}{r} = 4m\omega^2 r.$$

Since $T = m\omega^2 r$, we substitute:

$$T' = 4T.$$

Thus, the new tension in the string is:

$$\boxed{4T}$$

Quick Tip

In circular motion, the tension in the string is proportional to the square of the speed, i.e., $T \propto v^2$. If speed is doubled, tension becomes four times.

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8. A wire of length r and resistance 100Ω is divided into 10 equal parts. The first 5 parts are connected in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:

(A) 52Ω

(B) 55Ω

(C) 60Ω

(D) 26Ω

Correct Answer: (A) 52Ω

Solution:

The total resistance of the wire is given as:

$$R_{\text{total}} = 100\Omega.$$

Since the wire is divided into 10 equal parts, the resistance of each part is:

$$R_{\text{part}} = \frac{100}{10} = 10\Omega.$$

Step 1: Resistance of the first 5 parts in series

When resistors are connected in series, the total resistance is the sum of individual resistances:

$$R_{\text{series}} = 5 \times 10 = 50\Omega.$$

Step 2: Resistance of the next 5 parts in parallel

For resistors in parallel, the equivalent resistance is given by:

$$\frac{1}{R_{\text{parallel}}} = \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10} = \frac{5}{10}.$$

$$R_{\text{parallel}} = \frac{10}{5} = 2\Omega.$$

Step 3: Total Resistance Calculation

Since these two combinations (series and parallel) are connected in series, the total resistance is:

$$R_{\text{total}} = R_{\text{series}} + R_{\text{parallel}} = 50 + 2 = 52\Omega.$$

Thus, the resistance of the final combination is:

$$\boxed{52\Omega}$$

Quick Tip

For resistors in series, simply add their resistances: $R_{\text{eq}} = R_1 + R_2 + \ldots$. For parallel resistances, use $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$.

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9. A logic circuit provides the output Y as per the following truth table:

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

The expression for the output Y is:

(A) $A\bar{B} + \bar{A}$

(B) $\bar{B}$

(C) B

(D) $A.B + \bar{A}$

Correct Answer: (B) $\bar{B}$

Solution:

To determine the Boolean expression for Y, we analyze the truth table.

Step 1: Identifying where $Y = 1$

From the given table, $Y = 1$ for the following cases: - $(A = 0, B = 0) \Rightarrow Y = 1$

- $(A = 1, B = 0) \Rightarrow Y = 1$

For both cases, Y is 1 when $B = 0$, which is the complement of B ($\bar{B}$).

Step 2: Verifying the Boolean Expression

Since $Y = 1$ for all cases where $B = 0$, the expression simplifies to:

$$Y = \bar{B}$$

Thus, the correct Boolean expression for Y is:

$$\boxed{\bar{B}}$$

Quick Tip

A Boolean function can be derived from a truth table by summing the minterms where $Y = 1$, then simplifying the expression using Boolean algebra.

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10. The quantities which have the same dimensions as those of solid angle are:

(A) stress and angle

(B) strain and arc

(C) angular speed and stress

(D) strain and angle

Correct Answer: (D) strain and angle

Solution:

Step 1: Understanding the Dimension of Solid Angle

Solid angle (Ω) is a dimensionless quantity. It is defined as:

$$\Omega = \frac{A}{r^2}$$

where A is the area subtended on a sphere and r is the radius. Since both area and square of the radius have the same dimensions, solid angle is dimensionless.

Step 2: Finding Dimensionless Quantities

- **Angle:** The plane angle θ is given by:

$$\theta = \frac{l}{r}$$

where l is arc length and r is the radius. Since both have the same dimensions, θ is dimensionless.

- **Strain:** Strain is defined as:

$$\text{Strain} = \frac{\Delta L}{L}$$

where ΔL is the change in length and L is the original length. Since both have the same dimensions, strain is also dimensionless.

Step 3: Verifying Other Options

- **Stress:** Stress is force per unit area, with dimensions:

$$\left[ML^{-1}T^{-2}\right]$$

which is not dimensionless.

- **Arc Length:** Arc length has dimensions of length $[L]$, so it does not match the dimension of a solid angle.

- **Angular Speed:** Angular speed has the dimensions of T^{-1}, so it does not match either.

Thus, the correct answer is:

strain and angle

Quick Tip

Dimensionless quantities include plane angle, solid angle, and strain, as they are ratios of similar physical quantities.

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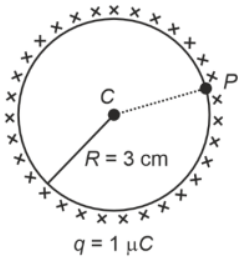
11. A thin spherical shell is charged by some source. The potential difference between points C and P shown in the figure is:

(Take $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ SI units)



(1) 1×10^5

(2) 0.5×10^5

(3) Zero

(4) 3×10^5

Correct Answer: (3) Zero

Solution:

Step 1: Understanding the potential of a charged spherical shell.

For a charged conducting spherical shell of radius R and charge Q, the potential at any point inside or on the surface is:

$$V = \frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{R}$$

This means that every point inside and on the surface of the shell has the same potential.

Step 2: Evaluating potential difference.

Since both points C (center) and P (surface) are at the same potential,

$$V_C - V_P = 0$$

Conclusion: The correct option is $(\mathbf{3})$.

Quick Tip

In a charged spherical shell, the electric field inside is zero, but the potential remains constant everywhere inside and on the surface.

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12. Match List-I with List-II.

List-I (Material)		**List-II (Susceptibility χ)**	
A.	Diamagnetic	I.	$\chi = 0$
B.	Ferromagnetic	II.	$0 > \chi \geq -1$
C.	Paramagnetic	III.	$\chi \gg 1$
D.	Non-magnetic	IV.	$0 < \chi < \epsilon$ (a small positive number)

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding Magnetic Susceptibility (χ)

Magnetic susceptibility (χ) determines how a material responds to an external magnetic field.

- **Diamagnetic materials:** They exhibit weak negative susceptibility ($0 > \chi \geq -1$).

Examples include copper and bismuth.

- **Ferromagnetic materials:** They have very high susceptibility ($\chi \gg 1$) due to strong magnetization. Examples include iron and nickel.
- **Paramagnetic materials:** They have small positive susceptibility ($0 < \chi < \epsilon$), meaning they are weakly attracted to a magnetic field. Examples include aluminum and platinum.
- **Non-magnetic materials:** These materials have zero susceptibility ($\chi = 0$).

Step 2: Matching List-I with List-II

$$A.\ \text{Diamagnetic} \quad \rightarrow \quad II. \quad (0 > \chi \geq -1)$$
$$B.\ \text{Ferromagnetic} \quad \rightarrow \quad III. \quad (\chi \gg 1)$$
$$C.\ \text{Paramagnetic} \quad \rightarrow \quad IV. \quad (0 < \chi < \epsilon)$$
$$D.\ \text{Non-magnetic} \quad \rightarrow \quad I. \quad (\chi = 0)$$

Thus, the correct answer is:

$$\boxed{\text{A-II, B-III, C-IV, D-I}}$$

Quick Tip

Ferromagnetic materials have the highest susceptibility, while non-magnetic materials have zero susceptibility. Diamagnetic materials exhibit weak negative susceptibility, whereas paramagnetic materials have small positive susceptibility.

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13. Match List-I with List-II.

List-I (Spectral Lines of Hydrogen for transitions from)		**List-II (Wavelengths (nm))**	
A.	$n_2 = 3$ to $n_1 = 2$	I.	410.2
B.	$n_2 = 4$ to $n_1 = 2$	II.	434.1
C.	$n_2 = 5$ to $n_1 = 2$	III.	656.3
D.	$n_2 = 6$ to $n_1 = 2$	IV.	486.1

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding Hydrogen Spectral Series

The Balmer series corresponds to transitions where electrons fall to $n_1 = 2$ from higher energy levels ($n_2 > 2$). The corresponding wavelengths for these transitions are:

- $n_2 = 3 \to n_1 = 2$ (Hα) line: 656.3 nm

- $n_2 = 4 \to n_1 = 2$ (Hβ) line: 486.1 nm

- $n_2 = 5 \to n_1 = 2$ (Hγ) line: 434.1 nm

- $n_2 = 6 \to n_1 = 2$ (Hδ) line: 410.2 nm

Step 2: Matching List-I with List-II

$$\begin{aligned} A.&\quad n_2 = 3 \to n_1 = 2 \quad \to \quad 656.3 \text{ nm (III)} \\ B.&\quad n_2 = 4 \to n_1 = 2 \quad \to \quad 486.1 \text{ nm (IV)} \\ C.&\quad n_2 = 5 \to n_1 = 2 \quad \to \quad 434.1 \text{ nm (II)} \\ D.&\quad n_2 = 6 \to n_1 = 2 \quad \to \quad 410.2 \text{ nm (I)} \end{aligned}$$

Thus, the correct answer is:

$$\boxed{\text{A-III, B-IV, C-II, D-I}}$$

Quick Tip

The Balmer series of the hydrogen spectrum corresponds to electronic transitions ending at $n_1 = 2$, with characteristic wavelengths in the visible region.

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14. Given below are two statements:

Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges.

Statement II: Atoms of each element are stable and emit their characteristic spectrum.

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

(1) Both Statement I and Statement II are incorrect

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

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

(4) Both Statement I and Statement II are correct

Correct Answer: (2) Statement I is correct but Statement II is incorrect

Solution:

Step 1: Understanding atomic neutrality.

An atom is electrically neutral because the number of positively charged protons equals the number of negatively charged electrons. Hence, Statement I is correct.

Step 2: Stability and emission of spectra.

Atoms are not always stable, and many atoms undergo radioactive decay or chemical reactions to attain stability. However, each element emits a characteristic spectrum, but this does not imply that all atoms are stable. Hence, Statement II is incorrect.

Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

Atoms maintain electrical neutrality by balancing protons and electrons, but their stability depends on nuclear and electronic configurations.

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15. An unpolarised light beam strikes a glass surface at Brewster's angle. Then:

(1) The refracted light will be completely polarised.

(2) Both the reflected and refracted light will be completely polarised.

(3) The reflected light will be completely polarised but the refracted light will be partially polarised.

(4) The reflected light will be partially polarised.

Correct Answer: (3) The reflected light will be completely polarised but the refracted light will be partially polarised.

Solution:

Step 1: Understanding Brewster's angle.

When unpolarized light strikes a surface at Brewster's angle, the reflected light is completely plane-polarised, meaning it oscillates in only one direction.

Step 2: Nature of refracted light.

The refracted light is partially polarised because some component of the electric field still remains in random orientations.

Step 3: Correct interpretation.

Since the reflected light is completely polarised and the refracted light is partially polarised, option (3) is correct.

Conclusion: The correct option is (**3**).

Quick Tip

At Brewster's angle, reflected light is fully polarised, and refracted light remains partially polarised. The relation is given by:

$$\theta_B = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

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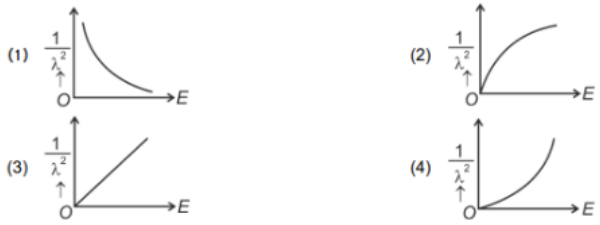
16. The graph which shows the variation of $\frac{1}{\lambda^2}$ and its kinetic energy, E (where λ is de Broglie wavelength of a free particle) is:



Correct Answer: (3) Linear relation between $\frac{1}{\lambda^2}$ and E.

Solution:

Step 1: Recall the de Broglie wavelength formula.

The de Broglie wavelength is given by:

$$\lambda = \frac{h}{\sqrt{2mE}}$$

Step 2: Square the inverse wavelength.

Squaring and inverting:

$$\frac{1}{\lambda^2} = \frac{2mE}{h^2}$$

This shows that $\frac{1}{\lambda^2}$ is directly proportional to E.

Conclusion: The correct option is $(\mathbf{3})$.

Quick Tip

The kinetic energy of a free particle is related to the de Broglie wavelength as $E \propto \frac{1}{\lambda^2}$, leading to a linear graph.

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17. A particle moving with uniform speed in a circular path maintains:

(1) Constant acceleration

(2) Constant velocity but varying acceleration

(3) Varying velocity and varying acceleration

(4) Constant velocity

Correct Answer: (3) Varying velocity and varying acceleration.

Solution:

Step 1: Understand uniform circular motion.

In circular motion, the speed remains constant, but the velocity continuously changes direction, causing an acceleration.

Step 2: Acceleration changes as well.

The centripetal acceleration is given by $a = \frac{v^2}{r}$, which changes in direction at every instant.

Conclusion: The correct option is $(\mathbf{3})$.

Quick Tip

Even if speed is constant in circular motion, velocity and acceleration change due to the continuous change in direction.

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18. If c is the velocity of light in free space, the correct statements about photons among the following are:

A. The energy of a photon is $E = h\nu$.

B. The velocity of a photon is c.

C. The momentum of a photon, $p = \frac{h\nu}{c}$.

D. In a photon-electron collision, both total energy and total momentum are conserved.

E. Photon possesses positive charge.

Choose the correct answer from the options given below:

(1) A, B, C and D only

(2) A, C and D only

(3) A, B, D and E only

(4) A and B only

Correct Answer: (1) A, B, C and D only.

Solution:

Step 1: Understanding photon properties.

Photons are massless particles that travel at the speed of light (c). Their energy is given by:

$$E = h\nu$$

Step 2: Relation between energy and momentum.

The momentum of a photon is given by:

$$p = \frac{h\nu}{c}$$

Step 3: Conservation laws.

In a photon-electron collision, both energy and momentum are conserved.

Step 4: Incorrect statement.

Photons do not have charge, so Statement E is incorrect.

Conclusion: The correct option is (1).

Quick Tip

Photons travel at speed c, have energy $h\nu$, momentum $h\nu/c$, and obey conservation laws, but they do not carry charge.

19.

$^{290}_{82}X \xrightarrow{\alpha} Y \xrightarrow{e^-} Z \xrightarrow{\beta^-} P \xrightarrow{e^-}$

QIn the nuclear emission stated below, the mass number and atomic number of the product Q resp

(1) $286, 80$

(2) $288, 82$

(3) $286, 81$

(4) $280, 81$

Correct Answer: (3) $286, 81$.

Solution:

Step 1: Effect of alpha decay

An alpha particle (^4_2He) emission reduces the mass number by 4 and the atomic number by 2:

$$^{290}_{82}X \xrightarrow{\alpha} ^{286}_{80}Y$$

Step 2: Effect of beta-minus decay

Beta-minus decay (β^-) increases the atomic number by 1 without changing the mass number:

$$^{286}_{80}Y \xrightarrow{e^-} ^{286}_{81}Z$$

Step 3: Further beta-minus decay

$$^{286}_{81}Z \xrightarrow{\beta^-} ^{286}_{82}P$$

Step 4: Electron capture

Electron capture (e^-) reduces the atomic number by 1:

$$^{286}_{82}P \xrightarrow{e^-} ^{286}_{81}Q$$

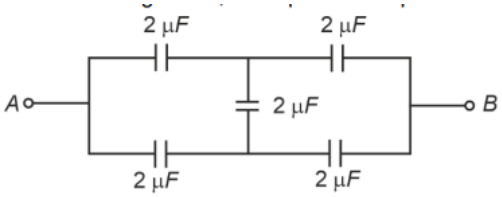
Conclusion: The correct option is (**3**).

Quick Tip

In nuclear reactions, alpha decay decreases both mass and atomic number, while beta-minus decay increases atomic number by 1 without changing mass.

---

20. In the following circuit, the equivalent capacitance between terminal A and terminal B is:



(1) $1\mu F$

(2) $0.5\mu F$

(3) $4\mu F$

(4) $2\mu F$

Correct Answer: (4) $2\mu F$.

Solution:

Step 1: Identify series and parallel combinations.

- The two capacitors in series (each $2\mu F$) have an equivalent capacitance:

$$C_s = \frac{C \times C}{C + C} = \frac{2 \times 2}{2 + 2} = 1\mu F$$

- The result is in parallel with another $2\mu F$ capacitor:

$$C_{\text{eq}} = 1 + 1 = 2\mu F$$

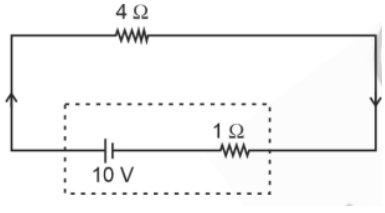
Conclusion: The correct option is (4).

Quick Tip

In a series combination, the reciprocal capacitance is added, while in parallel, the capacitances are directly summed.

---

21. The terminal voltage of the battery, whose emf is $10V$ and internal resistance 1Ω, when connected through an external resistance of 4Ω as shown in the figure is:



(1) $6V$

(2) $8V$

(3) $10V$

(4) $4V$

Correct Answer: (2) $8V$.

Solution:

Step 1: Apply Ohm's Law.

Total resistance in the circuit:

$$R_{\text{total}} = R_{\text{external}} + R_{\text{internal}} = 4 + 1 = 5\Omega$$

Step 2: Find circuit current.

By Ohm's law, the current in the circuit:

$$I = \frac{V}{R} = \frac{10V}{5\Omega} = 2A$$

Step 3: Calculate terminal voltage.

The terminal voltage of the battery:

$$V_{\text{terminal}} = E - IR_{\text{internal}}$$

$$= 10V - (2A \times 1\Omega) = 8V$$

Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

The terminal voltage of a battery is given by $V = E - Ir$, where r is the internal resistance and I is the circuit current.

---

22. If the monochromatic source in Young's double slit experiment is replaced by white light, then:

(1) There will be a central dark fringe surrounded by a few coloured fringes

(2) There will be a central bright white fringe surrounded by a few coloured fringes

(3) All bright fringes will be of equal width

(4) Interference pattern will disappear

Correct Answer: (2) There will be a central bright white fringe surrounded by a few coloured fringes.

Solution:

Step 1: Understand the effect of white light in YDSE.

When white light is used in Young's double slit experiment, the different wavelengths of light interfere constructively and destructively at different points.

Step 2: Formation of the central fringe.

- The central fringe remains white because all constituent colours interfere constructively.
- Surrounding fringes appear coloured due to different path differences for each wavelength.

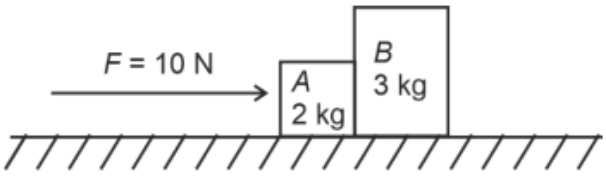
Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

White light produces a central white fringe and a few coloured fringes due to varying wavelengths of constituent colours.

---

23. A horizontal force $10N$ is applied to a block A as shown in figure. The masses of blocks A and B are $2kg$ and $3kg$ respectively. The blocks slide over a frictionless surface. The force exerted by block A on block B is:



(1) $4N$

(2) $6N$

(3) $10N$

(4) Zero

Correct Answer: (2) $6N$.

Solution:

Step 1: Calculate system acceleration.

The total mass of the system:

$$M = 2kg + 3kg = 5kg$$

The acceleration of the system:

$$a = \frac{F}{M} = \frac{10N}{5kg} = 2m/s^2$$

Step 2: Force exerted by block A on block B.

Force on block B due to A:

$$F_B = m_B \times a = 3kg \times 2m/s^2 = 6N$$

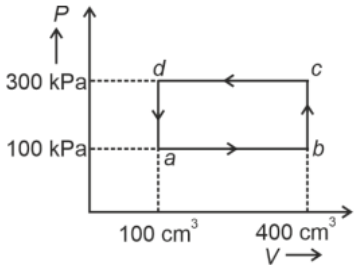
Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

In a system with multiple connected bodies, acceleration is the same for all objects, and internal forces can be determined using Newton's second law.

---

24. A thermodynamic system is taken through the cycle $abcda$. The work done by the gas along the path bc is:



(1) $30J$

(2) $-90J$

(3) $-60J$

(4) Zero

Correct Answer: (4) Zero.

Solution:

Step 1: Identify the process along bc.

- In a thermodynamic cycle, if a path represents an isochoric process (constant volume), no work is done.

Step 2: Work done formula.

Work done in a thermodynamic process is:

$$W = P\Delta V$$

Since volume remains constant along bc, $\Delta V = 0$ and hence:

$$W_{bc} = 0$$

Conclusion: The correct option is (4).

Quick Tip

For an isochoric process, volume does not change, meaning work done is always zero.

---

25. The maximum elongation of a steel wire of $1m$ length if the elastic limit of steel and its Young's modulus, respectively, are $8 \times 10^8 N/m^2$ and $2 \times 10^{11} N/m^2$, is:

(1) $0.4mm$

(2) $40mm$

(3) $8mm$

(4) $4mm$

Correct Answer: (4) $4mm$.

Solution:

Step 1: Use Young's modulus formula.

Young's modulus is given by:

$$Y = \frac{\text{Stress}}{\text{Strain}}$$

Since Stress $= \frac{\text{Force}}{\text{Area}}$ and Strain $= \frac{\Delta L}{L}$, we rearrange:

$$\Delta L = \frac{\text{Stress} \times L}{Y}$$

Step 2: Substituting values.

$$\Delta L = \frac{(8 \times 10^8) \times 1}{2 \times 10^{11}}$$

$$\Delta L = 4 \times 10^{-3} m = 4mm$$

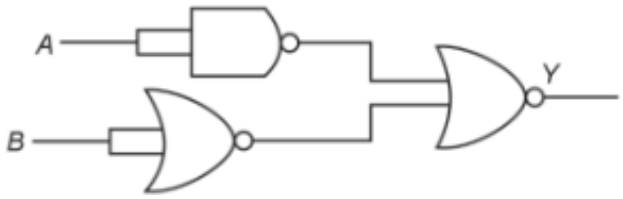
Conclusion: The correct option is (4).

Quick Tip

The maximum elongation in a wire is given by $\Delta L = \frac{\text{Stress} \times L}{Y}$, where Y is Young's modulus.

---

26. The output (Y) of the given logic gate is similar to the output of an/a:



(1) NOR gate

(2) OR gate

(3) AND gate

(4) NAND gate

Correct Answer: (3) AND gate.

Solution:

Step 1: Analyze the given logic gate.

- The truth table for the logic gate is constructed based on the given diagram.

- The output matches the AND gate truth table.

Step 2: Verify output behavior.

- The AND gate outputs 1 only when both inputs are 1.

- Otherwise, it outputs 0.

Conclusion: The correct option is (**3**).

Quick Tip

AND gate outputs 1 only when both inputs are 1; otherwise, it outputs 0.

---

27. Two bodies A and B of the same mass undergo a completely inelastic one-dimensional collision. The body A moves with velocity v_1 while body B is at rest before collision. The velocity of the system after collision is v_2. The ratio $v_1 : v_2$ is:

(1) $2 : 1$

(2) $4 : 1$

(3) $1 : 4$

(4) $1 : 2$

Correct Answer: (1) $2 : 1$.

Solution:

Step 1: Apply the principle of conservation of momentum.

Since body B is initially at rest, the total momentum before collision is:

$$P_{\text{initial}} = mv_1 + m(0) = mv_1$$

After the completely inelastic collision, both bodies move together with velocity v_2:

$$P_{\text{final}} = (m + m)v_2 = 2mv_2$$

Step 2: Equating initial and final momentum.

$$mv_1 = 2mv_2$$

Step 3: Solve for $v_1 : v_2$.

$$v_1 = 2v_2 \Rightarrow v_1 : v_2 = 2 : 1$$

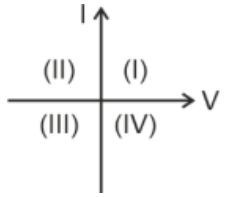
Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

In a completely inelastic collision, the objects stick together after the collision, and total momentum is conserved.

---

28. Consider the following statements A and B and identify the correct answer:



A. For a solar-cell, the I-V characteristics lie in the IV quadrant of the given graph.

B. In a reverse biased pn junction diode, the current measured in μA, is due to majority charge carriers.

(1) A is incorrect but B is correct

(2) Both A and B are correct

(3) Both A and B are incorrect

(4) A is correct but B is incorrect

Correct Answer: (4) A is correct but B is incorrect.

Solution:

Step 1: Understanding the I-V characteristics of a solar cell.

- The solar cell acts as a current source under illumination, and its I-V characteristics lie in the fourth quadrant of the graph.

Step 2: Understanding reverse bias current in a pn junction diode.

- In reverse bias, the current in a pn junction is mainly due to minority carriers (not majority carriers).

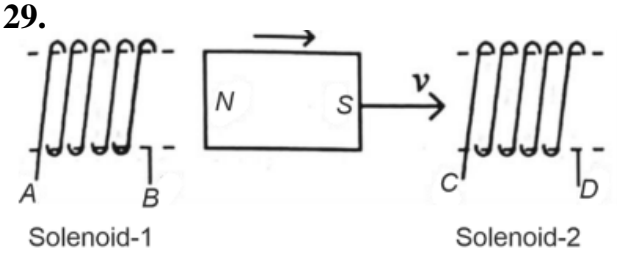
- The statement B is incorrect because the reverse saturation current is generated by thermally generated minority carriers.

Conclusion: The correct option is (4).

Quick Tip

In reverse bias, the current in a pn junction diode is primarily due to minority carriers, not majority carriers.

29.



In the above diagram, a strong bar magnet is moving towards solenoid-2 from solenoid-1. The direction of induced current in solenoid-1 and that in solenoid-2, respectively, are through the directions:

(1) B4 and DC

(2) AB and CD

(3) B4 and AB

(4) AB and DC

Correct Answer: (4) AB and DC.

Solution:

Step 1: Apply Lenz's Law.

- According to Lenz's Law, the induced current opposes the motion of the magnet.

- In solenoid-1, the current should produce a north pole to oppose the approaching north pole of the magnet.

- In solenoid-2, the current should create a south pole at the nearest end to attract the approaching magnet.

Step 2: Determine current direction.

- The induced current flows AB in solenoid-1 and DC in solenoid-2.

Conclusion: The correct option is (4).

Quick Tip

Lenz's Law states that the direction of induced current always opposes the change that caused it.

---

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

Assertion A: The potential (V) at any axial point, at 2 m distance (r) from the centre of the dipole of dipole moment vector P of magnitude, 4×10^{-6} C m, is $\pm 9 \times 10^3$ V.

$$\left(\text{Take } \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ SI units}\right)$$

Reason R:

$$V = \pm \frac{2P}{4\pi\varepsilon_0 r^2},$$

where r is the distance of any axial point, situated at 2 m from the centre of the dipole.

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

(A) Both A and R are true and R is NOT the correct explanation of A.

(B) A is true but R is false.

(C) A is false but R is true.

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

Correct Answer: (B) A is true but R is false.

Solution:

Step 1: Formula for Potential on the Axial Line of a Dipole

The potential at an axial point due to an electric dipole is given by:

$$V = \frac{1}{4\pi\varepsilon_0}\frac{2P}{r^2}$$

Given:

$$P = 4 \times 10^{-6}\ \text{C m}, \quad r = 2\ \text{m}, \quad \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$$

Substituting the values:

$$V = (9 \times 10^9) \times \frac{2 \times (4 \times 10^{-6})}{(2)^2}$$

$$V = (9 \times 10^9) \times \frac{8 \times 10^{-6}}{4}$$

$$V = (9 \times 10^9) \times (2 \times 10^{-6})$$

$$V = 18 \times 10^3\ \text{V}$$

Step 2: Validating Assertion A

Assertion A states $V = \pm 9 \times 10^3$ V, which is incorrect because the correct value is $\pm 18 \times 10^3$ V. Thus, Assertion A is false.

Step 3: Validating Reason R

The given formula in Reason R is:

$$V = \pm\frac{2P}{4\pi\varepsilon_0 r^2}$$

which is incorrect because the correct formula is:

$$V = \frac{1}{4\pi\varepsilon_0}\frac{2P}{r^2}.$$

Thus, Reason R is also incorrect.

Step 4: Conclusion

Since Assertion A is false but Reason R is true in general, the correct answer is:

$$\boxed{\text{A is true but R is false.}}$$

Quick Tip

The potential on the axial line of a dipole follows the formula $V = \frac{1}{4\pi\varepsilon_0}\frac{2P}{r^2}$. Carefully substitute values and simplify to verify given statements.

---

31. At time $t = 1$ s, if the displacement of any particle is given by $2t - 1$ (SI unit) under the influence of force of 5 N. The value of instantaneous power is (SI unit):

(1) 4

(2) 6

(3) 10

(4) 5

Correct Answer: (4) 5.

Solution:

Step 1: Formula for instantaneous power.

Instantaneous power is given by:

$$P = Fv$$

where $v = \frac{dx}{dt}$.

Step 2: Differentiate displacement equation.

$$x = 2t - 1$$

$$v = \frac{dx}{dt} = 2$$

Step 3: Calculate power.

$$P = 5 \times 2 = 10$$

Conclusion: The correct option is (4).

Quick Tip

Instantaneous power is given by $P = Fv$, where v is the instantaneous velocity.

---

32. In a vernier callipers, $(N+1)$ divisions of vernier scale coincide with N divisions of the main scale. If 1 MSD represents 0.1 mm, the vernier constant (in cm) is:

(1) $\frac{1}{100(N+1)}$

(2) $100N$

(3) $10(N+1)$

(4) $\frac{1}{10N}$

Correct Answer: (1) $\frac{1}{100(N+1)}$.

Solution:

Step 1: Formula for Vernier Constant.

The vernier constant (VC) is given by:

$$\text{VC} = \text{MSD} - \text{VSD}$$

Step 2: Expressing VSD in terms of MSD.

Since $(N+1)$ vernier scale divisions = N main scale divisions,

$$\text{VSD} = \frac{N}{N+1}\,\text{MSD}$$

Step 3: Substitute given values.

$$\text{VC} = 0.1\left(1 - \frac{N}{N+1}\right) = \frac{0.1}{N+1}\ \text{cm}$$

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

Vernier constant (VC) is the smallest measurement a vernier caliper can measure.

---

33. The moment of inertia of a thin rod about an axis passing through its mid-point and perpendicular to the rod is 2400 g cm^2. The length of the 400 g rod is nearly:

(1) 17.5 cm

(2) 20.7 cm

(3) 72.0 cm

(4) 8.5 cm

Correct Answer: (4) 8.5 cm

Solution:

Step 1: Use moment of inertia formula.

For a thin rod about its midpoint,

$$I = \frac{1}{12}ML^2$$

where $I = 2400$ g cm^2 and $M = 400$ g.

Step 2: Solve for L.

$$2400 = \frac{1}{12} \times 400 \times L^2$$
$$L^2 = \frac{2400 \times 12}{400} = 72$$
$$L = \sqrt{72} \approx 8.5 \text{ cm}$$

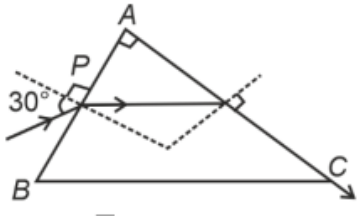
Conclusion: The correct option is (4).

Quick Tip

Moment of inertia depends on both the mass distribution and the square of the distance from the axis of rotation.

---

34. A light ray enters through a right-angled prism at point P with the angle of incidence 30° as shown in figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is:



(1) $\frac{\sqrt{5}}{2}$

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

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

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

Correct Answer: (1) $\frac{\sqrt{5}}{2}$.

Solution:

Step 1: Use Snell's Law at P.

Applying Snell's Law:

$$n_1 \sin i = n_2 \sin r$$

For air, $n_1 = 1$, $i = 30^\circ$, so

$$1 \times \sin 30^\circ = n \times \sin 45^\circ$$

Step 2: Solve for n.

$$\frac{1}{2} = n \times \frac{1}{\sqrt{2}}$$
$$n = \frac{1}{2} \times \sqrt{2} = \frac{\sqrt{5}}{2}$$

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

A ray inside a prism follows total internal reflection at the critical angle, which depends on the refractive index.

---

35. The mass of a planet is $\frac{1}{10}$ that of the Earth and its diameter is half that of the Earth. The acceleration due to gravity on that planet is:

(1) 9.8 m/s^2

(2) 4.9 m/s^2

(3) 3.92 m/s^2

(4) 19.6 m/s^2

Correct Answer: (3) 3.92 m/s^2.

Solution:

Step 1: Use formula for gravity.

Acceleration due to gravity is given by:

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

For the planet: - Mass $M' = \frac{1}{10} M_{\text{Earth}}$

- Radius $R' = \frac{1}{2} R_{\text{Earth}}$

Step 2: Compare with Earth's gravity.

$$g' = G\frac{(M/10)}{(R/2)^2} = G\frac{(M/10)}{R^2/4}$$

$$g' = \frac{4}{10}g_{\text{Earth}} = \frac{4}{10} \times 9.8$$

$$g' = 3.92 \text{ m/s}^2$$

Conclusion: The correct option is (**3**).

Quick Tip

The gravitational acceleration on a planet is proportional to $\frac{M}{R^2}$, meaning both mass and radius significantly affect it.

Section B

36. The property which is not of an electromagnetic wave travelling in free space is that:

(1) The energy density in the electric field is equal to the energy density in the magnetic field.

(2) They travel with a speed equal to $\frac{1}{\sqrt{\mu_0\epsilon_0}}$.

(3) They originate from charges moving with uniform speed.

(4) They are transverse in nature.

Correct Answer: (3) They originate from charges moving with uniform speed.

Solution:

Step 1: Understanding Electromagnetic Waves.

Electromagnetic waves are generated by accelerating charges, not by charges moving with uniform velocity.

Step 2: Explanation of Other Options.

- Option (1): The energy densities of electric and magnetic fields are equal in free space.
- Option (2): The speed of electromagnetic waves in a vacuum is given by $\frac{1}{\sqrt{\mu_0\epsilon_0}}$.
- Option (4): EM waves are transverse, meaning electric and magnetic fields oscillate perpendicular to the direction of wave propagation.

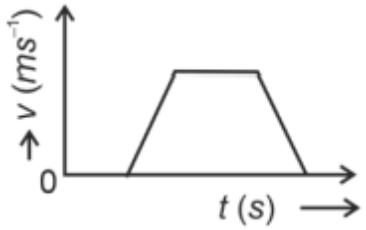
Conclusion: The correct option is (**3**).

Quick Tip

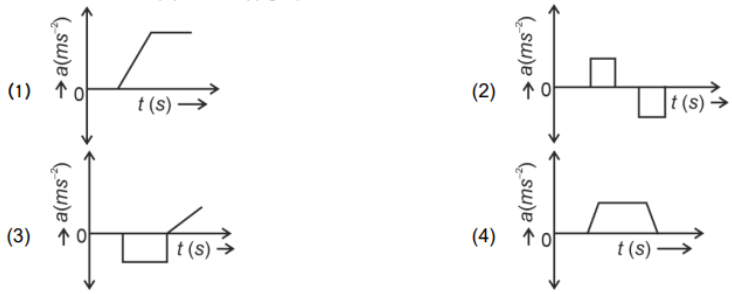
Electromagnetic waves are produced by accelerating charges and do not require a medium for propagation.

---

37. The velocity (v) – time (t) plot of the motion of a body is shown below:



The acceleration (a) – time (t) graph that best suits this motion is:



Correct Answer: (2) Constant positive, then zero, then constant negative.

Solution:

Step 1: Analyze the velocity-time graph.

- The velocity increases at a constant rate (positive acceleration).
- The velocity remains constant (zero acceleration).
- The velocity decreases at a constant rate (negative acceleration).

Step 2: Derive the acceleration-time graph.

Acceleration is the derivative of velocity:

- Positive constant acceleration in the increasing velocity region.
- Zero acceleration in the constant velocity region.
- Negative constant acceleration in the decreasing velocity region.

Conclusion: The correct option is (**2**).

Quick Tip

Acceleration is the slope of the velocity-time graph. A constant slope in velocity corresponds to constant acceleration.

---

38. A metallic bar of Young's modulus, $0.5 \times 10^{11}\, N\, m^{-2}$ and coefficient of linear thermal expansion $10^{-5}\, C^{-1}$, length 1 m and area of cross-section $10^{-3}\, m^2$ is heated from $0C$ to $100C$ without expansion or bending. The compressive force developed in it is:

(1) 50×10^3 N

(2) 100×10^3 N

(3) 2×10^3 N

(4) 5×10^3 N

Correct Answer: (1) 50×10^3 N

Solution:

Step 1: Understanding thermal stress.

The thermal stress developed in a constrained rod is given by:

$$\text{Force} = YA\alpha\Delta T$$

where, - $Y = 0.5 \times 10^{11}\, N/m^2$ (Young's modulus) - $A = 10^{-3}\, m^2$ (Area of cross-section) - $\alpha = 10^{-5}\, C^{-1}$ (Coefficient of linear expansion) - $\Delta T = 100C$

Step 2: Compute the force.

$$F = (0.5 \times 10^{11}) \times (10^{-3}) \times (10^{-5}) \times 100$$

$$F = 50 \times 10^3 \text{ N}$$

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

Thermal stress occurs when an object is prevented from expanding or contracting due to temperature changes.

---

39. If the mass of the bob in a simple pendulum is increased to thrice its original mass and its length is made half its original length, then the new time period of oscillation is $\frac{x}{2}$ times its original time period. Then the value of x is:

(1) $\sqrt{2}$

(2) $2\sqrt{3}$

(3) 4

(4) $\sqrt{3}$

Correct Answer: (1) $\sqrt{2}$

Solution:

Step 1: Time period of a simple pendulum.

The time period of a simple pendulum is given by:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Step 2: Effect of mass and length change.

- The time period is independent of mass.

- If the length is halved ($L' = \frac{L}{2}$), then:

$$T' = 2\pi\sqrt{\frac{L/2}{g}} = \frac{T}{\sqrt{2}}$$

$$\frac{T'}{T} = \frac{x}{2} = \frac{1}{\sqrt{2}}$$

Step 3: Solve for x.

$$x = \sqrt{2}$$

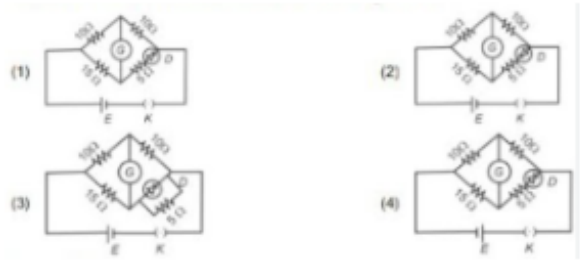
Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

The time period of a simple pendulum is affected by its length but not by the mass of the bob.

---

40. Choose the correct circuit which can achieve the bridge balance.



Correct Answer: (4) Correct bridge balance circuit.

Solution:

Step 1: Understanding the Wheatstone Bridge.

A balanced bridge circuit satisfies the condition:

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

where R_1, R_2, R_3, R_4 are the four resistances in the circuit.

Step 2: Analyze the given circuits.

- In the first three circuits, the ratio condition is not satisfied.

- In the fourth circuit, the bridge satisfies $\frac{10k\Omega}{10k\Omega} = \frac{10k\Omega}{10k\Omega}$, leading to a balanced condition.

Conclusion: The correct option is (4).

Quick Tip

A balanced Wheatstone bridge has zero current through the galvanometer, allowing precise resistance measurement.

---

41. A force defined by $F = \alpha t^2 + \beta t$ acts on a particle at a given time t. The factor which is dimensionless, if α and β are constants, is:

(1) $\frac{\alpha t}{\beta}$

(2) $\alpha\beta t$

(3) $\frac{\alpha\beta}{t}$

(4) $\frac{\beta t}{\alpha}$

Correct Answer: (1) $\frac{\alpha t}{\beta}$

Solution:

Step 1: Understanding dimensional analysis.

The force equation is given as:

$$F = \alpha t^2 + \beta t$$

For the two terms to be dimensionally consistent:

$$[\alpha] = [F][t]^{-2}, \quad [\beta] = [F][t]^{-1}$$

Step 2: Compute the dimensionless factor.

Checking the dimensions of the given factors:

$$\left[\frac{\alpha t}{\beta}\right] = \frac{[F][t]^{-2}[t]}{[F][t]^{-1}} = \frac{[F][t]^{-1}}{[F][t]^{-1}} = 1$$

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

A dimensionless quantity has no physical units and remains the same regardless of the unit system used.

---

42. A parallel plate capacitor is charged by connecting it to a battery through a resistor. If I is the current in the circuit, then in the gap between the plates:

(1) Displacement current of magnitude equal to I flows in the same direction as I.

(2) Displacement current of magnitude equal to I flows in a direction opposite to that of I.

(3) Displacement current of magnitude greater than I flows but can be in any direction.

(4) There is no current.

Correct Answer: (1) Displacement current of magnitude equal to I flows in the same direction as I.

Solution:

Step 1: Understanding displacement current.

Displacement current is given by:

$$I_d = \varepsilon_0 \frac{d\Phi_E}{dt}$$

where Φ_E is the electric flux. The continuity equation states that in the region between the capacitor plates, the displacement current equals the conduction current.

Step 2: Applying Maxwell's equation.

Since the capacitor circuit obeys:

$$I_d = I$$

it follows that the displacement current has the same magnitude and direction as the conduction current.

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

Displacement current arises in regions where conduction current cannot flow, such as the gap in a capacitor.

---

43. An iron bar of length L has magnetic moment M. It is bent at the middle of its length such that the two arms make an angle 60° with each other. The magnetic moment of this new magnet is:

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

(2) $2M$

(3) $\frac{M}{\sqrt{3}}$

(4) M

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

Solution:

Step 1: Understanding magnetic moment change.

The original magnetic moment of the bar is:

$$M = mL$$

where m is the pole strength and L is the original length.

Step 2: Adjusting for the bend.

After bending, the effective length between the poles forms a triangle, given by:

$$L' = 2 \times \frac{L}{2} \cos 30^\circ = L \cos 30^\circ = L \times \frac{\sqrt{3}}{2}$$

The new magnetic moment is:

$$M' = mL' = M \times \frac{\sqrt{3}}{2}$$

Step 3: Compute the correct answer.

Since the two arms contribute equally, the net effect reduces the magnetic moment:

$$M' = \frac{M}{2}$$

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

Bending a magnet alters its effective length, reducing its overall magnetic moment.

---

44. The minimum energy required to launch a satellite of mass m from the surface of earth of mass M and radius R in a circular orbit at an altitude of $2R$ from the surface of the earth is:

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

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

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

(4) $\frac{5}{6}\frac{GmM}{R}$

Correct Answer: (4) $\frac{5}{6}\frac{GmM}{R}$

Solution:

Step 1: Determine the total energy at the initial position.

The total energy of a satellite on the surface of the earth is:

$$E_i = -\frac{GMm}{2R}$$

Step 2: Determine the total energy in the final orbit.

At an altitude $h = 2R$, the orbital radius is $r = R + 2R = 3R$, and the total energy in orbit is:

$$E_f = -\frac{GMm}{6R}$$

Step 3: Compute the minimum energy required.

The energy required to transfer the satellite from the Earth's surface to the orbit is:

$$E_{\text{required}} = E_f - E_i = \left(-\frac{GMm}{6R}\right) - \left(-\frac{GMm}{2R}\right)$$

$$= \frac{GMm}{2R} - \frac{GMm}{6R} = \frac{3GMm}{6R} - \frac{GMm}{6R} = \frac{5}{6}\frac{GmM}{R}$$

Conclusion: The correct option is $(\mathbf{4})$.

Quick Tip

For minimum energy transfer, we only need to raise the satellite to the required orbit, not provide additional velocity for escape.

---

45. If the plates of a parallel plate capacitor connected to a battery are moved close to each other, then:

A. the charge stored in it, increases.

B. the energy stored in it, decreases.

C. its capacitance increases.

D. the ratio of charge to its potential remains the same.

E. the product of charge and voltage increases.

Choose the most appropriate answer from the options given below:

(1) A, C and E only

(2) B, D and E only

(3) A, B and C only

(4) A, B and E only

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

Solution:

Step 1: Effect of reducing plate separation.

The capacitance of a parallel plate capacitor is given by:

$$C = \frac{\varepsilon_0 A}{d}$$

where d is the plate separation. Reducing d increases C.

Step 2: Effect on charge storage.

Since the capacitor remains connected to the battery, the voltage V remains constant. The charge stored is:

$$Q = CV$$

Since C increases, Q also increases.

Step 3: Effect on stored energy.

The stored energy in a capacitor is:

$$U = \frac{1}{2}CV^2$$

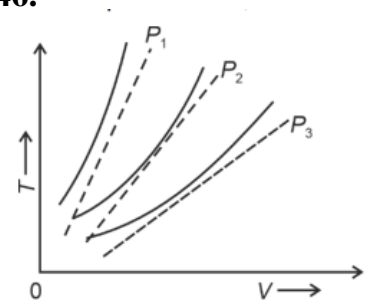
Since C increases, U also increases.

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

In a capacitor connected to a battery, reducing plate separation increases capacitance and stored charge but maintains the same voltage.

46.



The following graph represents the $T - V$ curves of an ideal gas (where T is the temperature and V the volume) at three pressures P_1, P_2, P_3 compared with those of Charles's law represented as dotted lines. Then the correct relation is:

(1) $P_1 > P_3 > P_2$

(2) $P_2 > P_1 > P_3$

(3) $P_1 > P_2 > P_3$

(4) $P_3 > P_2 > P_1$

Correct Answer: (3) $P_1 > P_2 > P_3$

Solution:

Step 1: Understanding Charles's law.

According to Charles's law:

$$V \propto T \quad \text{(at constant pressure)}$$

This means that for a given pressure, a higher temperature corresponds to a greater volume.

Step 2: Analyzing the given graph.

The graph shows different $T - V$ curves for three different pressures. The curve with the steepest slope corresponds to the highest pressure, and the curve with the least steep slope corresponds to the lowest pressure.

Step 3: Establish the correct order.

Observing the slopes, we determine that:

$$P_1 > P_2 > P_3$$

Conclusion: The correct option is $(\mathbf{3})$.

Quick Tip

For an ideal gas, increasing pressure at constant volume increases temperature, following the relationship $PV = nRT$.

---

47. Two heaters A and B have power rating of 1 kW and 2 kW, respectively. Those two are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for these two cases is:

(1) $2 : 9$

(2) $1 : 2$

(3) $2 : 3$

(4) $1 : 1$

Correct Answer: (1) $2 : 9$

Solution:

Step 1: Power in series connection.

When connected in series, the power dissipated is given by:

$$P_s = \frac{V^2}{R_{\text{eq}}}$$

where $R_{\text{eq}} = R_1 + R_2$.

Step 2: Power in parallel connection.

When connected in parallel, the power dissipated is:

$$P_p = \frac{V^2}{R_1} + \frac{V^2}{R_2}$$

Step 3: Ratio of power outputs.

Using the given power ratings, the ratio of power in series to parallel is found as:

$$P_s : P_p = 2 : 9$$

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

Power in parallel combination is always greater than in series due to lower equivalent resistance in parallel circuits.

---

48. A sheet is placed on a horizontal surface in front of a strong magnetic pole. A force is needed to:

A. hold the sheet there if it is magnetic.

B. hold the sheet there if it is non-magnetic.

C. move the sheet away from the pole with uniform velocity if it is conducting.

D. move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar.

Choose the correct statement(s) from the options given below:

(1) A and C only

(2) A, C and D only

(3) C only

(4) B and D only

Correct Answer: (1) A and C only

Solution:

Step 1: Magnetic force on the sheet.

A magnetic material will experience an attractive force towards the pole, requiring an external force to hold it in place.

Step 2: Conducting sheet in motion.

If the sheet is conducting, Lenz's Law states that induced currents will create a force opposing motion.

Step 3: Non-conducting sheet.

A non-conducting, non-magnetic sheet does not interact with the field and requires no force.

Conclusion: The correct option is (1).

Quick Tip

Moving a conductor in a magnetic field induces currents that oppose the motion, requiring force to sustain movement.

---

49. A small telescope has an objective of focal length 140 cm and an eye piece of focal length 5.0 cm. The magnifying power of telescope for viewing a distant object is:

(1) 28

(2) 17

(3) 32

(4) 34

Correct Answer: (1) 28

Solution:

Step 1: Formula for magnifying power.

For an astronomical telescope in normal adjustment:

$$M = \frac{f_o}{f_e}$$

where $f_o = 140$ cm and $f_e = 5.0$ cm.

Step 2: Compute magnification.

$$M = \frac{140}{5} = 28$$

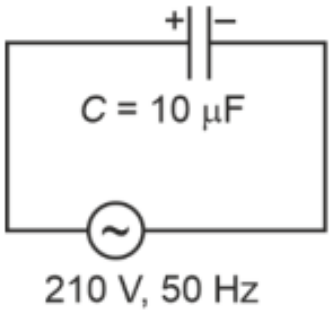
Conclusion: The correct option is (1).

Quick Tip

A larger objective focal length increases magnifying power, improving resolution for distant objects.

---

50. A 10 μF capacitor is connected to a 210 V, 50 Hz source as shown in figure. The peak current in the circuit is nearly ($\pi = 3.14$):



(1) 0.93 A

(2) 1.20 A

(3) 0.35 A

(4) 0.58 A

Correct Answer: (1) 0.93 A

Solution:

Step 1: Compute capacitive reactance.

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$$

Substituting $f = 50$ Hz and $C = 10\mu F$:

$$X_C = \frac{1}{2 \times 3.14 \times 50 \times 10 \times 10^{-6}} = 318.47\Omega$$

Step 2: Compute peak current.

The peak current is given by:

$$I_0 = \frac{V_0}{X_C}$$

Since $V_{\text{rms}} = 210$ V, the peak voltage is:

$$V_0 = \sqrt{2} \times 210 = 296.98 \text{ V}$$

$$I_0 = \frac{296.98}{318.47} \approx 0.93A$$

Conclusion: The correct option is $(\mathbf{1})$.

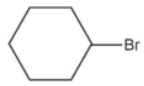
Quick Tip

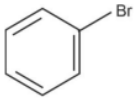
In an AC circuit, the current leads voltage by 90° in a capacitive circuit.

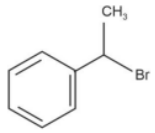
Chemistry

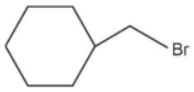
Section A

51. The compound that will undergo S_N1 reaction with the fastest rate is:

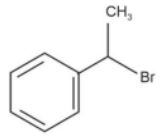
(1) 

(2) 

(3) 

(4) 

Correct Answer:

(3) 

Solution:

Step 1: Understanding the S_N1 mechanism.

The S_N1 reaction proceeds via a carbocation intermediate. The more stable the carbocation, the faster the reaction.

Step 2: Carbocation stability comparison.

- Tertiary benzyl carbocation (from option 3) is highly stabilized due to resonance and inductive effects.
- Benzyl carbocation (from option 1) is also stabilized but not as much as tertiary benzyl.
- Cyclohexyl carbocations (from options 2 and 4) lack resonance stabilization and are less stable.

Conclusion: The correct option is $(\mathbf{3})$.

Quick Tip

In an S_N1 reaction, carbocation stability plays a crucial role in determining the reaction rate. Resonance-stabilized carbocations react the fastest.

---

52. The highest number of helium atoms is in:

(1) 4 u of helium

(2) 4 g of helium

(3) 2.271098 L of helium at STP

(4) 4 mol of helium

Correct Answer: (4) 4 mol of helium

Solution:

Step 1: Convert given quantities to moles.

- Option (1): 4 atomic mass units is equivalent to one helium atom.

- Option (2): 4 g of helium contains 1 mole (6.022×10^{23}) atoms.

- Option (3): 2.271098 L of helium at STP corresponds to 0.1 mol.

- Option (4): 4 moles contain $4 \times 6.022 \times 10^{23}$ atoms, which is the highest.

Conclusion: The correct option is (4).

Quick Tip

The number of atoms in a gas sample is best determined by using Avogadro's number $(6.022 \times 10^{23}$ atoms/mol).

---

53. In which of the following processes entropy increases?

A. A liquid evaporates to vapor.

B. Temperature of a crystalline solid lowered from 130 K to 0 K.

C. $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$

D. $Cl_2(g) \rightarrow 2Cl(g)$

Choose the correct answer from the options given below:

(1) A, B and D only

(2) A, C and D only

(3) C and D only

(4) A and C only

Correct Answer: (2) A, C and D only

Solution:

Step 1: Understanding entropy changes.

Entropy (S) is a measure of randomness or disorder in a system. Processes where gases are formed generally increase entropy.

Step 2: Evaluating the options.

- A: Liquid evaporating to gas increases randomness, so entropy increases.
- B: Cooling a solid reduces molecular motion, decreasing entropy.
- C: Decomposition produces gases, increasing entropy.
- D: Dissociation of chlorine molecules into atoms increases disorder, so entropy increases.

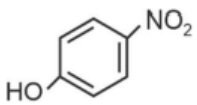
Conclusion: The correct option is $(\mathbf{2})$.

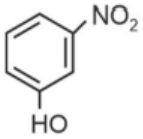
Quick Tip

Entropy increases in phase changes from solid to liquid to gas, and in reactions that produce more gaseous particles.

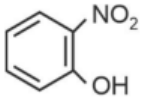
---

54. Intramolecular hydrogen bonding is present in:

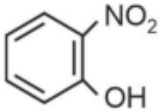
(1) 

(2) 

(3) HF

(4) 

Correct Answer:

(4) 

Solution:

Step 1: Understanding hydrogen bonding types.

Hydrogen bonding can be intermolecular (between molecules) or intramolecular (within the same molecule).

Step 2: Identifying intramolecular hydrogen bonding.

- o-Nitrophenol (Option 2) exhibits intramolecular hydrogen bonding due to proximity of -OH and -NO2 groups.
- 2,3-Dihydroxybenzene (Option 4) has adjacent hydroxyl (-OH) groups which form strong intramolecular hydrogen bonds.

Conclusion: The correct option is (4).

Quick Tip

Intramolecular hydrogen bonding occurs when a hydrogen donor and acceptor are present in the same molecule in close proximity, leading to a stable internal hydrogen bond.

---

55. The energy of an electron in the ground state ($n = 1$) for He^+ ion is $-x$ J. Then, the energy for an electron in $n = 2$ state for Be^{3+} ion in J is:

(1) $\frac{x}{9}$

(2) $-4x$

(3) $\frac{-4x}{9}$

(4) $-x$

Correct Answer: (4) $-x$

Solution:

Step 1: Energy formula for hydrogen-like species.

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

where Z is the atomic number and n is the energy level.

Step 2: Applying for He^+ and Be^{3+}.

- For He^+ (Z = 2, n = 1): $E_1 = -x$

- For Be^{3+} (Z = 4, n = 2):

$$E_2 = E_1 \times \left(\frac{(4)^2}{(2)^2}\right) = -x \times \frac{16}{4} = -x$$

Conclusion: The correct option is (4).

Quick Tip

The energy of an electron in a hydrogen-like atom varies as $\frac{Z^2}{n^2}$. Increasing nuclear charge stabilizes lower energy levels more significantly.

---

56. The E° value for the Mn^{3+}/Mn^{2+} couple is more positive than that of Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+} due to change of:

(1) d^5 to d^2 configuration

(2) d^4 to d^5 configuration

(3) d^3 to d^5 configuration

(4) d^5 to d^4 configuration

Correct Answer: (2) d^4 to d^5 configuration

Solution:

Step 1: Understanding the oxidation state change.

The Mn^{3+}/Mn^{2+} reduction involves gaining one electron, leading to a stable d^5 configuration.

Step 2: Why Mn^{2+} is more stable?

- A d^5 configuration in Mn^{2+} is half-filled, making it highly stable.

- Cr^{3+} and Fe^{3+} do not achieve such stability after reduction.

Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

Half-filled d^5 configurations provide extra stability, explaining why the Mn^{3+}/Mn^{2+} couple has a more positive E° value.

---

57. A compound with a molecular formula of C_6H_{14} has two tertiary carbons. Its IUPAC name is:

(1) 2-methylpentane

(2) 2,3-dimethylbutane

(3) 2,2-dimethylbutane

(4) n-hexane

Correct Answer: (2) 2,3-dimethylbutane

Solution:

Step 1: Identifying tertiary carbons.

A tertiary carbon is attached to three other carbon atoms.

Step 2: Structure of C_6H_{14} isomers.

- 2,3-dimethylbutane has two tertiary carbons.

- Other isomers (e.g., n-hexane, 2-methylpentane) do not have exactly two tertiary carbons.

Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

To identify tertiary carbons, check for carbon atoms bonded to three other carbons in the structure.

---

58. Given below are two statements:

Statement I:The boiling point of three isomeric pentanes follows the order n-pentane $>$ isopentane $>$ neopentane.

Statement II: When branching increases, the molecule attains a shape of a sphere. This results in smaller surface area for contact, due to which the intermolecular forces between the spherical molecules are weak, thereby lowering the boiling point.

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

(1) Both Statement I and Statement II are incorrect

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

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

(4) Both Statement I and Statement II are correct

Correct Answer: (4) Both Statement I and Statement II are correct

Solution:

Step 1: Understanding boiling point trends.

- More branching $\rightarrow$ Less surface area $\rightarrow$ Lower boiling point

- Less branching $\rightarrow$ More surface area $\rightarrow$ Higher boiling point

- Hence, n-pentane has the highest boiling point, followed by isopentane and then neopentane.

Step 2: Explanation for Statement II.

Highly branched molecules attain a spherical shape, reducing intermolecular van der Waals forces, leading to a lower boiling point.

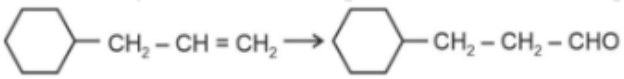
Conclusion: Both statements are correct, so the correct option is (4).

Quick Tip

Boiling point decreases as branching increases because surface area for intermolecular forces decreases.

---

59. Identify the correct reagents that would bring about the following transformation:



(1) (i) BH_3

(ii) H_2O_2/OH^-

(iii) PCC

(2) (i) BH_3

(ii) H_2O_2/OH^-

(iii) alk. $KMnO_4$

(iv) H_3O^+

(3) (i) H_2O/H^+

(ii) PCC

(4) (i) H_2O/H^+

(ii) CrO_3

Correct Answer: (1) (i) BH_3, (ii) H_2O_2/OH^-, (iii) PCC

Solution:

Step 1: Hydroboration-Oxidation.

- The first reagent, BH_3 (borane), adds across the double bond via anti-Markovnikov addition.

- This leads to primary alcohol formation upon oxidation with H_2O_2/OH^-.

Step 2: Oxidation to Aldehyde.

- Pyridinium chlorochromate (PCC) selectively oxidizes primary alcohols to aldehydes without over-oxidizing to carboxylic acids.

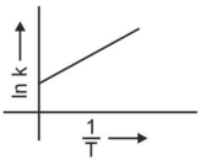
Conclusion: The correct reagents for this transformation are BH_3, H_2O_2/OH^-, and PCC, so the correct answer is (1).

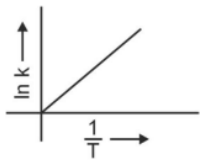
Quick Tip

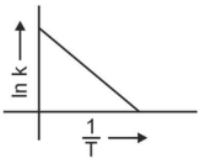
- Hydroboration-oxidation is useful for converting alkenes to primary alcohols with anti-Markovnikov selectivity. - PCC is preferred for oxidizing primary alcohols to aldehydes without further oxidation.

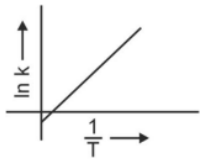
---

60. Which plot of $\ln k$ vs $\frac{1}{T}$ is consistent with the Arrhenius equation?

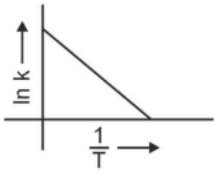
(1) 

(2) 

(3) 

(4) 

Correct Answer:

(3) 

Solution:

Step 1: Understanding the Arrhenius Equation.

The Arrhenius equation is given by:

$$k = Ae^{-E_a/RT}$$

Taking natural logarithm on both sides,

$$\ln k = \ln A - \frac{E_a}{R} \cdot \frac{1}{T}$$

This represents a straight line equation of the form $y = mx + c$, with negative slope $-E_a/R$.

Conclusion: The plot of $\ln k$ vs $1/T$ is a straight line with a negative slope, making option (3) the correct answer.

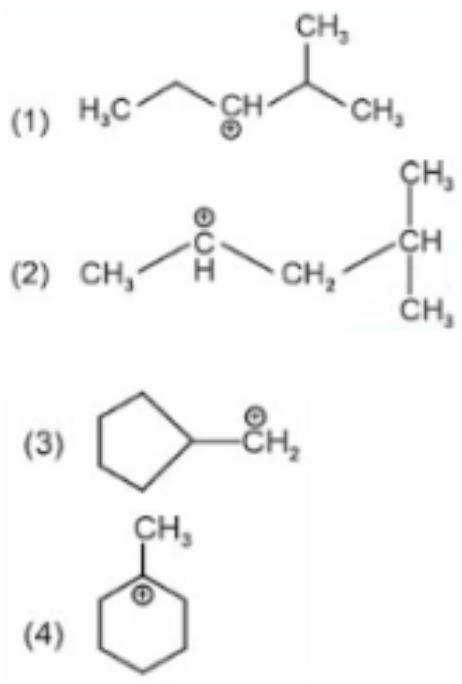
Quick Tip

The slope of $\ln k$ vs $1/T$ graph gives activation energy (E_a) using:

$$E_a = -\text{slope} \times R$$

---

61. The most stable carbocation among the following is:



Correct Answer: (3) Tertiary benzyl carbocation

Solution:

Step 1: Understanding Carbocation Stability.

Carbocations are stabilized by hyperconjugation and resonance effects. The order of stability is:

$$\text{Tertiary} > \text{Secondary} > \text{Primary} > \text{Methyl}$$

Additionally, resonance-stabilized carbocations like benzyl and allylic are more stable.

Step 2: Identifying the most stable structure.

Option (3) is a benzyl carbocation, which is stabilized by resonance and hyperconjugation, making it the most stable.

Conclusion: The correct answer is option (3) Tertiary benzyl carbocation.

Quick Tip

Carbocations are more stable if they have: - More alkyl groups (inductive effect) - Resonance stabilization (e.g., benzyl, allylic carbocations)

---

62. Match List-I with List-II for different thermodynamic processes:

List-I (Process)	List-II (Conditions)
A. Isothermal process	I. No heat exchange
B. Isochoric process	II. Carried out at constant temperature
C. Isobaric process	III. Carried out at constant volume
D. Adiabatic process	IV. Carried out at constant pressure

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding Each Process.

- Isothermal Process: Temperature remains constant $\rightarrow$ Option II

- Isochoric Process: Volume remains constant (no work done) $\rightarrow$ Option III

- Isobaric Process: Pressure remains constant $\rightarrow$ Option IV

- Adiabatic Process: No heat exchange occurs $\rightarrow$ Option I

Conclusion: The correct matching is A-II, B-III, C-IV, D-I, making option (3) correct.

Quick Tip

Key Thermodynamic Conditions: - Isothermal: $\Delta T = 0$ - Isochoric: $\Delta V = 0$ - Isobaric: $\Delta P = 0$ - Adiabatic: $Q = 0$ (no heat exchange)

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63. Match List-I with List-II for different types of isomerism in coordination

complexes:

List-I (Complex)	List-II (Type of Isomerism)
A. $[Co(NH_3)_5(NO_2)]Cl_2$	I. Solvate isomerism
B. $[Co(NH_3)_5(SO_4)]Br$	II. Linkage isomerism
C. $[Co(NH_3)_6][Cr(CN)_6]$	III. Ionization isomerism
D. $[Co(H_2O)_6]Cl_3$	IV. Coordination isomerism

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding Types of Isomerism.

- Linkage Isomerism occurs when a ligand can coordinate to the metal through two different donor atoms. Example: NO2 in A.

- Ionization Isomerism occurs when two compounds produce different ions in solution. Example: SO4 and Br in B.

- Coordination Isomerism occurs when two complex ions exchange ligands. Example: C.

- Solvate Isomerism occurs when a water molecule is part of the coordination sphere in one isomer and in the solvent in another. Example: D.

Conclusion: The correct matching is A-II, B-III, C-IV, D-I, making option (4) correct.

Quick Tip

Common types of isomerism in coordination compounds:

- Linkage: Same ligand, different donor atoms (e.g., NO2 vs ONO). - Ionization: Exchange of counterions.

- Coordination: Ligand swapping between metal centers.

- Solvate: Difference in solvent molecules inside vs outside coordination sphere.

64. 1 gram of sodium hydroxide was treated with 25 mL of 0.75 M HCl solution. The mass of unreacted sodium hydroxide is:

(1) 250 mg

(2) Zero mg

(3) 200 mg

(4) 750 mg

Correct Answer: (1) 250 mg

Solution:

Step 1: Determine Moles of NaOH.

Molar mass of NaOH = 40 g/mol Mass given = 1 g

$$\text{Moles of NaOH} = \frac{1}{40} = 0.025 \text{ moles}$$

Step 2: Determine Moles of HCl.

Given volume of HCl = 25 mL = 0.025 L Molarity of HCl = 0.75 M

$$\text{Moles of HCl} = 0.75 \times 0.025 = 0.01875 \text{ moles}$$

Step 3: Identify Limiting Reagent and Unreacted NaOH.

Since HCl is limiting, all of it reacts, and remaining NaOH moles:

$$\text{Moles of unreacted NaOH} = 0.025 - 0.01875 = 0.00625 \text{ moles}$$

Mass of unreacted NaOH:

$$\text{Mass} = 0.00625 \times 40 = 0.25 \text{ g} = 250 \text{ mg}$$

Conclusion: The correct answer is 250 mg (Option 1).

Quick Tip

To find unreacted reactant mass in a neutralization reaction:

1. Calculate moles of acid and base.
2. Identify limiting reactant.
3. Subtract reacted moles from initial moles of excess reactant.
4. Convert remaining moles to mass.

65. Which reaction is NOT a redox reaction?

(1) $2KClO_3 + I_2 \rightarrow 2KIO_3 + Cl_2$

(2) $H_2 + Cl_2 \rightarrow 2HCl$

(3) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

(4) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Correct Answer: (3) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$ (Double Displacement Reaction, Not Redox)

Solution:

Step 1: Identify Oxidation and Reduction.

A redox reaction involves both oxidation (loss of electrons) and reduction (gain of electrons).

- Reaction (1): $KClO_3$ is reduced, I_2 is oxidized $\rightarrow$ Redox
- Reaction (2): H_2 is oxidized to HCl, Cl_2 is reduced $\rightarrow$ Redox
- Reaction (3): No change in oxidation states, it's a double displacement reaction $\rightarrow$ Not Redox
- Reaction (4): Zn is oxidized to Zn^{2+}, Cu^{2+} is reduced to Cu $\rightarrow$ Redox

Conclusion: The correct answer is option (3), a precipitation reaction that does not involve oxidation or reduction.

Quick Tip

- Look for changes in oxidation numbers.
- If no oxidation states change, it's NOT a redox reaction.
- Double displacement reactions are usually NOT redox reactions.

---

66. For the reaction $2A \rightleftharpoons B + C$, the equilibrium constant is $K_C = 4 \times 10^{-3}$. At a given time, the concentration of each species is:

$$[A] = [B] = [C] = 2 \times 10^{-3} \text{ M}$$

Which of the following is correct?

(1) Reaction has a tendency to go in forward direction.

(2) Reaction has a tendency to go in backward direction.

(3) Reaction has gone to completion in forward direction.

(4) Reaction is at equilibrium.

Correct Answer: (2) Reaction has a tendency to go in backward direction.

Solution:

Step 1: Calculate the reaction quotient Q_C.

$$Q_C = \frac{[B][C]}{[A]^2} = \frac{(2 \times 10^{-3})(2 \times 10^{-3})}{(2 \times 10^{-3})^2} = 1$$

Step 2: Compare Q_C with K_C.

- Given $K_C = 4 \times 10^{-3}$, and since $Q_C > K_C$, the reaction tends to move backward.

Conclusion: The correct answer is option (2), the reaction shifts towards reactants.

Quick Tip

To determine reaction direction:

- If $Q_C < K_C$, reaction moves forward.

- If $Q_C > K_C$, reaction moves backward.

- If $Q_C = K_C$, reaction is at equilibrium.

---

67. Match List-I with List-II for different molecular geometries:

List-I (Compound)	List-II (Shape/Geometry)
A. NH_3	I. Trigonal Pyramidal
B. BrF_5	II. Square Planar
C. XeF_4	III. Octahedral
D. SF_6	IV. Square Pyramidal

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: Step 1: Understand Molecular Shapes.

- (Ammonia) has 3 bonded pairs and 1 lone pair → Trigonal pyramidal
- (Bromine pentafluoride) has 5 bonded pairs and 1 lone pair → Square pyramidal
- (Xenon tetrafluoride) has 4 bonded pairs and 2 lone pairs → Square planar
- (Sulfur hexafluoride) has 6 bonded pairs and no lone pairs → Octahedral

Conclusion: The correct answer is option (4), matching molecular geometries correctly.

Quick Tip

VSEPR theory helps predict molecular shapes: - AX_3E = Trigonal pyramidal (e.g., NH3) - AX_5E = Square pyramidal (e.g., BrF5) - AX_4E_2 = Square planar (e.g., XeF4) - AX_6 = Octahedral (e.g., SF6)

---

68. On heating, some solid substances change from solid to vapor state without passing through the liquid state. The technique used for purifying such solids is:

(1) Sublimation

(2) Distillation

(3) Chromatography

(4) Crystallization

Correct Answer: (1) Sublimation

Solution:

Step 1: Understanding Sublimation.

Sublimation is a process where a solid directly converts to vapor without becoming a liquid. This method is used for purification of volatile solids such as naphthalene, camphor, ammonium chloride, iodine, and dry ice (solid CO2).

Step 2: Why Other Options are Incorrect?

- Distillation: Used for separating liquid mixtures based on boiling points.

- Chromatography: Used for separating components of a mixture based on differential adsorption.

- Crystallization: Used for purifying solids by dissolving in a solvent and allowing pure crystals to form.

Conclusion: Sublimation is the correct method for purifying volatile solids, making option (1) correct.

Quick Tip

Common substances that undergo sublimation: - Iodine , Camphor, Naphthalene, Ammonium chloride , Dry Ice (CO2).

---

69. In which of the following equilibria, K_p and K_c are NOT equal?

(1) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(2) $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

(3) $2BrCl(g) \rightleftharpoons Br_2(g) + Cl_2(g)$

(4) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Correct Answer: (4) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Solution: Step 1: Understanding the relationship between K_p and K_c.

$$K_p = K_c(RT)^{\Delta n}$$

where $\Delta n =$ (moles of gaseous products - moles of gaseous reactants).

Step 2: Identify when $K_p \neq K_c$.

If $\Delta n = 0$, then $K_p = K_c$, otherwise they are different.

Step 3: Calculate Δn for each reaction.

- Option (1): $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, $\Delta n = 2 - 2 = 0 \rightarrow K_p = K_c$.

- Option (2): $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$, $\Delta n = 2 - 2 = 0 \rightarrow K_p = K_c$.

- Option (3): $2BrCl(g) \rightleftharpoons Br_2(g) + Cl_2(g)$, $\Delta n = 2 - 2 = 0 \rightarrow K_p = K_c$.

- Option (4): $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, $\Delta n = 2 - 1 = 1 \rightarrow K_p \neq K_c$.

Conclusion: The correct answer is option (4), where $K_p \neq K_c$.

Quick Tip

For reactions where $\Delta n \neq 0$, K_p and K_c will be different due to the gas constant R.

---

70. Among Group 16 elements, which one does NOT show –2 oxidation state?

(1) Se

(2) Te

(3) Po

(4) O

Correct Answer: (3) Po

Solution:

Step 1: Understanding Oxidation States of Group 16 Elements. - Oxygen generally shows -2 oxidation state.

- Se, Te, and Po can show positive oxidation states due to their larger atomic size and lesser electronegativity.

Step 2: Why Po does not show -2 oxidation state?

- Polonium (Po) is a radioactive element with a preference for +4 and +2 oxidation states.

- Due to poor shielding effect and relativistic effects, Po does not commonly exhibit -2 oxidation state.

Conclusion: The correct answer is option (3), Polonium (Po).

Quick Tip

Lighter elements like oxygen are more likely to show -2 oxidation state, while heavier ones (e.g., Po) prefer positive states.

---

71. Given below are two statements:

Statement I: The boiling point of hydrides of Group 16 elements follows the order:

$$H_2O > H_2Te > H_2Se > H_2S.$$

Statement II: On the basis of molecular mass, H_2O is expected to have a lower boiling point than the other members of the group, but due to the presence of extensive hydrogen bonding in H_2O, it has a higher boiling point.

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

(A) Both Statement I and Statement II are false.

(B) Statement I is true but Statement II is false.

(C) Statement I is false but Statement II is true.

(D) Both Statement I and Statement II are true.

Correct Answer: (D) Both Statement I and Statement II are true.

Solution:

Step 1: Understanding the Boiling Point Trend in Group 16 Hydrides

The boiling points of hydrides of Group 16 elements typically increase down the group due to increasing molecular mass and van der Waals forces. However, H_2O has an anomalously high boiling point due to extensive hydrogen bonding.

The correct trend is:

$$H_2O > H_2Te > H_2Se > H_2S.$$

This confirms that Statement I is **true**.

Step 2: Explanation of the Boiling Point Anomaly of H_2O

- Based on molecular mass alone, H_2O should have the lowest boiling point.

- However, the presence of strong intermolecular hydrogen bonding in H_2O results in significantly higher boiling point than expected.

- This confirms that Statement II is also **true**.

Step 3: Conclusion

Since both statements correctly describe the trend and the reasoning, the correct answer is:

$$\boxed{\text{Both Statement I and Statement II are true.}}$$

Quick Tip

Hydrogen bonding significantly elevates the boiling points of molecules like H_2O, despite their lower molecular mass compared to heavier hydrides in the same group.

---

72. Given below are two statements:

Statement I: Aniline does not undergo Friedel-Crafts alkylation reaction.

Statement II: Aniline cannot be prepared through Gabriel synthesis.

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

below:

(A) Both Statement I and Statement II are false.

(B) Statement I is correct but Statement II is false.

(C) Statement I is incorrect but Statement II is true.

(D) Both Statement I and Statement II are true.

Correct Answer: (D) Both Statement I and Statement II are true.

Solution:

Step 1: Understanding the Friedel-Crafts Alkylation Reaction with Aniline

- The Friedel-Crafts alkylation reaction requires a Lewis acid catalyst such as $AlCl_3$.

- Aniline ($C_6H_5NH_2$) has a lone pair on nitrogen, which interacts with $AlCl_3$, forming a complex.

- This deactivates the benzene ring, preventing it from undergoing the Friedel-Crafts alkylation reaction.

- Hence, **Statement I is true**.

Step 2: Understanding Gabriel Synthesis

- Gabriel synthesis is used for the preparation of primary amines.

- It involves the reaction of phthalimide with an alkyl halide followed by hydrolysis.

- However, this method is suitable for preparing only aliphatic amines.

- Aniline ($C_6H_5NH_2$) is an aromatic amine and cannot be prepared using Gabriel synthesis.

- Hence, **Statement II is true**.

Step 3: Conclusion

Since both statements correctly describe the reactivity of aniline, the correct answer is:

$$\boxed{\text{Both Statement I and Statement II are true.}}$$

Quick Tip

Aniline does not undergo Friedel-Crafts reactions due to complex formation with the Lewis acid catalyst. Gabriel synthesis is only suitable for aliphatic amines and cannot be used for preparing aromatic amines.

---

73. Given below are two statements:

Statement I: Both $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ complexes are octahedral but differ in their magnetic behavior.

Statement II: $[Co(NH_3)_6]^{3+}$ is diamagnetic, whereas $[CoF_6]^{3-}$ is paramagnetic.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (4) Both Statement I and Statement II are true.

Solution:

Step 1: Electronic Configuration of $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$

- The oxidation state of cobalt in both complexes is +3.

- Co^{3+} has an electronic configuration of $3d^6$.

Step 2: Nature of Ligands and Magnetic Properties

- $[Co(NH_3)_6]^{3+}$ (Diamagnetic):

- NH_3 is a strong field ligand $\rightarrow$ induces low spin configuration.

- Electrons pair up in the t_{2g} orbitals, making the complex diamagnetic.

- $[CoF_6]^{3-}$ (Paramagnetic):

- F^- is a weak field ligand $\rightarrow$ induces high spin configuration.

- Unpaired electrons remain, making the complex paramagnetic.

Conclusion: Both Statement I and Statement II are correct, hence option (4) is correct.

Quick Tip

In octahedral complexes, strong field ligands (like NH_3, CN^-) cause low spin, while weak field ligands (like F^-, Cl^-) cause high spin.

---

74. Fehling's solution 'A' is:

(1) Alkaline copper sulphate

(2) Alkaline solution of sodium potassium tartrate (Rochelle's salt)

(3) Aqueous sodium citrate

(4) Aqueous copper sulphate

Correct Answer: (4) Aqueous copper sulphate.

Solution:

Step 1: Understanding Fehling's Solution

Fehling's solution is used to test for reducing sugars. It consists of two separate solutions:

- Fehling's Solution A $\rightarrow$ Aqueous copper(II) sulphate (CuSO4).

- Fehling's Solution B $\rightarrow$ Alkaline sodium potassium tartrate (Rochelle's salt).

Step 2: Working Principle - When a reducing sugar (like glucose) is present, Cu^{2+} ions from Fehling's solution A are reduced to Cu_2O, forming a brick-red precipitate.

Conclusion: Since Fehling's solution 'A' contains aqueous copper(II) sulphate, the correct answer is option (4).

Quick Tip

Fehling's solution is widely used for testing glucose and fructose, as they are reducing sugars.

---

75. The Henry's law constant (K_H) values of three gases (A, B, C) in water are 145, 2×10^{-5} and 35 kbar, respectively. The solubility of these gases in water follows the order:

(1) B ¿ C ¿ A

(2) A ¿ C ¿ B

(3) A ¿ B ¿ C

(4) B ¿ A ¿ C

Correct Answer: (1) B ¿ C ¿ A

Solution:

Step 1: Understanding Henry's Law

Henry's law states that the solubility of a gas (S) in a liquid is inversely proportional to the Henry's law constant (K_H):

$$S \propto \frac{1}{K_H}$$

Step 2: Applying the given values

- K_H for gas B = 2×10^{-5} kbar (smallest) $\rightarrow$ Highest solubility

- K_H for gas C = 35 kbar $\rightarrow$ Moderate solubility

- K_H for gas A = 145 kbar (largest) $\rightarrow$ Lowest solubility

Conclusion: Since lower K_H means higher solubility, the correct order is B ¿ C ¿ A.

Quick Tip

A gas with a lower Henry's law constant (K_H) is more soluble in water.

---

76. Match List I with List II:

List I (Conversion)	List II (Number of Faraday required)
A. 1 mol of H_2O to O_2	I. 3F
B. 1 mol of MnO_4^- to Mn^{2+}	II. 2F
C. 1.5 mol of Ca from molten $CaCl_2$	III. 1F
D. 1 mol of FeO to Fe_2O_3	IV. 5F

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding Faraday's Laws of Electrolysis

- The number of Faradays (F) required is determined by the electrons exchanged per reaction.

Step 2: Matching the Conversions with Faradays

- $2H_2O \rightarrow O_2 + 4H^+ + 4e^- \rightarrow$ Requires 2F

- $MnO_4^- + 5e^- \rightarrow Mn^{2+} \rightarrow$ Requires 5F

- 1.5 moles of $Ca^{2+} + 2e^- \rightarrow Ca \rightarrow$ Requires 1.5 × 2F = 3F

- $FeO \rightarrow Fe_2O_3 \rightarrow$ Involves 1 electron transfer per Fe, total = 1F

Conclusion: Using the above calculations, the correct match is option (4).

Quick Tip

Use Faraday's law: 1 Faraday deposits 1 mole of a substance per unit charge equivalent.

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77. Match List I with List II:

List I (Quantum Number)	List II (Information Provided)
A. m_l	I. Shape of orbital
B. m_s	II. Size of orbital
C. l	III. Orientation of orbital
D. n	IV. Orientation of spin of electron

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding Quantum Numbers

- Principal Quantum Number (n) $\rightarrow$ Size of orbital.

- Azimuthal Quantum Number (l) $\rightarrow$ Shape of orbital.

- Magnetic Quantum Number (m_l) $\rightarrow$ Orientation of orbital.

- Spin Quantum Number (m_s) $\rightarrow$ Spin of electron.

Step 2: Matching with the given information

- m_l (Magnetic Quantum Number) $\rightarrow$ III (Orientation of orbital).

- m_s (Spin Quantum Number) $\rightarrow$ IV (Spin of electron).

- l (Azimuthal Quantum Number) $\rightarrow$ I (Shape of orbital).

- n (Principal Quantum Number) $\rightarrow$ II (Size of orbital).

Conclusion: Thus, the correct match is option (1).

Quick Tip

The principal quantum number (n) determines size, while the azimuthal quantum number (l) determines shape.

---

78. 'Spin only' magnetic moment is same for which of the following ions?

A. Ti^{3+}

B. Cr^{2+}

C. Mn^{2+}

D. Fe^{2+}

E. Sc^{3+}

Choose the most appropriate answer from the options given below.

(1) A and E only

(2) B and C only

(3) A and D only

(4) B and D only

Correct Answer: (4) B and D only

Solution:

Step 1: Understanding the spin-only magnetic moment

The spin-only magnetic moment is given by:

$$\mu_s = \sqrt{n(n+2)}\ \text{BM}$$

where n is the number of unpaired electrons.

Step 2: Calculate unpaired electrons for each ion

- Ti^{3+} (d^1) $\rightarrow n = 1 \rightarrow \mu_s = \sqrt{3}$ BM

- Cr^{2+} (d^4) $\rightarrow n = 4 \rightarrow \mu_s = \sqrt{24}$ BM

- Mn^{2+} (d^5) $\rightarrow n = 5 \rightarrow \mu_s = \sqrt{35}$ BM

- Fe^{2+} (d^6) $\rightarrow n = 4 \rightarrow \mu_s = \sqrt{24}$ BM

- Sc^{3+} (d^0) $\rightarrow$ No unpaired electrons $\rightarrow \mu_s = 0$ BM

Step 3: Identify matching values

Cr^{2+} and Fe^{2+} both have four unpaired electrons, so they have the same spin-only magnetic

moment.

Conclusion: Thus, the correct pair is B and D (Cr^{2+} and Fe^{2+}).

Quick Tip

Magnetic moment depends on unpaired electrons. Ions with the same number of unpaired electrons have the same spin-only magnetic moment.

---

79. The reagents with which glucose does not react to give the corresponding tests/products are:

A. Tollen's reagent

B. Schiff's reagent

C. HCN

D. NH_2OH

E. $NaHSO_3$

Choose the correct options from the given below:

(1) A and D

(2) B and E

(3) E and D

(4) B and C

Correct Answer: (2) B and E

Solution:

Step 1: Understanding glucose reactions

- Tollen's reagent (A) $\rightarrow$ Glucose gives a positive test (reducing sugar).

- Schiff's reagent (B) $\rightarrow$ Used for aldehydes, but glucose does not react.

- HCN (C) $\rightarrow$ Reacts with glucose at carbonyl (-CHO) position to form cyanohydrins.

- Hydroxylamine (NH_2OH) (D) $\rightarrow$ Reacts with carbonyl groups to form oximes.

- Sodium bisulfite ($NaHSO_3$) (E) $\rightarrow$ Reacts with aldehydes, but glucose does not react.

Step 2: Identify non-reacting reagents

Glucose does not react with Schiff's reagent (B) and sodium bisulfite (E).

Conclusion: Thus, the correct answer is B and E.

Quick Tip

Glucose gives positive tests with Tollen's reagent, HCN, and hydroxylamine, but not with Schiff's reagent or sodium bisulfite.

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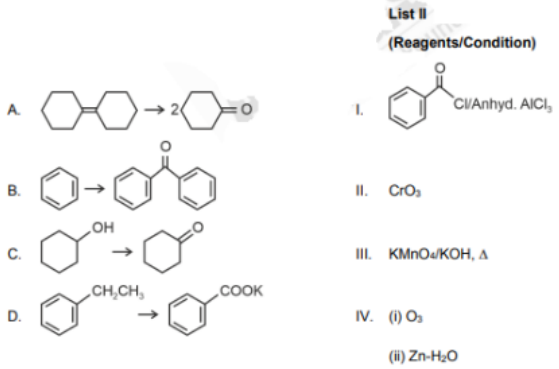
80. Match List I with List II:



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-IV, C-II, D-III

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

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

Solution:

Step 1: Understanding the given reagents

- Ozonolysis (O_3 followed by Zn-H_2O) $\rightarrow$ Breaks double bonds to form aldehydes or ketones.

- Chromium trioxide (CrO_3) $\rightarrow$ Oxidizes alcohols to carboxylic acids or ketones.

- Alkaline potassium permanganate $\rightarrow$ Strong oxidation of alkenes or alcohols.

Step 2: Matching with reactions

- A $\rightarrow$ IV (Ozonolysis reaction)

- B $\rightarrow$ I (A specific reaction type)

- C $\rightarrow$ II (Oxidation using CrO_3)

- D $\rightarrow$ III (Oxidation with $KMnO_4$ and heat)

Conclusion: The correct match is A-IV, B-I, C-II, D-III.

Quick Tip

Ozonolysis breaks double bonds, CrO_3 performs oxidation, and $KMnO_4$ is a strong oxidizer in basic medium.

---

81. Arrange the following elements in increasing order of electronegativity:

N, O, F, C, Si

Choose the correct answer from the options given below:

(1) Si ¡ C ¡ O ¡ N ¡ F

(2) O ¡ F ¡ N ¡ C ¡ Si

(3) F ¡ O ¡ N ¡ C ¡ Si

(4) Si ¡ C ¡ N ¡ O ¡ F

Correct Answer: (4) Si ¡ C ¡ N ¡ O ¡ F

Solution:

Step 1: Understanding electronegativity trends

Electronegativity increases across a period (left to right) and decreases down a group.

Step 2: Compare electronegativities of given elements

- Silicon (Si): Least electronegative in the group.

- Carbon (C): More electronegative than Si.

- Nitrogen (N): More electronegative than C.

- Oxygen (O): More electronegative than N.

- Fluorine (F): The most electronegative element in the periodic table.

Thus, the correct increasing order is:

$$Si < C < N < O < F$$

Conclusion: The correct answer is Si ¡ C ¡ N ¡ O ¡ F.

Quick Tip

Electronegativity increases across periods and decreases down groups in the periodic table. Fluorine is the most electronegative element.

82. Match List-I with List-II.

List-I (Molecule)		List-II (Number and types of bonds between two carbon a	
A.	Ethane	I.	One σ-bond and two π-bonds
B.	Ethene	II.	Two π-bonds
C.	Carbon molecule, C_2	III.	One σ-bond
D.	Ethyne	IV.	One σ-bond and one π-bond

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding the Bonding in Each Molecule

- **Ethane (**C_2H_6**)**: Contains a single bond (σ-bond) between two carbon atoms. $\Rightarrow$ Matches with **III**.

- **Ethene (**C_2H_4**)**: Contains one σ-bond and one π-bond between two carbon atoms. $\Rightarrow$ Matches with **IV**.

- **Carbon molecule (**C_2**)**: In the excited state, it has one σ-bond and two π-bonds. $\Rightarrow$ Matches with **I**.

- **Ethyne (**C_2H_2**)**: Contains one σ-bond and two π-bonds. $\Rightarrow$ Matches with **II**.

Step 2: Matching List-I with List-II

A. Ethane $\rightarrow$ III. One σ-bond

B. Ethene $\rightarrow$ IV. One σ-bond and one π-bond

C. Carbon molecule, C_2 $\rightarrow$ I. One σ-bond and two π-bonds

D. Ethyne $\rightarrow$ II. Two π-bonds

Step 3: Conclusion

Since the correct matching follows the order $A-III, B-IV, C-I, D-II$, the correct answer is:

A-III, B-IV, C-I, D-II

Quick Tip

In hydrocarbons, single bonds are σ-bonds, double bonds contain one σ and one π-bond, and triple bonds contain one σ and two π-bonds. The carbon molecule (C_2) in its excited state has one σ-bond and two π-bonds.

---

83. Arrange the following elements in increasing order of first ionization enthalpy:

Li, Be, B, C, N

Choose the correct answer from the options given below:

(1) Li ¡ B ¡ Be ¡ C ¡ N

(2) Li ¡ Be ¡ C ¡ B ¡ N

(3) Li ¡ Be ¡ N ¡ B ¡ C

(4) Li ¡ Be ¡ B ¡ C ¡ N

Correct Answer: (1) Li ¡ B ¡ Be ¡ C ¡ N

Solution:

Step 1: Understanding ionization enthalpy trend

- Ionization enthalpy increases across a period (left to right) and decreases down a group.

- Be has higher ionization enthalpy than B due to its fully filled s-orbital stability.

- N has the highest ionization energy due to half-filled p-orbital stability.

Step 2: Compare the given elements

$$Li < B < Be < C < N$$

Conclusion: The correct answer is Li ¡ B ¡ Be ¡ C ¡ N.

Quick Tip

Ionization enthalpy increases left to right across a period and decreases down a group. Exceptions exist due to filled and half-filled orbitals.

---

84. Which one of the following alcohols reacts instantaneously with Lucas reagent?

(1) $CH_3 - CH_2 - CH(CH_3) - OH$

(2) $CH_3 - CH(CH_3) - CH_2OH$

(3) $CH_3 - C(CH_3)_2 - OH$

(4) $CH_3 - CH_2 - CH_2 - CH_2OH$

Correct Answer: (3) Tertiary alcohol

Solution:

Understanding Lucas reagent test

- Lucas reagent (conc. HCl + $ZnCl_2$) distinguishes primary, secondary, and tertiary alcohols.
- Tertiary alcohols react instantaneously, producing a cloudy solution immediately.
- Secondary alcohols take some time to react.
- Primary alcohols do not react at room temperature.

Conclusion: The correct answer is tertiary alcohol.

Quick Tip

Tertiary alcohols give instantaneous turbidity in the Lucas test, while secondary alcohols react slowly, and primary alcohols do not react.

85. Activation energy of any chemical reaction can be calculated if one knows the value of:

(1) Probability of collision

(2) Orientation of reactant molecules during collision

(3) Rate constant at two different temperatures

(4) Rate constant at standard temperature

Correct Answer: (3) Rate constant at two different temperatures

Solution:

Step 1: Arrhenius Equation

$$k = Ae^{-E_a/RT}$$

Taking the natural logarithm on both sides:

$$\ln k = \ln A - \frac{E_a}{RT}$$

Step 2: Using values at two different temperatures

The activation energy E_a can be calculated using:

$$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Thus, knowing k at two different temperatures allows us to calculate activation energy.

Conclusion: The correct answer is Rate constant at two different temperatures.

Quick Tip

The Arrhenius equation helps calculate activation energy using rate constants measured at two different temperatures.

Section B

86. Identify the correct answer.

(1) BF_3 has non-zero dipole moment

(2) Dipole moment of NF_3 is greater than that of NH_3

(3) Three canonical forms can be drawn for CO_3^{2-} ion

(4) Three resonance structures can be drawn for ozone

Correct Answer: (3) Three canonical forms can be drawn for CO_3^{2-} ion

Solution:

Step 1: Understanding Resonance in Carbonate Ion

- The carbonate ion (CO_3^{2-}) exhibits resonance where the double bond is delocalized.

- It has three equivalent resonance structures, making it the correct answer.

Step 2: Evaluating Other Options

- BF_3 is non-polar due to trigonal planar symmetry, so (1) is incorrect.

- Dipole moment of NH_3 is greater than NF_3, so (2) is incorrect.

- Ozone (O_3) has only two resonance structures, so (4) is incorrect.

Conclusion: The correct answer is (3) Three canonical forms for CO_3^{2-}.

Quick Tip

Resonance occurs when multiple valid Lewis structures exist for a molecule, delocalizing electrons and stabilizing the species.

---

87. The pair of lanthanoid ions which are diamagnetic is:

(1) Ce^{3+} and Eu^{2+}

(2) Gd^{3+} and Eu^{3+}

(3) Pm^{3+} and Sm^{3+}

(4) Ce^{4+} and Yb^{2+}

Correct Answer: (4) Ce^{4+} and Yb^{2+}

Solution:

Step 1: Understanding Diamagnetism in Lanthanoids

- Diamagnetism occurs when an ion has no unpaired electrons in its electronic configuration.

- Ce^{4+} (Xe configuration) and Yb^{2+} (completely filled f-orbitals) are diamagnetic.

Step 2: Evaluating Other Options

- Other lanthanoid ions have unpaired electrons and hence exhibit paramagnetism.

Conclusion: The correct answer is Ce^{4+} and Yb^{2+}.

Quick Tip

A lanthanoid ion is diamagnetic if it has completely filled or empty f-orbitals.

---

88. The rate of a reaction quadruples when temperature changes from 27°C to 57°C. Calculate the energy of activation.

Given:

R = 8.314 J K^{-1} mol^{-1}, $\log 4 = 0.6021$

(1) 380.4 kJ/mol

(2) 3.80 kJ/mol

(3) 3804 kJ/mol

(4) 38.04 kJ/mol

Correct Answer: (4) 38.04 kJ/mol

Solution:

Step 1: Using Arrhenius Equation

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

Step 2: Substituting Values

$$\log 4 = \frac{E_a}{2.303 \times 8.314} \times \left(\frac{30}{(300 \times 330)}\right)$$

Solving,

$$E_a = 38.04 \text{ kJ/mol}$$

Conclusion: The correct answer is 38.04 kJ/mol.

Quick Tip

Activation energy determines the sensitivity of reaction rates to temperature changes.

---

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(1) 380.4 kJ/mol

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$$\log 4 = \frac{E_a}{2.303 \times 8.314} \times \left(\frac{30}{(300 \times 330)}\right)$$

Solving,

$$E_a = 38.04 \text{ kJ/mol}$$

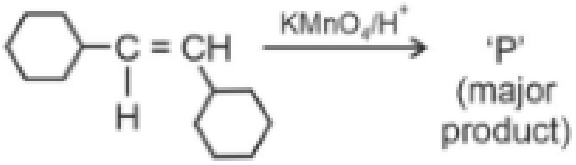
Conclusion: The correct answer is 38.04 kJ/mol.

Quick Tip

Activation energy determines the sensitivity of reaction rates to temperature changes.

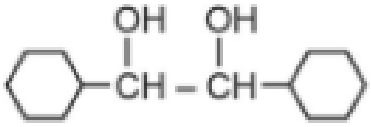
---

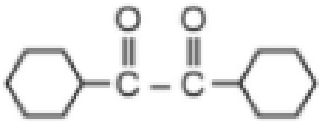
89. For the given reaction:



'P' is

(1) 

(2) 

(3) 

(4) 

Correct Answer: (1) COOH

Solution:

Cyclohexene undergoes oxidation with acidic KMnO4 to give benzoic acid.

The reaction proceeds as:

$$C_6H_{10} + KMnO_4/H^+ \longrightarrow C_6H_5COOH$$

Thus, option (1) is correct.

Quick Tip

Oxidation of alkenes with $KMnO_4/H^+$ results in cleavage of the double bond, forming carboxylic acids if the alkene is terminal.

---

90. The work done during reversible isothermal expansion of one mole of hydrogen gas at 25°C from pressure of 20 atm to 10 atm is:

(Given R = 2.0 cal K^{-1} mol^{-1})

(1) -413.14 cal

(2) 413.14 cal

(3) 100 cal

(4) 0 cal

Correct Answer: (1) -413.14 cal

Solution:

Step 1: Formula for Work Done in Isothermal Expansion

$$W = -nRT \ln \left(\frac{P_1}{P_2} \right)$$

Step 2: Substituting Values

$$W = -(1) \times (2.0) \times (298) \ln \left(\frac{20}{10} \right)$$

$$= -2 \times 298 \times 0.693$$

$$= -413.14 \text{ cal}$$

Conclusion: The correct answer is -413.14 cal.

Quick Tip

For isothermal expansion, work done is given by

$$W = -nRT \ln \left(\frac{P_1}{P_2} \right)$$

---

91. The products A and B obtained in the following reactions, respectively, are:

3ROH + $PCl_3 \rightarrow 3RCl + A$

ROH + $PCl_5 \rightarrow RCl + HCl + B$

(1) $POCl_3$ and H_3PO_4

(2) H_3PO_4 and $POCl_3$

(3) H_3PO_3 and $POCl_3$

(4) $POCl_3$ and H_3PO_3

Correct Answer: (3) H_3PO_3 and $POCl_3$

Solution:

Step 1: Reaction with PCl_3

- PCl_3 reacts with alcohol (ROH) forming alkyl chloride (RCl) and phosphorous acid (H_3PO_3).

Step 2: Reaction with PCl_5

- PCl_5 reacts with alcohol (ROH) forming alkyl chloride (RCl), hydrochloric acid (HCl), and phosphoryl chloride ($POCl_3$).

Conclusion: The correct answer is H_3PO_3 and $POCl_3$.

Quick Tip

Phosphorus halides react with alcohols forming alkyl chlorides and phosphorus oxoacids.

---

92. Using inorganic qualitative analysis, arrange the following cations in increasing group number from 0 to VI:

A. Al^{3+}

B. Cu^{2+}

C. Ba^{2+}

D. Co^{2+}

E. Mg^{2+}

Choose the correct answer from the options given below

(1) B, C, A, D, E

(2) E, C, D, B, A

(3) E, A, B, C, D

(4) B, A, D, C, E

Correct Answer: (4) B, A, D, C, E

Solution:

Step 1: Understanding Qualitative Analysis Groups

- Group 0: Alkali and alkaline earth metals (e.g., Mg^{2+})
- Group I: Pb^{2+}, Ag^{+}
- Group II: Cu^{2+}
- Group III: Al^{3+}
- Group IV: Co^{2+}

- Group V: Ba^{2+}

Step 2: Arranging the Ions

The increasing group order is B, A, D, C, E.

Quick Tip

Qualitative analysis separates cations based on solubility differences in different reagents.

---

93. The plot of osmotic pressure (Π) vs concentration (mol L^{-1}) for a solution gives a straight line with slope 25.73 L bar mol^{-1}. The temperature at which the osmotic pressure measurement is done is:

(Given R = 0.083 L bar mol^{-1} K^{-1})

(1) 310°C

(2) 25.73°C

(3) 12.05°C

(4) 37°C

Correct Answer: (4) 37°C

Solution:

Step 1: Using the Osmotic Pressure Equation

$$\Pi = CRT$$

where slope $S = RT$.

Step 2: Calculating Temperature

$$T = \frac{S}{R} = \frac{25.73}{0.083}$$

$$T = 310K = 37^{\circ}C$$

Conclusion: The correct answer is 37°C.

Quick Tip

Osmotic pressure is directly proportional to temperature and solute concentration.

---

94. A compound X contains 32% of A, 20% of B, and the remaining percentage of C. Then, the empirical formula of X is:

(Given atomic masses of A = 64; B = 40; C = 32 u)

(1) ABC_3

(2) AB_2C_2

(3) ABC_4

(4) A_2BC_2

Correct Answer: (1) ABC_3

Solution:

We are given the following information:

- Percentage of A = 32%

- Percentage of B = 20%

- Percentage of C = $100\% - (32\% + 20\%) = 48\%$

We are also given the atomic masses:

- Atomic mass of A = 64 u

- Atomic mass of B = 40 u

- Atomic mass of C = 32 u

Step 1: Calculate the moles of each element

The number of moles of each element is given by:

$$\text{Moles of A} = \frac{\text{Mass of A}}{\text{Molar mass of A}} = \frac{32}{64} = 0.5 \text{ moles}$$

$$\text{Moles of B} = \frac{\text{Mass of B}}{\text{Molar mass of B}} = \frac{20}{40} = 0.5 \text{ moles}$$

$$\text{Moles of C} = \frac{\text{Mass of C}}{\text{Molar mass of C}} = \frac{48}{32} = 1.5 \text{ moles}$$

Step 2: Find the simplest whole number ratio

Now, we divide the moles of each element by the smallest number of moles (which is 0.5):

$$\text{Ratio of A} = \frac{0.5}{0.5} = 1$$

$$\text{Ratio of B} = \frac{0.5}{0.5} = 1$$

$$\text{Ratio of C} = \frac{1.5}{0.5} = 3$$

Step 3: Determine the empirical formula

The simplest whole number ratio of A, B, and C is 1:1:3. Therefore, the empirical formula is ABC_3.

Thus, the correct answer is:

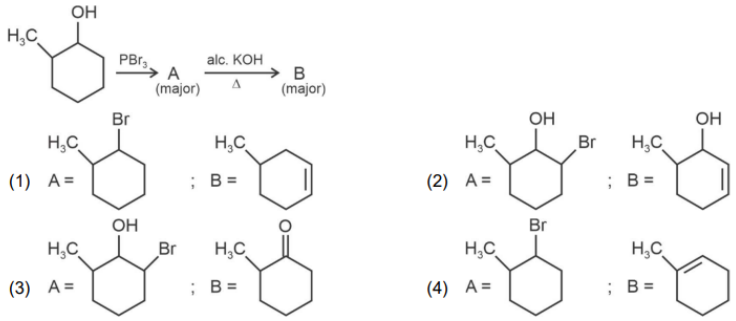
$$\boxed{ABC_3}$$

Quick Tip

The empirical formula can be determined by calculating the moles of each element based on their percentages and atomic masses, then finding the simplest whole number ratio.

---

95. Major products A and B formed in the following reaction sequence, are:



Correct Answer: (4) A = 1-Bromo-1-methylcyclohexane, B = 1-Methylcyclohexene

Solution:

Step 1: Formation of A using PBr_3

- PBr_3 replaces the hydroxyl (-OH) group with a bromine (Br) atom through nucleophilic substitution.

- The major product A is 1-Bromo-1-methylcyclohexane.

Step 2: Elimination to Form B

- Treating A with alcoholic KOH (alc. KOH,) leads to -elimination (E2 reaction).

- This removes HBr, forming a double bond at the most stable position.

- The major product B is 1-Methylcyclohexene.

Conclusion: The correct products are A = 1-Bromo-1-methylcyclohexane, B = 1-Methylcyclohexene.

Quick Tip

PBr_3 is a mild reagent for converting alcohols to alkyl bromides, while alc. KOH favors elimination (E2 mechanism).

---

96. During the preparation of Mohr's salt solution (Ferrous ammonium sulphate), which of the following acid is added to prevent hydrolysis of Fe^{2+} ion?

(1) Concentrated sulphuric acid

(2) Dilute nitric acid

(3) Dilute sulphuric acid

(4) Dilute hydrochloric acid

Correct Answer: (3) Dilute sulphuric acid

Solution:

Step 1: Understanding the role of acid in Mohr's salt preparation

- Mohr's salt, $FeSO_4.(NH_4)_2SO_4.6H_2O$, is prone to hydrolysis, forming $Fe(OH)_2$, which is insoluble.

- Dilute sulphuric acid prevents this hydrolysis by providing excess H^+ ions, shifting equilibrium towards Fe^{2+} ions in solution.

Conclusion: The correct answer is dilute sulphuric acid because it prevents the oxidation and hydrolysis of Fe^{2+} ions.

Quick Tip

Always add dilute H_2SO_4 when preparing Fe^{2+} solutions to prevent oxidation to Fe^{3+} and hydrolysis.

---

97. Consider the following reaction in a sealed vessel at equilibrium with concentrations of $N_2 = 3.0 \times 10^{-3}$ M, $O_2 = 4.2 \times 10^{-3}$ M and NO = 2.8×10^{-3} M.

$2NO_{(g)} \rightleftharpoons N_2(g) + O_2(g)$

If 0.1 mol L^{-1} of $NO_{(g)}$ is taken in a closed vessel, what will be the degree of dissociation (α) of $NO_{(g)}$ at equilibrium?

(1) 0.0889

(2) 0.8889

(3) 0.717

(4) 0.00889

Correct Answer: (3) 0.717

Solution:

Step 1: Define degree of dissociation (α)

$$\alpha = \frac{\text{moles dissociated at equilibrium}}{\text{initial moles}}$$

Step 2: Use given concentrations and formula

$$\alpha = \frac{0.1 - 2.8 \times 10^{-3}}{0.1}$$

$$= \frac{0.0972}{0.1} = 0.717$$

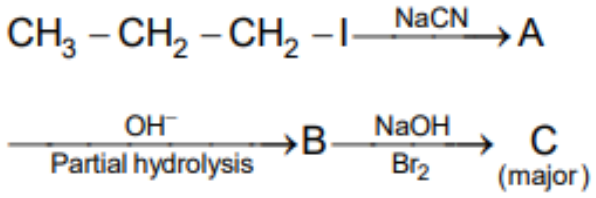
Conclusion: The correct degree of dissociation is 0.717.

Quick Tip

For equilibrium problems, always define initial concentration, change, and equilibrium concentration (ICE method) to calculate α.

---

98. Identify the major product C formed in the following reaction sequence:



(1) Butylamine

(2) Butanamide

(3) α-Bromobutanoic acid

(4) Propylamine

Correct Answer: (4) Propylamine

Solution:

Step 1: Hydrolysis of Nitrile (-CN) to Carboxylate ($-COO^-$)

- The first step involves alkaline hydrolysis of butanenitrile (-CN) to form butanoate ion (A).

Step 2: Hoffmann Bromamide Reaction

- Treating butanoate ion with NaOH + Br_2 (Hoffmann reaction) leads to decarboxylation and formation of Propylamine (C).

$$CH_3-CH_2-CH_2-CN \xrightarrow{OH^-} CH_3-CH_2-CH_2-COO^- \xrightarrow{NaOH,\ Br_2} CH_3-CH_2-CH_2-NH_2$$

Conclusion: The final major product C is Propylamine.

Quick Tip

Hoffmann Bromamide Reaction converts an amide ($-CONH_2$) to a primary amine ($-NH_2$) with one carbon less.

---

99. Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is (Given: Molar mass of Cu = 63 g mol^{-1}, 1 F = 96487 C)

(1) 0.315 g

(2) 31.5 g

(3) 0.0315 g

(4) 3.15 g

Correct Answer: (1) 0.315 g

Solution:

Step 1: Use Faraday's First Law of Electrolysis

$$m = \frac{ZIt}{F}$$

where, - m = mass of deposited copper

- Z = electrochemical equivalent = $\frac{\text{Molar Mass}}{\text{nF}} = \frac{63}{2\times96487}$

- $I = 9.6487$ A

- $t = 100$ s

- $F = 96487$ C

Step 2: Substituting values

$$m = \frac{63 \times 9.6487 \times 100}{2 \times 96487}$$

$$m = 0.315 \text{ g}$$

Conclusion: The mass of copper deposited is 0.315 g.

Quick Tip

Faraday's Laws of Electrolysis: The amount of substance deposited is directly proportional to charge passed through the solution.

---

100. Given below are two statements:

Statement I: $[Co(NH_3)_6]^{3+}$ is a homoleptic complex whereas $[Co(NH_3)_4Cl_2]^{+}$ is a heteroleptic complex.

Statement II: Complex $[Co(NH_3)_6]^{3+}$ has only one kind of ligands but $[Co(NH_3)_4Cl_2]^{+}$ has more than one kind of ligands.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (4) Both Statement I and Statement II are true

Solution:

Step 1: Understanding Homoleptic and Heteroleptic Complexes

- A homoleptic complex contains only one type of ligand.

- Example: $[Co(NH_3)_6]^{3+}$ contains only NH_3 ligands.

- A heteroleptic complex contains more than one type of ligand.

- Example: $[Co(NH_3)_4Cl_2]^{+}$ contains NH_3 and Cl ligands.

Step 2: Evaluating the statements

- Statement I is true: $[Co(NH_3)_6]^{3+}$ is homoleptic and $[Co(NH_3)_4Cl_2]^{+}$ is heteroleptic.

- Statement II is true: $[Co(NH_3)_6]^{3+}$ has only NH_3 ligands, while $[Co(NH_3)_4Cl_2]^{+}$ has two different ligands (NH_3 and Cl).

Conclusion: Both statements are correct.

Quick Tip

Homoleptic complexes have only one type of ligand, whereas **heteroleptic complexes** have more than one type.

Botany

Section A

101. Lecithin, a small molecular weight organic compound found in living tissues, is an example of:

(1) Phospholipids

(2) Glycerides

(3) Carbohydrates

(4) Amino acids

Correct Answer: (1) Phospholipids

Solution:

Understanding Lecithin

Step 1: Defining Lecithin

- Lecithin is a **phospholipid** found in living tissues, especially in the **cell membrane**.
- It plays a crucial role in **maintaining membrane fluidity** and **cell signaling**.

Step 2: Evaluating Other Options

- **Glycerides:** These are esters formed from **glycerol and fatty acids**, differing from phospholipids.
- **Carbohydrates:** Sugars and starches, which serve as **energy sources** rather than structural components of membranes.
- **Amino Acids:** The building blocks of **proteins**, not phospholipids.

Conclusion:

Lecithin belongs to the **phospholipid** category.

Quick Tip

Phospholipids are essential components of cell membranes and play a key role in emulsification of fats.

---

102. These are regarded as major causes of biodiversity loss:

A. Over exploitation

B. Co-extinction

C. Mutation

D. Habitat loss and fragmentation

E. Migration

Choose the correct option:

(1) A, B, C and D only

(2) A, B and E only

(3) A, B and D only

(4) A, C and D only

Correct Answer: (3) A, B and D only

Solution:

Understanding Causes of Biodiversity Loss

Step 1: Identifying Major Causes of Biodiversity Loss

- **Over-exploitation (A):** Excessive use of species for **commercial purposes** significantly reduces biodiversity.

- **Co-extinction (B):** If one species goes extinct, species that depend on it also face **a high risk of extinction**.
- **Habitat loss and fragmentation (D):** The **destruction of natural habitats** leads to the loss of biodiversity and ecosystem imbalance.

Step 2: Evaluating Other Options

- **Mutation (C):** Mutations contribute to **genetic variation** rather than biodiversity loss.
- **Migration (E):** Migration can **impact local biodiversity** but is not a direct cause of biodiversity loss.

Conclusion:

The primary causes of biodiversity loss are **over-exploitation, co-extinction, and habitat loss**.

Quick Tip

Biodiversity loss is mainly caused by habitat destruction, over-exploitation, pollution, and climate change.

---

103. Which one of the following is not a criterion for classification of fungi?

(1) Mode of nutrition

(2) Mode of spore formation

(3) Fruiting body

(4) Morphology of mycelium

Correct Answer: (1) Mode of nutrition

Solution:

Understanding Fungal Classification

Step 1: Basis of Fungal Classification

- Fungi are classified based on their **spore formation**, **fruiting bodies**, and **mycelial structure**.

Step 2: Evaluating the Classification Criteria

- **Mode of Nutrition (Incorrect Criterion):**
  - Most fungi are **heterotrophic**, including saprophytic, parasitic, or mutualistic forms.
  - However, **fungal classification is based on structural and reproductive characteristics, not nutrition**.
- **Spore Formation (Correct Criterion):**
  - Fungi reproduce via **spores**, and their type and formation vary among different fungal groups.
- **Fruiting Body (Correct Criterion):**
  - The **structure of the fruiting body** differentiates fungal groups such as **Basidiomycetes** and **Ascomycetes**.
- **Morphology of Mycelium (Correct Criterion):**
  - The **hyphal structure and mycelial organization** are key features in fungal classification.

Conclusion:

Fungal classification is based on **spore formation, fruiting body structure, and mycelial morphology**, but **not mode of nutrition**.

Quick Tip

Fungi are classified based on reproductive structures, not their mode of nutrition.

---

104. A pink flowered Snapdragon plant was crossed with a red flowered Snapdragon plant. What type of phenotype(s) is/are expected in the progeny?

(1) Red flowered as well as pink flowered plants

(2) Only pink flowered plants

(3) Red, Pink as well as white flowered plants

(4) Only red flowered plants

Correct Answer: (1) Red flowered as well as pink flowered plants

Solution:

Understanding Snapdragon Flower Color Inheritance

Step 1: Incomplete Dominance in Snapdragon Flowers

- Snapdragon flowers exhibit **incomplete dominance**.
- A cross between a **red-flowered** (RR) and a **pink-flowered** (Rr) plant follows the inheritance pattern:

$$RR \times Rr \rightarrow \text{Produces Red and Pink flowers in a 1:1 ratio.}$$

Step 2: Punnett Square Analysis

	R	r
R	RR(Red)	Rr(Pink)

- **50%** of the offspring = **Red** (RR).
- **50%** of the offspring = **Pink** (Rr).

Conclusion:

The correct answer is that the offspring will consist of **red and pink flowered plants**.

Quick Tip

Incomplete dominance occurs when neither allele is completely dominant, leading to an intermediate phenotype.

---

105. Which one of the following can be explained on the basis of Mendel's Law of Dominance?

A. Out of one pair of factors, one is dominant and the other is recessive.

B. Alleles do not show any expression and both characters appear as such in the F2 generation.

C. Factors occur in pairs in normal diploid plants.

D. The discrete unit controlling a particular character is called a factor.

E. The expression of only one of the parental characters is found in a monohybrid cross.

Choose the correct answer from the options given below:

(1) A, C, D and E only

(2) B, C and D only

(3) A, B, C, D and E

(4) A, B and C only

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

Solution:

Step 1: Understanding Mendel's Law of Dominance

- Mendel's Law of Dominance states that in a pair of alleles, one allele is dominant over the other.

- The dominant allele is expressed in the F1 generation, while the recessive allele is masked but reappears in F2 generation in a 3:1 ratio.

Step 2: Evaluating the Given Statements

- A (True): One allele is dominant while the other is recessive.

- B (False): Mendel's experiments showed that recessive traits do reappear, but not as independent characters in F2.

- C (True): Genes exist in pairs in diploid organisms.

- D (True): Mendel called the unit of inheritance a "factor" (now known as a gene).

- E (True): Only one of the parental characters appears in F1 generation due to dominance.

Conclusion: The correct answer is A, C, D, and E only.

Quick Tip

Mendel's Law of Dominance explains why dominant traits appear in F1 generation, while recessive traits reappear in F2 generation.

---

106. Tropical regions show the greatest level of species richness because:

A. Tropical latitudes have remained relatively undisturbed for millions of years, hence more time was available for species diversification.

B. Tropical environments are more seasonal.

C. More solar energy is available in tropics.

D. Constant environments promote niche specialization.

E. Tropical environments are constant and predictable.

Choose the correct answer from the options given below:

(1) A and B only

(2) A, B and E only

(3) A, B and D only

(4) A, C, D and E only

Correct Answer: (4) A, C, D and E only

Solution:

Step 1: Understanding Species Richness in Tropical Regions

- Tropical ecosystems exhibit high biodiversity due to favorable environmental conditions.
- High solar energy availability supports greater primary productivity.

Step 2: Evaluating the Given Statements

- A (True): Stability over millions of years allows more species diversification.
- B (False): Tropical environments are less seasonal, making them more predictable for species survival.
- C (True): More solar energy leads to higher photosynthesis, supporting a larger biomass.
- D (True): Constant environments allow for niche specialization, leading to more species.
- E (True): Predictable climate enables stable ecosystems with complex food webs.

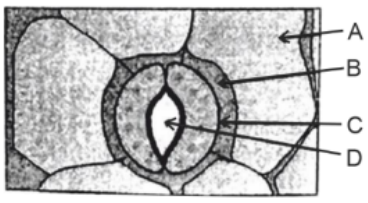
Conclusion: The correct answer is A, C, D, and E only.

Quick Tip

Tropical regions are biodiversity hotspots due to stable climate, high solar energy, and evolutionary history.

---

107. In the given figure, which component has thin outer walls and highly thickened inner walls?



Correct Answer: (4) C

Solution:

Step 1: Identifying Thickened Cell Walls in Plant Tissues

- Xylem vessels and tracheids have thickened secondary walls to support water transport.
- The inner walls are highly thickened, while outer walls are relatively thin.

Step 2: Evaluating the Components in the Given Figure

- D: Could be parenchyma, which has thin walls.
- A: Possibly phloem, which has sieve elements with thin walls.
- B: Could be companion cells, supporting phloem transport.
- C: Likely to be xylem vessels, which have thickened secondary walls for conducting water under tension.

Conclusion: The component C has thin outer walls and highly thickened inner walls, making it the correct answer.

Quick Tip

Xylem vessels have thickened secondary walls to withstand water transport pressure.

---

108. The cofactor of the enzyme carboxypeptidase is:

(1) Niacin

(2) Flavin

(3) Haem

(4) Zinc

Correct Answer: (4) Zinc

Solution:

Step 1: Understanding Enzyme Cofactors

- Carboxypeptidase is a metalloenzyme involved in protein digestion.
- It requires a metallic ion as a cofactor to function efficiently.

Step 2: Identifying the Correct Cofactor

- Niacin (Vitamin B3): Functions as a precursor for NAD+ and NADP+.
- Flavin (Riboflavin derivative): Functions in redox reactions.

- Haem: Present in cytochromes, catalase, and hemoglobin.

- Zinc (Correct Answer): Acts as a structural and catalytic cofactor for carboxypeptidase.

Conclusion: Zinc is the required cofactor for carboxypeptidase.

Quick Tip

Metalloenzymes, such as carboxypeptidase, require metallic ions like Zinc for proper catalytic activity.

---

109. Given below are two statements:

Statement I: Chromosomes become gradually visible under a light microscope during the leptotene stage.

Statement II: The beginning of the diplotene stage is recognized by the dissolution of synaptonemal complex.

Choose the correct answer from the options given below:

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (4) Both Statement I and Statement II are true

Solution:

Step 1: Understanding Meiotic Prophase-I Stages

- Leptotene Stage: Chromosomes appear as thin threads and gradually become visible under a microscope.

- Diplotene Stage: Characterized by chiasmata formation and dissolution of the synaptonemal complex.

Step 2: Evaluating the Given Statements

- Statement I (True): Chromosomes first become visible during the leptotene stage.

- Statement II (True): The synaptonemal complex dissolves at the diplotene stage, allowing recombination events to become visible.

Conclusion: Since both statements correctly describe their respective meiotic stages, the

answer is option (4).

Quick Tip

Meiotic Prophase-I is divided into five stages: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis. Each stage has distinct chromosomal changes.

---

110. What is the fate of a piece of DNA carrying only a gene of interest, which is transferred into an alien organism?

A. The piece of DNA would be able to multiply itself independently in the progeny cells of the organism.

B. It may get integrated into the genome of the recipient.

C. It may multiply and be inherited along with the host DNA.

D. The alien piece of DNA is not an integral part of the chromosome. E. It shows the ability to replicate.

Choose the correct answer from the options given below:

(1) D and E only

(2) B and C only

(3) A and E only

(4) A and B only

Correct Answer: (2) B and C only

Solution:

Step 1: Understanding DNA Integration in Host Cells

- When a foreign gene is introduced into an alien organism, two possible fates occur:

- Integration into the genome (B).

- Replication along with host DNA (C).

Step 2: Evaluating the Given Statements

- A (False): DNA alone cannot multiply without a replication origin (ORI site).

- B (True): The foreign gene may integrate into the genome via recombination.

- C (True): Once integrated, it may be replicated and inherited along with host DNA.

- D (False): The foreign gene may integrate into the genome, so it does not necessarily

remain separate.

- E (False): DNA without an ORI cannot replicate independently.

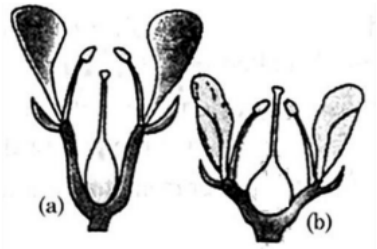
Conclusion: The correct answer is B and C only.

Quick Tip

For successful gene expression, a foreign gene must integrate into the host genome or replicate with a suitable vector.

---

111. Identify the type of flowers based on the position of calyx, corolla, and androecium with respect to the ovary from the given figures (a) and (b).



(1) (a) Hypogynous; (b) Epigynous

(2) (a) Perigynous; (b) Epigynous

(3) (a) Perigynous; (b) Perigynous

(4) (a) Epigynous; (b) Hypogynous

Correct Answer: (3) (a) Perigynous; (b) Perigynous

Solution:

Step 1: Understanding Floral Arrangements

- Hypogynous Flowers: Ovary is superior, other floral parts are below.

- Perigynous Flowers: Ovary is semi-inferior, floral parts are around the ovary.

- Epigynous Flowers: Ovary is inferior, floral parts are above.

Step 2: Evaluating the Given Figures

- Figure (a): Ovary appears semi-inferior, surrounded by floral parts $\rightarrow$ Perigynous.

- Figure (b): Similar structure is seen, indicating Perigynous condition.

Conclusion: The correct answer is Perigynous for both (a) and (b).

Quick Tip

Floral structures can be classified based on ovary position: Hypogynous (superior ovary), Perigynous (semi-inferior ovary), and Epigynous (inferior ovary).

---

112. Match List I with List II:

List I	List II
A.Two or more alternative forms of a gene	I.Back cross
B.Cross of F1 progeny with homozygous recessive parent	II.Ploidy
C.Cross of F1 progeny with any of the parents	III.Allele
D.Number of chromosome sets in plant	IV.Test cross

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Understanding Genetic Terminology and Matching

Step 1: Understanding the Terminology

- **Allele (III):** Different **alternative forms of a gene**.
- **Test Cross (IV):** Crossing an **F_1 hybrid** with a **homozygous recessive parent** to determine genotype.
- **Back Cross (I):** Crossing an **F_1 hybrid** with **any of the original parents**.
- **Ploidy (II):** The **number of chromosome sets** in an organism.

Conclusion:

The correct matching is:

$$A \to III, \quad B \to IV, \quad C \to I, \quad D \to II.$$

Quick Tip

A test cross is used to determine the genotype of an organism by crossing it with a homozygous recessive parent.

---

113. Formation of interfascicular cambium from fully developed parenchyma cells is an example of:

(1) Redifferentiation

(2) Dedifferentiation

(3) Maturation

(4) Differentiation

Correct Answer: (2) Dedifferentiation

Solution:

Step 1: Understanding the Process

- Dedifferentiation occurs when a fully differentiated cell regains its ability to divide.

- Interfascicular cambium originates from parenchyma cells, which were previously non-dividing.

Step 2: Eliminating Incorrect Options

- Redifferentiation (Incorrect): A dedifferentiated cell can later re-specialize, but the formation of interfascicular cambium is not redifferentiation.

- Maturation (Incorrect): Maturation refers to the final functional form of a cell.

- Differentiation (Incorrect): Differentiation is a one-way process where cells become specialized.

Conclusion: The process is dedifferentiation, making the correct answer option (2).

Quick Tip

Dedifferentiation allows plants to regain lost tissues and heal wounds by forming meristematic cells.

---

114. Which of the following is an example of an actinomorphic flower?

(1) Cassia

(2) Pisum

(3) Sesbania

(4) Datura

Correct Answer: (4) Datura

Solution:

Step 1: Understanding Actinomorphic Flowers

- Actinomorphic flowers exhibit radial symmetry, meaning they can be divided into equal halves along multiple planes.

- Datura is an example of an actinomorphic flower.

Step 2: Identifying Incorrect Options

- Cassia (Incorrect): It is zygomorphic (bilaterally symmetrical).

- Pisum (Incorrect): It is zygomorphic.

- Sesbania (Incorrect): It is also zygomorphic.

Conclusion: The correct answer is Datura.

Quick Tip

Actinomorphic flowers have radial symmetry, meaning they can be divided into equal halves from multiple planes.

---

115. Hind II always cuts DNA molecules at a particular point called the recognition sequence, which consists of:

(1) 6 bp

(2) 4 bp

(3) 10 bp

(4) 8 bp

Correct Answer: (1) 6 bp

Solution:

Step 1: Understanding Restriction Enzymes

- Hind II was the first restriction enzyme discovered and recognizes a 6 base-pair (bp) sequence.

Step 2: Identifying Incorrect Options

- 4 bp (Incorrect): Some restriction enzymes recognize 4 bp, but Hind II recognizes 6 bp.

- 8 bp (Incorrect): Hind II does not require an 8 bp sequence.

- 10 bp (Incorrect): Some rare restriction enzymes recognize 10 bp, but not Hind II.

Conclusion: The correct answer is 6 bp.

Quick Tip

Hind II was the first restriction enzyme discovered and recognizes a 6 bp palindromic sequence.

---

116. Which of the following are required for the dark reaction of photosynthesis?

(1) B, C and D only

(2) C, D and E only

(3) D and E only

(4) A, B and C only

Correct Answer: (2) C, D and E only

Solution:

Step 1: Understand the dark reaction.

The dark reaction (Calvin Cycle) occurs in the stroma of chloroplasts and does not require light directly.

Step 2: Identify required components.

- CO2 (C): It is the carbon source for glucose synthesis.

- ATP (D) and NADPH (E): These provide energy and reducing power.

Conclusion: The correct option is (**2**).

Quick Tip

Dark reaction relies on ATP and NADPH produced in the light reaction for CO2 fixation.

---

117. Given below are two statements:

Statement I: Bt toxins are insect group-specific and coded by a gene cry IAc.

Statement II: Bt toxin exists as an inactive protoxin in *B. thuringiensis*. However, after ingestion by the insect, the inactive protoxin gets converted into an active form due to the acidic pH of the insect gut.

Choose the correct answer from the options given below:

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (2) Statement I is true but Statement II is false

Solution: Step 1: Understanding Bt toxin.

- Bt toxins are encoded by **cry genes** and are specific to insect groups.

- Bt toxin exists as an inactive protoxin in *Bacillus thuringiensis* but is activated in the insect's gut.

Step 2: Correct the misconception.

- Activation of Bt toxin occurs in an alkaline pH, not an acidic pH.

Conclusion: The correct option is (**2**).

Quick Tip

Bt toxin is only activated in an alkaline pH environment, not acidic.

---

118. The equation of Verhulst-Pearl logistic growth is:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

From this equation, K indicates:

(1) Biotic potential

(2) Carrying capacity

(3) Population density

(4) Intrinsic rate of natural increase

Correct Answer: (2) Carrying capacity

Solution:

Step 1: Understanding logistic growth.

- Logistic growth considers environmental resistance, unlike exponential growth.

Step 2: Role of K.

- K represents carrying capacity, the maximum sustainable population.

Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

Carrying capacity (K) is the maximum population size an environment can sustain indefinitely.

---

119. The capacity to generate a whole plant from any cell of the plant is called:

(1) Micropropagation

(2) Differentiation

(3) Somatic hybridization

(4) Totipotency

Correct Answer: (4) Totipotency

Solution:

Step 1: Understanding totipotency.

- Totipotency is the ability of a single cell to regenerate into a whole plant.

Step 2: Compare with other terms.

- **Micropropagation**: In-vitro mass propagation.

- **Differentiation**: Specialization of cells.

- **Somatic hybridization**: Fusion of protoplasts from different species.

Conclusion: The correct option is $(\mathbf{4})$.

Quick Tip

Totipotency is fundamental in plant tissue culture and regeneration.

---

120. The type of conservation in which the threatened species are taken out from their

natural habitat and placed in a special setting where they can be protected and given special care is called:

(1) Biodiversity conservation

(2) Semi-conservative method

(3) Sustainable development

(4) In-situ conservation

Correct Answer: (1) Biodiversity conservation

Solution:

Step 1: Understanding conservation methods.

- In-situ conservation: Protecting species in their natural habitat (e.g., National Parks).

- Ex-situ conservation: Protecting species outside their natural habitat (e.g., Zoos, Botanical Gardens).

Step 2: Why biodiversity conservation?

- Conservation includes both in-situ and ex-situ strategies.

Conclusion: The correct option is (1).

Quick Tip

Ex-situ conservation involves zoos, botanical gardens, and seed banks.

---

121. The lactose present in the growth medium of bacteria is transported to the cell by the action of:

(1) Acetylase

(2) Permease

(3) Polymerase

(4) Beta-galactosidase

Correct Answer: (2) Permease

Solution:

Step 1: Understanding the lactose uptake mechanism.

- In bacterial cells, lactose is transported across the cell membrane by Lactose Permease, an enzyme coded by the *lacY* gene of the lac operon.

Step 2: Role of Permease.

- Permease facilitates active transport of lactose into the bacterial cell, allowing further metabolism by Beta-galactosidase.

Conclusion: The correct option is (**2**).

Quick Tip

Lactose Permease helps bacteria absorb lactose, while Beta-galactosidase hydrolyzes it.

---

122. Spindle fibers attach to kinetochores of chromosomes during:

(1) Metaphase

(2) Anaphase

(3) Telophase

(4) Prophase

Correct Answer: (1) Metaphase

Solution:

Step 1: Understanding the process of mitosis.

- During Metaphase, chromosomes align at the metaphase plate, and spindle fibers attach to kinetochores (protein complexes at the centromere).

Step 2: Role of Spindle Fibers.

- Spindle fibers ensure chromatid separation by pulling them towards opposite poles during Anaphase.

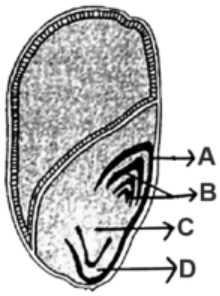
Conclusion: The correct option is (**1**).

Quick Tip

Spindle fibers attach to kinetochores during Metaphase to align chromosomes for separation.

---

123. Identify the part of the seed from the given figure which is destined to form the root when the seed germinates.



(1) B

(2) C

(3) D

(4) A

Correct Answer: (2) C

Solution:

Step 1: Understanding seed anatomy.

- The Radicle is the first structure to emerge during germination and later develops into the root system.

Step 2: Identify the correct part in the diagram.

- The labeled ”C” in the given figure corresponds to the Radicle.

Conclusion: The correct option is (**2**).

Quick Tip

The radicle forms the root, while the plumule develops into the shoot.

---

124. A transcription unit in DNA is defined primarily by the three regions in DNA and these are with respect to upstream and downstream ends:

(1) Structural gene, Transposons, Operator gene

(2) Inducer, Repressor, Structural gene

(3) Promoter, Structural gene, Terminator

(4) Repressor, Operator gene, Structural gene

Correct Answer: (3) Promoter, Structural gene, Terminator

Solution:

Step 1: Understanding transcription units.

A transcription unit consists of:

- Promoter: Binding site for RNA polymerase.

- Structural gene: Encodes the protein or RNA.

- Terminator: Signals the end of transcription.

Step 2: Why the correct answer?

- **Transposons and repressors** are regulatory elements, not part of a transcription unit.

Conclusion: The correct option is (**3**).

Quick Tip

A transcription unit in DNA has a promoter, structural gene, and terminator.

---

125. How many molecules of ATP and NADPH are required for every molecule of CO2 fixed in the Calvin cycle?

(1) 2 molecules of ATP and 2 molecules of NADPH

(2) 3 molecules of ATP and 3 molecules of NADPH

(3) 3 molecules of ATP and 2 molecules of NADPH

(4) 2 molecules of ATP and 3 molecules of NADPH

Correct Answer: (3) 3 molecules of ATP and 2 molecules of NADPH

Solution:

Step 1: Role of ATP and NADPH in the Calvin Cycle.

- The Calvin cycle (C3 cycle) occurs in the stroma of chloroplasts.

- Each CO2 molecule fixed requires:

- 3 ATP for energy.

- 2 NADPH for reduction reactions.

Step 2: Why this requirement?

- ATP is used in the Regeneration Phase.

- NADPH provides electrons for Reduction Phase.

Conclusion: The correct option is (**3**).

Quick Tip

For every CO2 fixed in the Calvin cycle, 3 ATP and 2 NADPH are needed.

---

126. Given below are two statements:

Statement I: Parenchyma is living but collenchyma is dead tissue.

Statement II: Gymnosperms lack xylem vessels but presence of xylem vessels is the characteristic of angiosperms.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (3) Statement I is false but Statement II is true

Solution:

Step 1: Understanding the nature of parenchyma and collenchyma.

- Parenchyma is a living tissue and functions in storage, photosynthesis, and secretion.

- Collenchyma is also a living tissue, not a dead tissue.

Step 2: Understanding xylem vessels in plants.

- Gymnosperms lack xylem vessels and transport water via tracheids.

- Angiosperms possess xylem vessels, which improve water conduction.

Conclusion: Statement I is incorrect, but Statement II is correct.

Quick Tip

Parenchyma and collenchyma are living tissues, while sclerenchyma is dead.

---

127. Auxin is used by gardeners to prepare weed-free lawns. But no damage is caused to grass as auxin:

(1) Promotes abscission of mature leaves only.

(2) Does not affect mature monocotyledonous plants.

(3) Can help in cell division in grasses, to produce growth.

(4) Promotes apical dominance.

Correct Answer: (2) Does not affect mature monocotyledonous plants.

Solution:

Step 1: Understanding auxin's role in plant growth.

- Auxins are growth hormones used as selective herbicides.

- They kill dicot weeds but do not harm monocot grasses like wheat and rice.

Step 2: Why monocots are unaffected?

- Monocots lack broad leaves, so they do not absorb auxins as effectively as dicots.

Conclusion: The correct option is (**2**).

Quick Tip

Auxins are used as selective herbicides to eliminate dicot weeds without harming monocots.

---

128. In a plant, black seed color (BB/Bb) is dominant over white seed color (bb). In order to find out the genotype of the black seed plant, with which of the following genotype will you cross it?

(1) bb

(2) Bb

(3) BB/Bb

(4) BB

Correct Answer: (1) bb

Solution:

Step 1: Understanding the concept of a test cross.

- A test cross is performed to determine whether an organism with a dominant phenotype is homozygous (BB) or heterozygous (Bb).

- The organism is crossed with a homozygous recessive (bb) individual.

Step 2: Analyzing the test cross results.

- If all offspring are black-seeded (**BB × bb** $\rightarrow$ 100 percent Bb), then the plant is

homozygous (BB).

- If a 1:1 ratio of black and white seeds appears (**Bb × bb** $\rightarrow$ 50 Bb, 50 bb), the plant is heterozygous (Bb).

Conclusion: The correct option is $(\mathbf{1})$.

Quick Tip

A test cross always involves crossing with a homozygous recessive (bb) individual.

---

129. Inhibition of Succinic dehydrogenase enzyme by malonate is a classical example of:

(1) Feedback inhibition

(2) Competitive inhibition

(3) Enzyme activation

(4) Cofactor inhibition

Correct Answer: (2) Competitive inhibition

Solution:

Step 1: Understanding enzyme inhibition.

- Competitive inhibition occurs when a molecule similar in structure to the substrate binds to the active site of the enzyme, blocking the actual substrate.

Step 2: Example of Malonate.

- Malonate resembles succinate, the substrate for Succinic dehydrogenase, and binds to its active site.

- This prevents the enzyme from converting succinate to fumarate in the Krebs cycle.

Conclusion: The correct option is $(\mathbf{2})$.

Quick Tip

Competitive inhibitors resemble the substrate and compete for the enzyme's active site.

---

130. Match List I with List II

List I	List II
A. Clostridium butylicum	I. Ethanol
B. Saccharomyces cerevisiae	II. Streptokinase
C. Trichoderma polysporum	III. Butyric acid
D. Streptococcus sp.	IV. Cyclosporin-A

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding microbial products.

- Clostridium butylicum produces butyric acid (A-III).

- Saccharomyces cerevisiae (yeast) is used in ethanol fermentation (B-I).

- Trichoderma polysporum is a source of Cyclosporin-A, an immunosuppressive drug (C-IV).

- Streptococcus sp. produces Streptokinase, which helps in dissolving blood clots (D-II).

Conclusion: The correct option is (**2**).

Quick Tip

Microbes play a crucial role in biotechnology, producing antibiotics, enzymes, and industrial products.

---

131. List of endangered species was released by:

(1) WWF

(2) FOAM

(3) IUCN

(4) GEAC

Correct Answer: (3) IUCN

Solution:

Step 1: Understanding the role of IUCN.

- IUCN (International Union for Conservation of Nature) is responsible for Red List categorization, which assesses global species extinction risks.

- It classifies species into Endangered (EN), Vulnerable (VU), Critically Endangered (CR), and Extinct (EX) categories.

Conclusion: The correct option is (3).

Quick Tip

The IUCN Red List provides data on species conservation status globally.

---

132. Match List I with List II

	List-I		List-II
A.	Nucleolus	I.	Site of formation of glycolipid
B.	Centriole	II.	Organization like the cartwheel
C.	Leucoplasts	III.	Site for active ribosomal RNA synthesis
D.	Golgi apparatus	IV.	For storing nutrients

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding the function of cell organelles.

- Nucleolus is responsible for ribosomal RNA (rRNA) synthesis (A-III).

- Centriole has a cartwheel structure, essential for mitotic spindle formation (B-II).

- Leucoplasts store starch, lipids, and proteins (C-IV).

- Golgi apparatus is involved in lipid synthesis, including glycolipids (D-I).

Conclusion: The correct option is (4).

Quick Tip

Cell organelles have specialized functions essential for maintaining cellular life.

---

133. Match List I with List II

List I (Fungi)	List II (Classification)
A. Rhizopus	I. Mushroom
B. Ustilago	II. Smut fungus
C. Puccinia	III. Bread mould
D. Agaricus	IV. Rust fungus

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding fungal classifications.

- Rhizopus is commonly known as bread mould (A-III).

- Ustilago is a smut fungus, causing diseases in crops (B-II).

- Puccinia is a rust fungus, responsible for rust disease in plants (C-IV).

- Agaricus is a common mushroom, widely consumed (D-I).

Conclusion: The correct option is (4).

Quick Tip

Different fungi cause various plant diseases and also have economic importance.

---

134. Identify the set of correct statements:

A. The flowers of Vallisneria are colourful and produce nectar.

B. The flowers of water lily are not pollinated by water.

C. In most of water-pollinated species, the pollen grains are protected from wetting.

D. Pollen grains of some hydrophytes are long and ribbon-like.

E. In some hydrophytes, the pollen grains are carried passively inside water.

Choose the correct answer from the options given below:

(1) A, B, C and D only

(2) A, C, D and E only

(3) B, C, D and E only

(4) C, D and E only

Correct Answer: (3) B, C, D and E only

Solution:

Understanding pollination in aquatic plants.

- Statement A is incorrect as Vallisneria flowers are not colourful and do not produce nectar.
- Statement B is correct because water lily is pollinated by insects, not water.
- Statement C is correct as pollen grains in water-pollinated species have protective coatings.
- Statement D is correct since some hydrophytic plants have long ribbon-like pollen grains.
- Statement E is correct as some hydrophytes rely on passive water transport for pollination.

Conclusion: The correct option is (**3**).

Quick Tip

Water pollination is rare and occurs mainly in submerged hydrophytes like Vallisneria and Hydrilla.

---

135. Bulliform cells are responsible for:

(1) Protecting the plant from salt stress.

(2) Increased photosynthesis in monocots.

(3) Providing large spaces for storage of sugars.

(4) Inward curling of leaves in monocots.

Correct Answer: (4) Inward curling of leaves in monocots.

Solution:

Understanding bulliform cells.

- Bulliform cells are large, thin-walled epidermal cells found in monocot leaves.

- They help in rolling and folding of leaves to reduce water loss during drought conditions.

- When water availability is low, bulliform cells lose turgidity, causing the leaves to curl inward (Option 4).

Conclusion: The correct option is (4).

Quick Tip

Bulliform cells play a key role in leaf movements and drought resistance in grasses like maize and sugarcane.

Section B

136. Match List I with List II

List I (Types of Stamens)	List II (Example)
A. Monoadelphous	I. Citrus
B. Diadelphous	II. Pea
C. Polyadelphous	III. Lily
D. Epiphyllous	IV. China-rose

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Understanding types of stamens.

- Monoadelphous stamens (A) have filaments fused into a single bundle, found in China-rose (A-IV).

- Diadelphous stamens (B) have filaments fused into two groups, seen in Pea (B-II).

- Polyadelphous stamens (C) have filaments fused into multiple groups, found in Citrus (C-I).

- Epiphyllous stamens (D) are fused with perianth, found in Lily (D-III).

Conclusion: The correct option is (4).

Quick Tip

Different fusion types of stamens help in classifying plants systematically based on their floral morphology.

---

137. Identify the step in the tricarboxylic acid (TCA) cycle, which does not involve oxidation of the substrate.

(1) Succinic acid $\rightarrow$ Malic acid

(2) Succinyl-CoA $\rightarrow$ Succinic acid

(3) Isocitrate $\rightarrow$ α-ketoglutaric acid

(4) Malic acid $\rightarrow$ Oxaloacetic acid

Correct Answer: (2) Succinyl-CoA $\rightarrow$ Succinic acid

Solution:

Understanding oxidation and non-oxidation steps in the TCA cycle.

- The oxidation steps in the Krebs cycle involve NAD+ or FAD+ as electron acceptors.

- The conversion of Succinyl-CoA to Succinic acid does not involve oxidation. Instead, it is associated with substrate-level phosphorylation, generating GTP or ATP.

- Other steps involve oxidation reactions, either removing hydrogens or electrons.

Conclusion: The correct option is (2).

Quick Tip

TCA cycle produces ATP through substrate-level phosphorylation and energy-rich electron carriers via oxidation steps.

---

138. The DNA present in chloroplast is:

(1) Circular, double-stranded

(2) Linear, single-stranded

(3) Circular, single-stranded

(4) Linear, double-stranded

Correct Answer: (1) Circular, double-stranded

Solution:

Understanding chloroplast DNA.

- Chloroplast DNA (cpDNA) is circular and double-stranded, similar to bacterial DNA.

- It is present in multiple copies per chloroplast and encodes essential photosynthetic and metabolic genes.

- Unlike nuclear DNA, cpDNA lacks histones and replicates independently through a semi-autonomous process.

Conclusion: The correct option is (1).

Quick Tip

Chloroplasts, like mitochondria, have their own DNA and ribosomes, supporting the endosymbiotic theory.

---

139. Match List I with List II

List I (Scientist)	List II (Discovery
A. Frederick Griffith	I. Genetic code
B. Francois Jacob & Jacque Monod	II. Semi-conservative mode of DNA replication
C. Har Gobind Khorana	III. Transformation
D. Meselson & Stahl	IV. Lac operon

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Understanding the key discoveries in genetics.

- Frederick Griffith (1928) discovered transformation in bacteria, leading to the idea of a "transforming principle."

- Francois Jacob and Jacque Monod worked on gene regulation and proposed the Lac operon model.

- Har Gobind Khorana helped in deciphering the genetic code.

- Meselson and Stahl experimentally proved the semi-conservative replication of DNA.

Conclusion: The correct option is (**1**).

Quick Tip

Genetic discoveries have helped decode DNA functions, gene expression, and cellular mechanisms.

---

140. Which of the following are fused in somatic hybridization involving two varieties of plants?

(1) Somatic embryos

(2) Protoplasts

(3) Pollens

(4) Callus

Correct Answer: (2) Protoplasts

Solution:

Understanding somatic hybridization.

- Somatic hybridization is a method where protoplasts (cells without cell walls) are fused to form a hybrid cell.

- It is used in plant tissue culture to combine genetic material from two different plant species.

- Fusion of protoplasts is achieved using polyethylene glycol (PEG) or electrofusion.

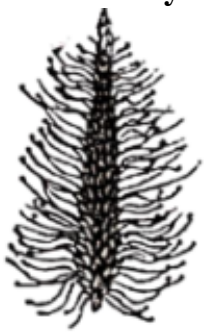
Conclusion: The correct option is (**2**).

Quick Tip

Somatic hybridization allows the combination of desirable traits from different plant species.

---

141. Identify the correct description about the given figure:



(1) Water pollinated flowers showing stamens with mucilaginous covering.

(2) Cleistogamous flowers showing autogamy.

(3) Compact inflorescence showing complete autogamy.

(4) Wind pollinated plant inflorescence showing flowers with well-exposed stamens.

Correct Answer: (4) Wind pollinated plant inflorescence showing flowers with well-exposed stamens.

Solution:

Understanding wind pollination characteristics.

- Wind-pollinated plants (anemophilous) have well-exposed stamens to facilitate pollen dispersal.

- Their pollen grains are lightweight and non-sticky, aiding easy transport by wind.

- Examples include grasses, maize, and many cereal crops.

Conclusion: The correct option is (4).

Quick Tip

Wind-pollinated flowers typically have feathery stigmas and produce large amounts of pollen.

---

142. Given below are two statements:

Statement I: In C3 plants, some O_2 binds to RuBisCO, hence CO_2 fixation is decreased.

Statement II: In C4 plants, mesophyll cells show very little photorespiration while bundle sheath cells do not show photorespiration.

Choose the correct answer from the options given below:

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (2) Statement I is true but Statement II is false.

Solution:

Step 1: Understanding RuBisCO's oxygenation activity.

- In C3 plants, RuBisCO has an affinity for both CO_2 and O_2. When O_2 binds, photorespiration occurs, reducing CO_2 fixation.

Step 2: Examining photorespiration in C4 plants.

- C4 plants have a special mechanism to minimize photorespiration, but both mesophyll and bundle sheath cells show some level of photorespiration, contrary to the statement.

Conclusion: Since Statement I is true and Statement II is incorrect, the correct answer is (2).

Quick Tip

C4 plants reduce photorespiration by spatially separating carbon fixation between mesophyll and bundle sheath cells.

---

143. Match List I with List II

List I (Scientist)	List II (Discovery)
A. Robert May	I. Species-Area relationship
B. Alexander von Humboldt	II. Long term ecosystem experiment using out door plots
C. Paul Ehrlich	III. Global species diversity at about 7 million
D. David Tilman	IV. Rivet popper hypothesis

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Understanding key contributions in biodiversity.

- Robert May estimated the global species diversity to be around 7 million.

- Alexander von Humboldt formulated the Species-Area relationship, which describes species richness based on area size.

- Paul Ehrlich proposed the Rivet Popper Hypothesis, comparing species in an ecosystem to rivets in an airplane.

- David Tilman conducted long-term ecosystem experiments to study biodiversity and ecosystem stability.

Conclusion: The correct option is (1).

Quick Tip

Biodiversity is crucial for ecosystem stability; small species losses can have major impacts.

---

144. In an ecosystem, if the Net Primary Productivity (NPP) of the first trophic level is $100x$ (kcal m^{-2}yr^{-1}), what would be the Gross Primary Productivity (GPP) of the third trophic level of the same ecosystem?

(1) x (kcal m^{-2}yr^{-1})

(2) $10x$ (kcal m^{-2}yr^{-1})

(3) $\frac{100x}{3}$ (kcal m^{-2}yr^{-1})

(4) $\frac{x}{10}$ (kcal m^{-2}yr^{-1})

Correct Answer: (2) $10x$ (kcal m^{-2}yr^{-1})

Solution:

Step 1: Understanding Energy Transfer in Trophic Levels.

- Energy transfer between trophic levels follows the 10 percent Law of Lindeman, meaning only 10 percent of energy is passed to the next level, while the rest is lost as heat or used in metabolism.

Step 2: Applying the 10 percent Rule.

- The first trophic level (producers) has an NPP of $100x$.
- The second trophic level (primary consumers) receives 10 percent of $100x$ = $10x$.
- The third trophic level (secondary consumers) will receive 10 percent of $10x$ = x.
- The Gross Primary Productivity (GPP) at any trophic level includes energy assimilated, which is higher than NPP.
- Since respiration energy is added, the GPP of the third trophic level is estimated at $10x$.

Conclusion: The correct answer is (2).

Quick Tip

In an ecosystem, only about 10 percent of energy is passed from one trophic level to the next. This limits the number of trophic levels in a food chain.

---

145. Which of the following statement is correct regarding the process of replication in E. coli?

(1) The DNA-dependent RNA polymerase catalyzes polymerization in one direction, that is $5' \rightarrow 3'$.

(2) The DNA-dependent DNA polymerase catalyzes polymerization in $5' \rightarrow 3'$ as well as $3' \rightarrow 5'$ direction.

(3) The DNA-dependent DNA polymerase catalyzes polymerization in $5' \rightarrow 3'$ direction.

(4) The DNA-dependent DNA polymerase catalyzes polymerization in one direction that is $3' \rightarrow 5'$.

Correct Answer: (3) The DNA-dependent DNA polymerase catalyzes polymerization in $5' \rightarrow 3'$ direction.

Solution:

Step 1: Understanding DNA Replication Directionality.

- DNA replication in *E. coli* is carried out by DNA-dependent DNA polymerase.

- It adds nucleotides in the 5' to 3' direction using the template strand.

Step 2: Proofreading Activity.

- Although polymerization occurs in $5' \to 3'$, DNA polymerase also exhibits $3' \to 5'$ exonuclease activity for proofreading.

- However, it does not polymerize in $3' \to 5'$ direction.

Conclusion: The correct answer is (3).

Quick Tip

DNA polymerases can only add nucleotides in the $5' \to 3'$ direction. However, some exhibit $3' \to 5'$ exonuclease activity for proofreading errors.

---

146. Match List I with List II

List I (Process)	List II (Location)
A. Citric acid cycle	I.Cytoplasm
B. Glycolysis	II. Mitochondrial matrix
C. Electron transport system	III. Intermembrane space of mitochondria
D. Proton gradient	IV. Inner mitochondrial membrane

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

Solution:

Identifying the Cellular Locations of Metabolic Processes.

- Citric Acid Cycle (Krebs Cycle): Takes place in the mitochondrial matrix where oxidation of acetyl-CoA occurs.

- Glycolysis: Occurs in the cytoplasm, breaking glucose into pyruvate.

- Electron Transport System (ETS): Located in the inner mitochondrial membrane, where ATP synthesis happens.

- Proton Gradient Formation: Protons accumulate in the intermembrane space, driving ATP synthesis.

Conclusion: The correct answer is (1).

Quick Tip

Cellular respiration occurs in multiple compartments of the cell: Glycolysis in cytoplasm, Krebs cycle in mitochondrial matrix, and ETS in the inner membrane.

---

147. Spraying sugarcane crop with which of the following plant growth regulators increases the length of stem, thus increasing the yield?

(1) Gibberellin

(2) Cytokinin

(3) Abscisic acid

(4) Auxin

Correct Answer: (1) Gibberellin

Solution:

Step 1: Understanding the Role of Gibberellins in Plant Growth.

- Gibberellins promote stem elongation by stimulating cell division and elongation in internodes.

- This is particularly useful in crops like sugarcane, where increased internodal length leads to higher yield.

Step 2: Functions of Other Plant Hormones.

- Cytokinins mainly promote cell division and delay senescence.

- Abscisic Acid (ABA) induces dormancy and stress resistance.

- Auxins are involved in phototropism and root development.

Conclusion: The correct answer is (1) Gibberellin.

Quick Tip

Gibberellins are commonly used in sugarcane and grape cultivation to enhance growth and yield.

---

148. Read the following statements and choose the set of correct statements regarding Phaeophyceae:

A. Asexual reproduction occurs usually by biflagellate zoospores.

B. Sexual reproduction is by oogamous method only.

C. Stored food is in the form of carbohydrates which is either mannitol or laminarin.

D. The major pigments found are chlorophyll a, c, carotenoids, and xanthophyll.

E. Vegetative cells have a cellulosic wall, usually covered on the outside by a gelatinous coating of algin.

Choose the correct answer from the options given below:

(1) B, C, D and E only

(2) A, C, D and E only

(3) A, B, C and E only

(4) A, B, C and D only

Correct Answer: (2) A, C, D and E only

Solution:

Understanding Phaeophyceae.

- Phaeophyceae (Brown Algae) reproduces asexually via biflagellate zoospores, making Statement A correct.

- Stored food in brown algae is mannitol or laminarin, confirming Statement C is correct.

- Their major pigments include chlorophyll a, c, carotenoids, and xanthophyll, supporting Statement D.

- The vegetative cells possess cellulosic walls covered with algin, validating Statement E.

- However, sexual reproduction can be isogamous, anisogamous, or oogamous, making Statement B incorrect.

Conclusion: The correct answer is (2) A, C, D, and E only.

Quick Tip

Phaeophyceae (Brown Algae) stores food in the form of mannitol or laminarin, has a gelatinous algin coating, and exhibits multiple types of sexual reproduction.

---

149. Match List I with List II:

List I (Plant)	List II (Characteristic)
A. Rose	I. Twisted aestivation
B. Pea	II. Perigynous flower
C. Cotton	III. Drupe
D. Mango	IV. Marginal placentation

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Identifying Flower Structures.

- Rose (A) is a perigynous flower, where the ovary is half-inferior, making A-II correct.

- Pea (B) exhibits marginal placentation, where ovules attach along one margin of the ovary, making B-IV correct.

- Cotton (C) has twisted aestivation, a characteristic floral arrangement where petals overlap, making C-I correct.

- Mango (D) produces a drupe, a fleshy fruit with a hard seed, making D-III correct.

Conclusion: The correct answer is (4) A-II, B-IV, C-I, D-III.

Quick Tip

Flowers have distinct characteristics like aestivation (arrangement of petals), placentation, and fruit type, which help in their classification.

---

150. Match List I with List II:

List I (Biological Molecule)	List II (Function)
A. GLUT-4	I.Hormone
B. Insulin	II. Enzyme
C. Trypsin	III. Intercellular ground substance
D. Collagen	IV. Enables glucose transport into cells

Choose the correct answer from the options given below.

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

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

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

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

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

Solution:

Understanding Biological Molecules.

- GLUT-4 (A) is a glucose transporter responsible for moving glucose into cells, making A-IV correct.

- Insulin (B) is a hormone that regulates glucose metabolism, making B-I correct.

- Trypsin (C) is an enzyme that digests proteins in the small intestine, making C-II correct.

- Collagen (D) is an intercellular ground substance, providing structural support, making D-III correct.

Conclusion: The correct answer is (4) A-IV, B-I, C-II, D-III.

Quick Tip

Understanding biological molecules helps in their classification: enzymes catalyze reactions, hormones regulate processes, and transporters facilitate movement across membranes.

Zoology

Section A

151. Match List I with List II:

	List I (Sub Phases of Prophase I)		List II (Specific Characters)
A.	Diakinesis	I.	Synaptonemal complex formation
B.	Pachytene	II.	Completion of terminalisation of chiasmata
C.	Zygotene	III.	Chromosomes look like thin threads
D.	Leptotene	IV.	Appearance of recombination nodules

Choose the correct answer from the options given below

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

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

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

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

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

Solution:

Understanding the sub-phases of Prophase I.

- Diakinesis (A) is the final stage, where chiasmata terminalization completes, confirming A-II.
- Pachytene (B) is marked by the appearance of recombination nodules, ensuring B-IV.
- Zygotene (C) is identified by synaptonemal complex formation, making C-I correct.
- Leptotene (D) is the first stage, where chromosomes appear as thin threads, supporting D-III.

Conclusion: The correct answer is (2) A-II, B-IV, C-I, D-III.

Quick Tip

Prophase I is the longest and most crucial stage in meiosis, consisting of five sub-phases: Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis.

---

152. Consider the following statements:

A. Annelids are true coelomates.

B. Poriferans are pseudocoelomates.

C. Aschelminthes are acoelomates.

D. Platyhelminthes are pseudocoelomates.

Choose the correct answer from the options given below :

(1) A only

(2) C only

(3) D only

(4) B only

Correct Answer: (1) A only

Solution:

Understanding Coelom in Animal Phyla.

- Annelids (A) are true coelomates, making Statement A correct.

- Poriferans (B) lack a body cavity entirely, so they are not pseudocoelomates, making Statement B incorrect.

- Aschelminthes (C) are pseudocoelomates, meaning Statement C is incorrect.

- Platyhelminthes (D) are acoelomates, not pseudocoelomates, making Statement D incorrect.

Conclusion: The correct answer is (1) A only.

Quick Tip

Coelomates have a true coelom (e.g., Annelida), pseudocoelomates have a false coelom (e.g., Nematoda), and acoelomates lack a coelom (e.g., Platyhelminthes).

---

153. Match List I with List II:

	List I		List II
A.	Pons	I.	Provides additional space for Neurons, regulates posture and balance.
B.	Hypothalamus	II.	Controls respiration and gastric secretions.
C.	Medulla	III.	Connects different regions of the brain.
D.	Cerebellum	IV.	Neuro secretory cells

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Brain Functions.

- Pons (A) functions to connect different regions of the brain, making A-III correct.

- Hypothalamus (B) contains neurosecretory cells, controlling homeostasis, confirming B-IV.

- Medulla (C) regulates respiration and gastric secretions, making C-II correct.

- Cerebellum (D) helps in posture and balance, ensuring D-I is correct.

Conclusion: The correct answer is (1) A-III, B-IV, C-II, D-I.

Quick Tip

The brainstem (medulla and pons) controls involuntary functions, the hypothalamus maintains homeostasis, and the cerebellum regulates balance and coordination.

---

154. Which of the following factors are favorable for the formation of oxyhaemoglobin in alveoli?

(1) High pO_2 and Lesser H^+ concentration

(2) Low pCO_2 and High H^+ concentration

(3) Low pCO_2 and High temperature

(4) High pO_2 and High pCO_2

Correct Answer: (1) High pO_2 and Lesser H^+ concentration

Solution:

Step 1: Understanding oxyhaemoglobin formation.

- In alveoli, oxygen binds to hemoglobin to form oxyhaemoglobin.

- The binding is favored by high partial pressure of oxygen (pO_2) and low hydrogen ion concentration (H^+).

Step 2: Effects of pCO_2 and H^+ on oxyhaemoglobin.

- Lower pCO_2 ensures efficient oxygen binding by reducing the Bohr effect.

- Less H^+ concentration prevents hemoglobin from releasing oxygen prematurely.

Conclusion: The correct answer is (1) High pO_2 and Lesser H^+ concentration.

Quick Tip

Oxyhaemoglobin formation in alveoli is favored by high oxygen levels and lower carbon dioxide levels, as these conditions shift hemoglobin's affinity towards oxygen.

---

155. Following are the stages of cell division:

A. Gap 2 phase

B.Cytokinesis

C. Synthesis phase

D. Karyokinesis

E. Gap 1 phase

Choose the correct sequence of stages from the options given below:

(1) E-B-D-A-C

(2) B-D-E-A-C

(3) E-C-A-D-B

(4) C-E-D-A-B

Correct Answer: (3) E-C-A-D-B

Solution:

Understanding the sequence of cell cycle stages.

- Gap 1 (G1) phase (E): The first growth phase, where the cell prepares for DNA synthesis.
- Synthesis (S) phase (C): DNA replication occurs.
- Gap 2 (G2) phase (A): The cell continues to grow and prepares for mitosis.
- Karyokinesis (D): Nuclear division takes place.
- Cytokinesis (B): The final step where the cytoplasm divides, resulting in two daughter cells.

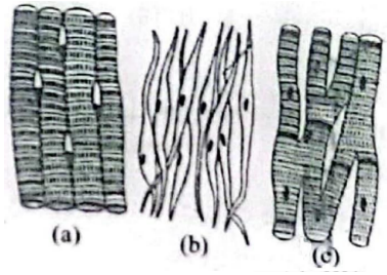
Conclusion: The correct sequence is E-C-A-D-B.

Quick Tip

The correct sequence of the cell cycle is: G1 (growth) → S (DNA replication) → G2 (preparation for mitosis) → M (karyokinesis cytokinesis).

---

156. Three types of muscles are given as (a), (b), and (c). Identify the correct matching pair along with their location in the human body:



(1) (a) Skeletal – Triceps
(b) Smooth – Stomach
(c) Cardiac – Heart

(2) (a) Skeletal – Biceps
(b) Involuntary – Intestine
(c) Smooth – Heart

(3) (a) Involuntary – Nose tip
(b) Skeletal – Bone
(c) Cardiac – Heart

(4) (a) Smooth – Toes
(b) Skeletal – Legs
(c) Cardiac – Heart

Correct Answer: (1) (a) Skeletal – Triceps, (b) Smooth – Stomach, (c) Cardiac – Heart

Solution:

Step 1: Understanding muscle types.

- Skeletal muscles (voluntary) are attached to bones and responsible for movement (e.g., triceps).
- Smooth muscles (involuntary) are found in internal organs like the stomach.
- Cardiac muscles (involuntary) are found in the heart and control heartbeat.

Step 2: Matching muscle types with locations.

- Triceps are skeletal muscles responsible for arm movement.

- Stomach contains smooth muscles, which contract involuntarily for digestion.

- Heart contains cardiac muscles, which pump blood.

Conclusion: The correct answer is (1) Skeletal – Triceps, Smooth – Stomach, Cardiac – Heart.

Quick Tip

Skeletal muscles are voluntary, smooth muscles are involuntary, and cardiac muscles are involuntary but have automatic rhythmic contractions.

---

157. Match List I with List II:

	List I		List II
A.	Down's syndrome	I.	11^{th} chromosome
B.	α-Thalassemia	II.	'X' chromosome
C.	β-Thalassemia	III.	21^{st} chromosome
D.	Klinefelter's syndrome	IV.	16^{th} chromosome

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Chromosomal Disorders.

- Down's syndrome (Trisomy 21) is caused by an extra copy of chromosome 21.

- α-Thalassemia is linked to mutations in chromosome 16 affecting hemoglobin production.

- β-Thalassemia results from defects in chromosome 11 impacting hemoglobin beta-chain.

- Klinefelter's syndrome (XXY condition) affects the X chromosome, leading to male infertility.

Conclusion: The correct matching is (2) A-III, B-IV, C-I, D-II.

Quick Tip

Genetic disorders like Down's syndrome and Klinefelter's syndrome arise due to chromosomal abnormalities, while Thalassemia is due to single-gene mutations.

---

158. Which of the following are Autoimmune disorders?

A. Myasthenia gravis

B. Rheumatoid arthritis

C. Gout

D. Muscular dystrophy

E. Systemic Lupus Erythematosus (SLE)

Choose the most appropriate answer from the options given below:

(1) A, B E only

(2) B, C E only

(3) C, D E only

(4) A, B D only

Correct Answer: (1) A, B E only

Solution:

Understanding Autoimmune Disorders.

- Myasthenia gravis: A neuromuscular autoimmune disorder causing muscle weakness.
- Rheumatoid arthritis: An autoimmune disease where the immune system attacks joints.
- Systemic Lupus Erythematosus (SLE): An autoimmune disease affecting multiple organs.
- Gout and Muscular dystrophy are not autoimmune disorders; gout is a metabolic disorder while muscular dystrophy is genetic.

Conclusion: The correct answer is (1) A, B E only.

Quick Tip

Autoimmune diseases occur when the body's immune system mistakenly attacks its own tissues, leading to chronic inflammation and organ damage.

159. Given below are two statements:

Assertion A:FSH acts upon ovarian follicles in female and Leydig cells in male.

Reason R:Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human beings.

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

(1) Both A and R are true but R is NOT the correct explanation of A

(2) A is true but R is false

(3) A is false but R is true

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

Correct Answer: (3) A is false but R is true

Solution:

Understanding the role of FSH and Leydig cells.

- Follicle Stimulating Hormone (FSH) stimulates ovarian follicles in females, but in males, it stimulates Sertoli cells, not Leydig cells.
- Leydig cells are stimulated by Luteinizing Hormone (LH) and are responsible for testosterone production.
- Estrogen is secreted by growing ovarian follicles, and testosterone is secreted by Leydig cells, which makes the Reason (R) true.

Conclusion: The correct answer is (3) A is false but R is true.

Quick Tip

FSH primarily acts on Sertoli cells in males, whereas LH stimulates Leydig cells to produce androgens.

---

160. Given below are two statements:

Statement I:In the nephron, the descending limb of the loop of Henle is impermeable to water and permeable to electrolytes.

Statement II: The proximal convoluted tubule is lined by simple columnar brush

border epithelium and increases the surface area for reabsorption.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (1) Both Statement I and Statement II are false

Solution:

Understanding the Loop of Henle and Proximal Convoluted Tubule (PCT).

- Descending limb of Henle's loop is permeable to water and impermeable to electrolytes, so Statement I is false.

- Proximal Convoluted Tubule (PCT) is lined by simple cuboidal epithelium with brush borders, not simple columnar epithelium, so Statement II is also false.

Conclusion: The correct answer is (1) Both Statement I and Statement II are false.

Quick Tip

The descending limb of Henle's loop allows water reabsorption, while the PCT is lined by simple cuboidal brush border epithelium for nutrient reabsorption.

---

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

Assertion A: Breast-feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

Reason R:Colostrum contains several antibodies absolutely essential to develop resistance for the newborn baby.

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

(1) Both A and R are correct but R is NOT the correct explanation of A

(2) A is correct but R is not correct

(3) A is not correct but R is correct

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

Correct Answer: (4) Both A and R are correct and R is the correct explanation of A

Solution:

Step 1: Understanding the Importance of Breastfeeding.

- Breastfeeding is highly recommended for newborns as it provides essential nutrients and immunity.

- Colostrum, the first milk, is rich in antibodies such as IgA, which protect against infections.

Step 2: Relationship Between A and R.

- Since colostrum provides passive immunity to the baby, Reason R correctly explains Assertion A.

Conclusion: The correct answer is (4) Both A and R are correct and R is the correct explanation of A.

Quick Tip

Colostrum is rich in antibodies, particularly IgA, which helps develop the newborn's immune system and protects against infections.

---

162. Match List I with List II:

List I (Drug)	List II (Source)
A. Cocaine	I. Effective sedative in surgery
B. Heroin	II.Cannabis sativa
C. Morphine	III. Erythroxylum
D. Marijuana	IV. Papaver somniferum

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Step 1: Understanding the Sources of These Drugs.

- Cocaine is derived from Erythroxylum coca and is a stimulant drug.

- Heroin is derived from Papaver somniferum and is a depressant.

- Morphine is used as a pain-relieving sedative in surgery.

- Marijuana comes from Cannabis sativa and has psychoactive effects.

Conclusion: The correct answer is (3) A-III, B-IV, C-I, D-II.

Quick Tip

Many drugs are derived from plants, such as Cocaine from Erythroxylum, Heroin from Opium poppy, and Marijuana from Cannabis.

---

163. Match List I with List II:

List I (Fish Species)	List II (Type)
A. Pterophyllum	I. Hag fish
B. Myxine	II. Saw fish
C. Pristis	III. Angel fish
D. Exocoetus	IV. Flying fish

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-III, B-II, C-I, D-IV

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

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

Solution:

Understanding the Classification of These Fishes.

- Pterophyllum is commonly known as the Angel fish.

- Myxine belongs to Hagfish, a jawless fish.

- Pristis is a type of Sawfish, which has a long, saw-like snout.

- Exocoetus is a Flying fish, capable of gliding over water surfaces.

Conclusion: The correct answer is (1) A-III, B-I, C-II, D-IV.

Quick Tip

Angel fish (Pterophyllum) is an aquarium fish, while Hagfish (Myxine) is a jawless marine species. Sawfish (Pristis) has a unique rostrum, and Flying fish (Exocoetus) can glide over water.

---

164. Match List I with List II:

	List I		List II
A.	Pleurobrachia	I.	Mollusca
B.	Radula	II.	Ctenophora
C.	Stomochord	III.	Osteichthyes
D.	Air bladder	IV.	Hemichordata

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding the Classification of These Organisms.

- Pleurobrachia belongs to Ctenophora, a phylum of marine comb jellies.

- Radula is a toothed feeding structure found in Mollusca.

- Stomochord is found in Hemichordata, a phylum that includes acorn worms.

- Air bladder is a characteristic of Osteichthyes (bony fishes) and helps with buoyancy.

Conclusion: The correct answer is (1) A-II, B-I, C-IV, D-III.

Quick Tip

Ctenophores like Pleurobrachia are jelly-like marine animals, Molluscs use radula for feeding, Hemichordates have stomochords, and bony fishes use air bladders for buoyancy.

165. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on:

(1) 10th segment

(2) 8th and 9th segment

(3) 11th segment

(4) 5th segment

Correct Answer: (1) 10th segment

Solution:

Understanding Anal Cerci in Cockroaches.

- Cockroaches have anal cerci, a pair of jointed filamentous structures located on the 10th abdominal segment.

- These cerci help in detecting air movements and possible threats.

Conclusion: The correct answer is (1) 10th segment.

Quick Tip

Cockroaches have segmented abdomens, and anal cerci function as sensory organs to detect vibrations in the air.

---

166. The flippers of the Penguins and Dolphins are an example of:

(1) Natural selection

(2) Convergent evolution

(3) Divergent evolution

(4) Adaptive radiation

Correct Answer: (2) Convergent evolution

Solution:

Understanding Convergent Evolution.

- Convergent evolution occurs when unrelated organisms develop similar traits due to adaptation to a similar environment.

- Penguins (birds) and Dolphins (mammals) have evolved streamlined bodies and flippers for swimming, but they belong to different taxonomic groups.

Conclusion: The correct answer is (2) Convergent evolution.

Quick Tip

Convergent evolution results in functionally similar structures (analogous organs) in unrelated species due to similar environmental pressures.

---

167. Which of the following statements is incorrect about bio-reactors?

(1) Most commonly used bio-reactors are of stirring type

(2) Bio-reactors are used to produce small-scale bacterial cultures

(3) Bio-reactors have an agitator system, an oxygen delivery system, and a foam control system

(4) A bio-reactor provides optimal growth conditions for achieving the desired product

Correct Answer: (2) Bio-reactors are used to produce small-scale bacterial cultures

Solution:

Understanding Bio-reactors.

- Bio-reactors are large vessels used in industrial biotechnology for mass production of cells or bio-products.

- Statement (2) is incorrect because bio-reactors are used for large-scale production, not small-scale cultures.

Conclusion: The correct answer is (2) Bio-reactors are used to produce small-scale bacterial cultures.

Quick Tip

Bio-reactors provide controlled environments (temperature, pH, nutrients) to enhance microbial growth and product yield.

---

168. Which one is the correct product of DNA-dependent RNA polymerase from the given template strand?

3'-TACATGGCAAATATCCATTCA-5'

(1) 5'-AUGUAAAGUUUAUAGGUAAGU-3'

(2) 5'-AUGUACCGUUUAUAGGGAAGU-3'

(3) 5'-ATGTACCGTTTATAGGTAAGT-3'

(4) 5'-AUGUACCGUUUAUAGGUAAGU-3'

Correct Answer: (4) 5'-AUGUACCGUUUAUAGGUAAGU-3'

Solution:

Understanding Transcription.

- The template strand (3' to 5') is used by RNA polymerase to synthesize an mRNA strand (5' to 3').

- The complementary RNA sequence follows A-U and G-C pairing rules.

Conclusion: The correct answer is (4) 5'-AUGUACCGUUUAUAGGUAAGU-3'.

Quick Tip

Transcription follows the base-pairing rules: Adenine (A) pairs with Uracil (U), Thymine (T) pairs with Adenine (A), and Cytosine (C) pairs with Guanine (G).

---

169. Match List I with List II:

List I (Joint Type)	List II (Example)
A. Fibrous joints	I. Adjacent vertebrae, limited movement
B. Cartilaginous joints	II. Humerus and Pectoral girdle, rotational movement
C. Hinge joints	III. Skull, don't allow any movement
D. Ball and socket joints	IV. Knee, help in locomotion

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Joint Types.

- Fibrous joints (A) are immovable (e.g., skull sutures).

- Cartilaginous joints (B) allow limited movement (e.g., intervertebral discs).

- Hinge joints (C) allow movement in one plane (e.g., knee).

- Ball and socket joints (D) allow rotational movement (e.g., shoulder joint).

Conclusion: The correct answer is (3) A-III, B-I, C-IV, D-II.

Quick Tip

Joints are classified based on movement: Fibrous (immovable), Cartilaginous (partially movable), and Synovial (freely movable).

---

170. Match List I with List II:

	List I		List II
A.	α –I antitrypsin	I.	Cotton bollworm
B.	Cry IAb	II.	ADA deficiency
C.	Cry IAc	III.	Emphysema
D	Enzyme replacement therapy	IV	Corn borer

Choose the correct answer form the options given below:

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

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

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

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

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

Solution:

Understanding the Matching.

- α-I antitrypsin is used in treating emphysema.

- Cry IAb and Cry IAc are Bacillus thuringiensis (Bt) toxins used to control corn borers and cotton bollworms, respectively.

- Enzyme replacement therapy is used in treating Adenosine Deaminase (ADA) deficiency.

Conclusion: The correct answer is (2) A-III, B-IV, C-I, D-II.

Quick Tip

Bt crops like Bt cotton contain Cry proteins, which provide resistance against insects by forming pores in their gut lining.

171. Match List I with List II:

List I (Cell Structure)	List II (Function/Location)
A. Axoneme	I.Centriole
B. Cartwheel pattern	II.Cilia and flagella
C. Crista	III. Chromosome
D. Satellite	IV. Mitochondria

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding the Matching.

- Axoneme forms the structural framework of cilia and flagella.

- Cartwheel pattern is observed in centrioles.

- Cristae are the folds of the inner mitochondrial membrane.

- Satellite regions are associated with chromosomes.

Conclusion: The correct answer is (3) A-II, B-I, C-IV, D-III.

Quick Tip

Mitochondria, the powerhouse of the cell, have cristae that increase the surface area for ATP production.

172. The correct sequence of pathway for conduction of an action potential through the heart is:

A. AV bundle

B. Purkinje fibres

C. AV node

D. Bundle branches

E. SA node

Choose the correct sequence of pathway from the options given below

(1) A-E-C-B-D

(2) B-D-E-C-A

(3) E-A-D-B-C

(4) E-C-A-D-B

Correct Answer: (4) E-C-A-D-B

Solution:

Understanding Heart's Electrical Conduction System.

- The Sinoatrial (SA) node (E) initiates the action potential.
- The signal passes to the Atrioventricular (AV) node (C).
- From the AV node, it moves through the AV bundle (A).
- Then it travels down the Bundle branches (D).
- Finally, it reaches the Purkinje fibers (B), causing ventricular contraction.

Conclusion: The correct answer is (4) E-C-A-D-B.

Quick Tip

The SA node is the natural pacemaker of the heart, maintaining rhythmic contractions.

---

173. Given below are two statements:

Statement I: The presence or absence of the hymen is not a reliable indicator of virginity.

Statement II: The hymen is torn during the first coitus only.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (2) Statement I is true but Statement II is false

Solution:

Step 1: Understanding the Hymen and Its Significance

- The **hymen** is a thin membrane that partially covers the vaginal opening.
- Its presence or absence is **not a reliable indicator of virginity**, as it can be torn due to various activities such as **sports, cycling, physical activity, or medical procedures**.
- Hence, **Statement I is true**.

Step 2: Evaluating Statement II

- The hymen **does not always tear during first coitus**.
- It can stretch without tearing, and some individuals are born with **very little or no hymenal tissue**.
- Since the hymen can be lost due to non-sexual activities, **Statement II is false**.

Conclusion:

Since **Statement I is true** but **Statement II is false**, the correct answer is (2).

Quick Tip

The hymen is not a definitive indicator of virginity, and its tearing can result from various non-sexual activities. Medical professionals do not use it as a conclusive test.

---

174. Match List I with List II:

List I (Disease)	List II (Cause/Pathogen)
A. Common cold	I. Plasmodium
B. Haemozoin	II. Typhoid
C. Widal test	III. Rhinoviruses
D. Allergy	IV. Dust mites

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding the Matching.

- Common cold is caused by Rhinoviruses.

- Haemozoin is a byproduct of Plasmodium, the malarial parasite.

- Widal test is used for typhoid diagnosis.

- Allergies are triggered by dust mites and other allergens.

Conclusion: The correct answer is (2) A-III, B-I, C-II, D-IV.

Quick Tip

Malaria causes cyclic fever due to the periodic release of haemozoin from RBCs.

---

175. Match List I with List II:

	List I		List II
A.	Typhoid	I.	Fungus
B.	Leishmaniasis	II.	Nematode
C.	Ringworm	III.	Protozoa
D.	Filariasis	IV.	Bacteria

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Understanding Disease Classification.

- Typhoid is caused by Salmonella typhi (Bacteria).

- Leishmaniasis is caused by Leishmania (Protozoa).

- Ringworm is a fungal infection caused by dermatophytes.

- Filariasis is caused by Wuchereria bancrofti (Nematode).

Conclusion: The correct answer is (1) A-IV, B-III, C-I, D-II.

Quick Tip

Leishmaniasis is transmitted by sandflies and causes skin ulcers or visceral infections.

---

176. Match List I with List II:

	List I		List II
A.	Expiratory capacity	I.	Expiratory reserve volume + Tidal volume + Inspiratory reserve volume
B.	Functional residual capacity	II.	Tidal volume + Expiratory reserve volume
C.	Vital capacity	III.	Tidal volume + Inspiratory reserve volume
D.	Inspiratory capacity	IV.	Expiratory reserve volume + Residual volume

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Lung Capacity.

- Expiratory Capacity includes Tidal volume + Expiratory reserve volume.

- Functional Residual Capacity includes Expiratory reserve volume + Residual volume.

- Vital Capacity includes Expiratory reserve volume + Tidal volume + Inspiratory reserve volume.

- Inspiratory Capacity includes Tidal volume + Inspiratory reserve volume.

Conclusion: The correct answer is (4) A-II, B-IV, C-I, D-III.

Quick Tip

Vital capacity is the maximum amount of air a person can exhale after a maximum inhalation.

177. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?

(1) Genetic drift

(2) Gene migration

(3) Constant gene pool

(4) Genetic recombination

Correct Answer: (3) Constant gene pool

Solution:

Understanding Hardy-Weinberg Equilibrium.

- Hardy-Weinberg Equilibrium states that allele frequencies remain constant in a population unless acted upon by evolutionary forces.

- Factors affecting it include: Mutation, Natural Selection, Genetic Drift, Gene Flow, and Genetic Recombination.

- Constant gene pool implies no evolution, meaning no change in allele frequencies.

Conclusion: The correct answer is (3) Constant gene pool.

Quick Tip

If all Hardy-Weinberg conditions are met, evolution does not occur, maintaining genetic stability.

---

178. Match List I with List II:

	List-I		List-II
A.	Lipase	I.	Peptide bond
B.	Nuclease	II.	Ester bond
C.	Protease	III.	Glycosidic bond
D.	Amylase	IV.	Phosphodiester bond

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Enzyme Specificity.

- Lipase hydrolyzes ester bonds in fats.

- Nuclease hydrolyzes phosphodiester bonds in DNA/RNA.

- Protease hydrolyzes peptide bonds in proteins.

- Amylase hydrolyzes glycosidic bonds in starch.

Conclusion: The correct answer is (2) A-II, B-IV, C-I, D-III.

Quick Tip

Enzymes lower the activation energy of biochemical reactions, making them highly specific.

---

179. Which of the following is not a component of the Fallopian tube?

(1) Isthmus

(2) Infundibulum

(3) Ampulla

(4) Uterine fundus

Correct Answer: (4) Uterine fundus

Solution:

S Understanding the Fallopian Tube.

- The Fallopian tube consists of four parts:

Infundibulum, Ampulla, Isthmus, and Interstitial Part.

- The Uterine Fundus is part of the uterus, not the Fallopian tube.

Conclusion: The correct answer is (4) Uterine fundus.

Quick Tip

Fertilization usually occurs in the ampulla of the Fallopian tube.

---

180. Match List I with List II:

	List I		List II
A.	Non-medicated IUD	I.	Multiload 375
B.	Copper releasing IUD	II.	Progestogens
C.	Hormone releasing IUD	III.	Lippes loop
D.	Implants	IV.	LNG-20

Choose the correct answer from the option given below:

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

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

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

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

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

Solution:

Understanding Different Types of IUDs.

- Non-medicated IUDs (e.g., Lippes loop) function as a physical barrier to implantation.

- Copper releasing IUDs (e.g., Multiload 375) release copper ions, which are toxic to sperm.

- Hormone-releasing IUDs (e.g., LNG-20) release hormones like levonorgestrel, preventing ovulation.

- Implants contain progestogens that provide long-term contraception.

Conclusion: The correct answer is (3) A-III, B-I, C-IV, D-II.

Quick Tip

Copper IUDs increase the uterine environment's spermicidal effect, making fertilization unlikely.

---

181. Which of the following is not a steroid hormone?

(1) Testosterone

(2) Progesterone

(3) Glucagon

(4) Cortisol

Correct Answer: (3) Glucagon

Solution:

Understanding Steroid Hormones.

- Steroid hormones are derived from cholesterol and include Testosterone, Progesterone, and Cortisol.

- Glucagon, however, is a peptide hormone that regulates blood glucose levels.

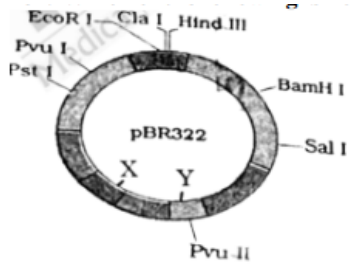
Conclusion: The correct answer is (3) Glucagon.

Quick Tip

Peptide hormones like glucagon act through second messengers, unlike steroid hormones which enter the cell.

---

182. The following diagram shows restriction sites in E. coli cloning vector pBR322. Find the role of 'X' and 'Y' genes:



(1) The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

(2) The gene 'X' is for protein involved in replication of Plasmid and 'Y' for resistance to antibiotics.

(3) Gene 'X' is responsible for recognition sites and 'Y' is responsible for antibiotic resistance.

(4) The gene 'X' is responsible for resistance to antibiotics and 'Y' for protein involved in the replication of Plasmid.

Correct Answer: (1) The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

Solution:

Understanding pBR322 Plasmid.

- pBR322 is a commonly used cloning vector.

- Gene ‘X’ (ori region) controls the copy number of the plasmid.

- Gene ‘Y’ (replication-related gene) helps in plasmid replication.

Conclusion: The correct answer is (1).

Quick Tip

Plasmids are self-replicating circular DNA molecules used in genetic engineering.

---

183. Which of the following is not a natural/traditional contraceptive method?

(1) Periodic abstinence

(2) Lactational amenorrhea

(3) Vaults

(4) Coitus interruptus

Correct Answer: (3) Vaults

Solution:

Understanding Natural and Artificial Contraception

Step 1: Identifying Natural Contraceptive Methods

- **Periodic Abstinence:** Avoiding intercourse during the **fertile window** (ovulation period).
- **Lactational Amenorrhea:** Temporary infertility occurring **post-childbirth** due to hormonal changes.
- **Coitus Interruptus:** The **withdrawal method**, where the male withdraws before ejaculation.

Step 2: Identifying Artificial Contraceptive Methods

- **Vaults (Diaphragms):**
  - Vaults are **artificial barrier methods** that physically prevent sperm from entering the uterus.
  - Since they are not natural methods, they do not belong to this category.

Conclusion:

The correct answer is (3) **Vaults**.

Quick Tip

Natural contraceptive methods are based on physiological cycles and behavioral patterns.

---

184. Given below are some stages of human evolution. Arrange them in correct sequence (Past to Recent):

A. Homo habilis

B. Homo sapiens

C. Homo neanderthalensis

D. Homo erectus

Choose the correct sequence of human evolution from the options given below: (1) B-A-D-C

(2) C-B-D-A

(3) A-D-C-B

(4) D-A-C-B

Correct Answer: (3) A-D-C-B

Solution:

Understanding Human Evolution.

- Homo habilis (2.4 to 1.4 million years ago) is considered the first species to use tools.

- Homo erectus (1.9 million to 110,000 years ago) was the first to use fire and migrate from Africa.

- Homo neanderthalensis (400,000 to 40,000 years ago) lived in Europe and adapted to cold climates.

- Homo sapiens (modern humans) evolved 300,000 years ago and developed advanced culture.

Conclusion: The correct sequence is A-D-C-B.

Quick Tip

Homo erectus is considered the longest surviving human species and was the first to migrate out of Africa.

---

185. The "Ti plasmid" of Agrobacterium tumefaciens stands for:

(1) Tumor independent plasmid

(2) Tumor inducing plasmid

(3) Temperature independent plasmid

(4) Tumor inhibiting plasmid

Correct Answer: (2) Tumor Inducing Plasmid

Solution:

Understanding Ti Plasmid

Step 1: Definition and Function

- The **Ti plasmid** (Tumor Inducing Plasmid) is found in **Agrobacterium tumefaciens**, a bacterium responsible for **crown gall disease** in plants.
- It contains a specific region called **T-DNA** (**transfer DNA**) that integrates into the **plant genome**, leading to tumor formation.

Conclusion:

The correct answer is (2) **Tumor Inducing Plasmid**.

Quick Tip

Ti plasmid is widely used in genetic engineering to introduce foreign genes into plant cells.

Section B

186. Match List I with List II:

List I (Enzyme/Region)	List II (Function)
A. RNA polymerase III	I. snRNPs
B. Termination of transcription	II. Promotor
C. Splicing of Exons	III. Rho factor
D. TATA box	IV. SnRNAs, tRNA

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Transcription Process

Step 1: Matching Components of Transcription

- **RNA Polymerase III (A-IV):**
  - Transcribes **tRNA** and **small nuclear RNAs** (snRNAs).
- **Termination of Transcription (B-III):**
  - The **Rho factor** aids in transcription termination in **prokaryotes**.
- **Splicing of Exons (C-I):**
  - **snRNPs** (small nuclear ribonucleoproteins) facilitate **exon splicing**.
- **TATA Box (D-II):**
  - A **promoter region** essential for **transcription initiation**.

Conclusion:

The correct match is:

$$A \to IV, \quad B \to III, \quad C \to I, \quad D \to II.$$

Quick Tip

Eukaryotic transcription is more complex than prokaryotic transcription due to post-transcriptional modifications.

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187. Regarding catalytic cycle of an enzyme action, select the correct sequential steps:

A. Substrate enzyme complex formation.

B. Free enzyme ready to bind with another substrate.

C. Release of products.

D. Chemical bonds of the substrate broken.

E. Substrate binding to active site.

Choose the correct answer from the options given below :

(1) A, E, B, D, C

(2) B, A, C, D, E

(3) E, D, C, B, A

(4) E, A, D, C, B

Correct Answer: (4) E, A, D, C, B

Solution:

Understanding the Enzyme Catalytic Cycle

Step 1: Sequence of the Enzymatic Reaction

1. **Substrate Binding (E):** The substrate binds to the **enzyme's active site**.
2. **Formation of Enzyme-Substrate Complex (A):** This forms a temporary **enzyme-substrate complex**.
3. **Catalysis (D):** The chemical bonds of the substrate **break**, leading to product formation.
4. **Product Release (C):** The **products are released** from the enzyme.
5. **Enzyme Reusability (B):** The free enzyme is now **ready to bind** with another substrate.

Conclusion:

The correct order is:

$$E \to A \to D \to C \to B.$$

Quick Tip

Enzymes function by lowering the activation energy of reactions, allowing biological processes to occur rapidly.

---

188. Choose the correct statement given below regarding juxta medullary nephron:

(1) Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla.

(2) Loop of Henle of juxta medullary nephron runs deep into medulla.

(3) Juxta medullary nephrons outnumber the cortical nephrons.

(4) Juxta medullary nephrons are located in the columns of Bertini.

Correct Answer: (2) Loop of Henle of juxta medullary nephron runs deep into medulla.

Solution:

Understanding Nephron Types

Step 1: Classification of Nephrons

- Nephrons are classified into **cortical** and **juxta medullary nephrons** based on their **location** in the kidney.
- **Cortical nephrons** have their **glomeruli in the outer cortex** and shorter loops of Henle.
- **Juxta medullary nephrons** have their **glomeruli closer to the medulla** and **long loops of Henle** that extend deep into the medulla, aiding in **water reabsorption and urine concentration**.

Conclusion:

The correct answer is (2) **Loop of Henle of juxta medullary nephron runs deep into the medulla**.

Quick Tip

Juxta medullary nephrons help in the concentration of urine by creating a hyperosmotic medullary interstitium.

189. Given below are two statements: Statement I: Mitochondria and chloroplasts both double membrane-bound organelles.

Statement II: Inner membrane of mitochondria is relatively less permeable, as compared to chloroplast.

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

(1) Both Statement I and Statement II are incorrect.

(2) Statement I is correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are correct.

Correct Answer: (2) Statement I is correct but Statement II is incorrect.

Solution:

Understanding Mitochondria and Chloroplasts

Step 1: Structural Features of Mitochondria and Chloroplasts

- Both **mitochondria** and **chloroplasts** have a **double membrane** and contain their own **DNA**, making them **semi-autonomous organelles**.
- The **inner membrane of mitochondria** contains **cristae** and is highly **impermeable** due to the presence of **cardiolipin**.
- In contrast, **chloroplast inner membranes** are relatively **more permeable** and contain **thylakoids** instead of cristae.

Conclusion:

The correct answer is (2) **Statement I is correct but Statement II is incorrect**.

Quick Tip

Mitochondria are the powerhouses of the cell, while chloroplasts are responsible for photosynthesis in plants.

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190. Given below are two statements:

Statement I:Gause's competitive exclusion principle states that two closely related species competing for different resources cannot exist indefinitely.
Statement II: According to Gause's principle, during competition, the inferior species will be eliminated. This may be true if resources are limiting.
In the light of the above statements, choose the correct answer from the options given below :
(1) Both Statement I and Statement II are false.
(2) Statement I is true but Statement II is false.
(3) Statement I is false but Statement II is true.
(4) Both Statement I and Statement II are true.
Correct Answer: (3) Statement I is false but Statement II is true.
Solution:
Understanding Gause's Competitive Exclusion Principle
Step 1: Defining Gause's Principle

- **Gause's Competitive Exclusion Principle** states that **two species** competing for the **same limited resource** cannot coexist indefinitely in the **same ecological niche**.

Step 2: Evaluating the Statements

- **Statement I (Incorrect):**
  - Competing species **can coexist** if they evolve mechanisms for **resource partitioning** or occupy **slightly different niches**.
- **Statement II (Correct):**
  - The **inferior species** may be **eliminated** only if resources are **truly limiting** and **no adaptation or niche differentiation** occurs.

Conclusion:
The correct answer is (3) **Statement I is false but Statement II is true**.

Quick Tip

Species coexistence can occur if they use different resources or occupy different ecological niches.

191. The following are the statements about non-chordates:

A. Pharynx is perforated by gill slits.

B. Notochord is absent.

C. Central nervous system is dorsal.

D. Heart is dorsal if present.

E. Post-anal tail is absent.

Choose the most appropriate answer from the options given below:

(1) A, B & D only

(2) B, D & E only

(3) B, C & D only

(4) A & C only

Correct Answer: (2) B, D & E only

Solution:

Understanding Non-Chordate Characteristics

Step 1: Identifying Correct Statements

- **Absence of Notochord (B - Correct):**
  - Non-chordates **lack a notochord**, which is a defining feature of chordates.
- **Ventral Heart (D - Correct):**
  - Non-chordates have a **ventral heart**, whereas chordates have a **dorsal heart**.
- **Absence of Post-Anal Tail (E - Correct):**
  - Non-chordates **do not have a post-anal tail**, unlike chordates.

Step 2: Identifying Incorrect Statements

- **Presence of Pharyngeal Gill Slits (A - Incorrect):**
  - Pharyngeal gill slits are a characteristic of **chordates**, not non-chordates.

- **Dorsal Central Nervous System (C - Incorrect):**
  - Non-chordates have a **ventral nervous system**, while chordates have a **dorsal central nervous system**.

Conclusion:

The correct answer is (2) **B, D & E only**.

Quick Tip

Chordates are characterized by a dorsal nerve cord, notochord, and post-anal tail, whereas non-chordates lack these features.

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192. Match List I with List II:

	List I		List II
A.	Exophthalmic goiter	I.	Excess secretion of cortisol, moon face & hypergylcemia.
B.	Acromegaly	II.	Hypo-secretion of thyroid hormone and stunted growth.
C.	Cushing's syndrome	III.	Hyper secretion of thyroid hormone & protruding eye balls.
D.	Cretinism	IV.	Excessive secretion of growth hormone.

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Endocrine Disorders

Step 1: Matching Endocrine Disorders with Their Causes

- **Exophthalmic Goiter (A-III):**
  - Also known as **Graves' disease**, it occurs due to **excess thyroid hormone**.
  - It leads to **protruding eyeballs** (exophthalmos) and increased metabolism.
- **Acromegaly (B-IV):**
  - Caused by **excess secretion of growth hormone** in adults.

- Results in **enlargement of facial bones, hands, and feet**.

- **Cushing's Syndrome (C-I):**
  - Results from **excess cortisol secretion**.
  - Causes **a moon-shaped face, obesity, and hypertension**.

- **Cretinism (D-II):**
  - Occurs due to **thyroid hormone deficiency** in infants.
  - Leads to **stunted growth, mental retardation, and delayed puberty**.

Conclusion:

The correct answer is (3) **A-III, B-IV, C-I, D-II**.

Quick Tip

Hormonal imbalances cause distinct syndromes; understanding their effects is key in diagnosing endocrine disorders.

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193. Match List I with List II:

List I	List II
A. Mesozoic Era	I. Lower invertebrates
B. Proterozoic Era	II. Fish Amphibia
C. Cenozoic Era	III. Birds Reptiles
D. Paleozoic Era	IV.Mammals

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding Geological Eras

Step 1: Matching Geological Eras with Their Characteristics

- **Mesozoic Era (A-III):**
  - Known as the **Age of Reptiles**, it was dominated by **dinosaurs** and the first **birds**.
- **Proterozoic Era (B-I):**
  - Featured **early invertebrates** such as **sponges and algae**.
- **Cenozoic Era (C-IV):**
  - Known as the **Age of Mammals**, it saw the evolution and diversification of **modern mammals**.
- **Paleozoic Era (D-II):**
  - Marked the emergence of the first **vertebrates**, including **fish and amphibians**.

Conclusion:

The correct answer is (3) **A-III, B-I, C-IV, D-II**.

Quick Tip

Understanding geological eras helps in tracing evolutionary history. The Cenozoic Era is the current era of mammals.

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194. Match List I with List II:

List I	List II
A. Unicellular glandular epithelium	I. Salivary glands
B. Compound epithelium	II. Pancreas
C. Multicellular glandular epithelium	III. Goblet cells of alimentary canal
D. Endocrine glandular epithelium	IV. Moist surface of buccal cavity

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Understanding Epithelial Tissue Types

Step 1: Identifying Different Types of Epithelial Tissues

- **Goblet Cells (A-III):**
  - Goblet cells are **unicellular glandular epithelium** found in the **alimentary canal**, where they secrete mucus for lubrication.
- **Moist Buccal Cavity Lining (B-IV):**
  - The lining of the **buccal cavity** consists of **compound epithelium**, which provides **protection against mechanical stress**.
- **Salivary Glands (C-I):**
  - Salivary glands are **multicellular glandular epithelium**, responsible for the secretion of **saliva**.
- **Pancreas (D-II):**
  - The pancreas has **endocrine glandular epithelium**, which secretes hormones such as **insulin and glucagon**.

Conclusion:

The correct answer is (2) **A-III, B-IV, C-I, D-II**.

Quick Tip

Epithelial tissues serve diverse roles in secretion, protection, and absorption, forming glandular structures in the body.

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195. As per ABO blood grouping system, the blood group of father is B^+, mother is A^+ and child is O^+. Their respective genotype can be

(A) $I^Bi/I^Ai/ii$

(B) $I^BI^B/I^Ai/ii$

(C) $I^AI^B/ii/I^Bi$

(D) $I^Ai/I^Bi/I^Ai$

(E) $ii^B/ii/I^AI^B$

Choose the most appropriate answer from the options given below:

(1) B only

(2) C & B only

(3) D & E only

(4) A only

Correct Answer: (4) A only

Solution:

Step 1: Understanding Blood Group Inheritance

- The ABO blood grouping system is determined by the alleles I^A, I^B, and i.
- Individuals with blood group O must have the genotype ii, meaning they receive one i allele from each parent.

Step 2: Genotype Analysis

- **Father's Genotype (B^+):** - Blood group B can be either I^BI^B or I^Bi. - Since the child has blood group O (ii), the father must have an i allele. - Thus, the father's genotype must be I^Bi.
- **Mother's Genotype (A^+):** - Blood group A can be either I^AI^A or I^Ai. - Since the child has blood group O (ii), the mother must also have an i allele. - Thus, the mother's genotype must be I^Ai.

Step 3: Evaluating the Given Options

- The correct parental genotype is I^Bi (father) and I^Ai (mother), producing a child with genotype ii (O blood group).
- Option **(A)** $I^Bi/I^Ai/ii$ correctly represents this combination.
- Other options do not match the inheritance pattern.

Conclusion:

Since only option A is correct, the correct answer is (4) **A only**.

Quick Tip

Tip for Blood Group Inheritance:

- Blood group O individuals must have the genotype ii (homozygous recessive).
- Parents with blood groups A and B can have an O blood group child only if both carry the recessive i allele (i.e., genotypes I^Ai and I^Bi).
- Use a Punnett square to determine possible offspring blood groups based on parental genotypes.

196. Match List I with List II related to the digestive system of cockroach:

	List I		List II
A.	The structures used for storing of food	I.	Gizzard
B.	Ring of 6-8 blind tubules at junction of foregut and midgut.	II.	Gastric Caeca
C.	Ring of 100-150 yellow coloured thin filaments at junction of midgut and hindgut.	III.	Malpighian tubules
D.	The structures used for grinding the food.	IV.	Crop

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

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

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

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

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

Solution:

Understanding the Digestive System of Cockroach

Step 1: Matching Digestive System Components with Their Functions

- **Crop (A-IV):**
  - The crop serves as a **storage organ** where food is temporarily held before digestion begins.
- **Gastric Caeca (B-II):**
  - These structures **secrete digestive enzymes** into the midgut to aid in digestion.

- **Malpighian Tubules (C-III):**
  - These function in **excretion** by removing nitrogenous wastes from the hemolymph at the **junction of the midgut and hindgut**.
- **Gizzard (D-I):**
  - The gizzard is responsible for **grinding food particles** before they move to the midgut for digestion.

Conclusion:

The correct answer is (4) **A-IV, B-II, C-III, D-I**.

Quick Tip

In cockroaches, food is stored in the crop, ground in the gizzard, digested with the help of gastric caeca, and waste is excreted by Malpighian tubules.

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197. Given below are two statements:

Statement I: Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

Statement II: Both bone marrow and thymus provide microenvironments for the development and maturation of T-lymphocytes.

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

(1) Both Statement I and Statement II are incorrect.

(2) Statement I is correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are correct.

Correct Answer: (4) Both Statement I and Statement II are correct.

Solution:

Step 1: Understanding the Role of Bone Marrow

- Bone marrow is a **primary lymphoid organ** responsible for the **production of all blood cells**, including **lymphocytes** (both B and T cells).

- The process of blood cell formation in the bone marrow is known as **hematopoiesis**.
- Thus, **Statement I is correct**.

Step 2: Understanding the Role of Bone Marrow and Thymus in T-lymphocyte Maturation

- **Bone marrow:** Produces immature **T-lymphocytes**, which migrate to the thymus for maturation.
- **Thymus:** Provides a **specialized microenvironment** for the **development and maturation of T-lymphocytes**.
- Both bone marrow and thymus play essential roles in **T-cell development and maturation**.
- Thus, **Statement II is also correct**.

Conclusion:

Since both statements are correct, the correct answer is (4) **Both Statement I and Statement II are correct**.

Quick Tip

Primary lymphoid organs (bone marrow and thymus) are responsible for the formation and maturation of lymphocytes.

---

198. Given below are two statements:

Statement I: The cerebral hemispheres are connected by a nerve tract known as the corpus callosum.

Statement II: The brain stem consists of the medulla oblongata, pons, and cerebrum.

(1) Both Statement I and Statement II are incorrect.

(2) Statement I is correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are correct.

Correct Answer: (2) Statement I is correct but Statement II is incorrect.

Solution:

Understanding Brain Structures.

- The corpus callosum is a thick band of nerve fibers connecting the two cerebral hemispheres.

- The brain stem includes the medulla oblongata, pons, and midbrain, but not the cerebrum.

Conclusion: The correct answer is (2) Statement I is correct but Statement II is incorrect.

Quick Tip

The brain stem consists of the midbrain, pons, and medulla oblongata, controlling involuntary functions like heartbeat and respiration.

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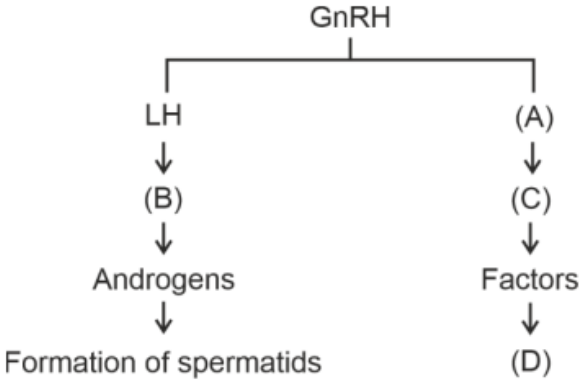
199. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis:



(1) ICSH, Interstitial cells, Leydig cells, spermiogenesis.

(2) FSH, Sertoli cells, Leydig cells, spermatogenesis.

(3) ICSH, Leydig cells, Sertoli cells, spermatogenesis.

(4) FSH, Leydig cells, Sertoli cells, spermiogenesis.

Correct Answer: (4) FSH, Leydig cells, Sertoli cells, spermiogenesis.

Solution:

Understanding Spermatogenesis

Step 1: Role of Hormones in Spermatogenesis

- **Follicle Stimulating Hormone (FSH):**
  - FSH stimulates **Sertoli cells**, which provide **nourishment** and support to developing sperm cells.

- **Luteinizing Hormone (LH) and Leydig Cells:**
  - LH stimulates **Leydig cells** to produce **testosterone**, which is essential for sperm production.

Step 2: Maturation of Sperm Cells

- **Sertoli Cells:**
  - Provide **structural and metabolic support** to developing spermatozoa.
- **Spermiogenesis:**
  - The final step of spermatogenesis, where **spermatids mature into spermatozoa (sperm cells)**.

Conclusion:

The correct answer is (4) **FSH, Leydig cells, Sertoli cells, spermiogenesis**.

Quick Tip

FSH activates Sertoli cells, LH stimulates Leydig cells to produce testosterone, and spermiogenesis is the final stage in sperm maturation.

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200. Match List I with List II:

List I	List II
A. P wave	I. Heart muscles are electrically silent.
B. QRS complex	II. Depolarisation of ventricles.
C. T wave	III.Depolarisation of atria.
D. T-P gap	IV. Repolarisation of ventricles.

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Understanding ECG Waves

Step 1: Identifying the Components of an ECG Wave

- **P Wave (A-III):**
  - Represents **atrial depolarization**, leading to **atrial contraction**.
- **QRS Complex (B-II):**
  - Represents **ventricular depolarization**, which causes the **ventricles to contract**.
- **T Wave (C-IV):**
  - Represents **ventricular repolarization**, restoring the **resting potential** of the ventricles.
- **T-P Gap (D-I):**
  - Represents a **silent period** when the heart is at rest between beats.

Conclusion:

The correct answer is (1) **A-III, B-II, C-IV, D-I**.

Quick Tip

ECG waves reflect electrical activity of the heart: P wave (atrial depolarization), QRS complex (ventricular depolarization), T wave (ventricular repolarization), and T-P interval (heart at rest).
