NEET 2024 R1 Question Paper with Solutions

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

General Instructions

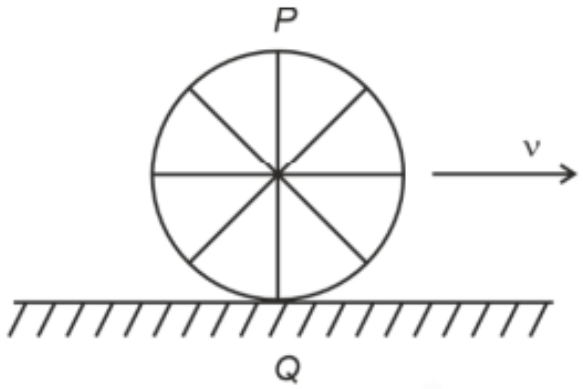
Read the following instructions very carefully and strictly follow them:

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. 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: The velocity of a point on a rolling wheel is the vector sum of the linear velocity of the wheel's center and the tangential velocity of the point due to rotation.

- For the topmost point P, the tangential velocity due to rotation is in the same direction as the linear velocity. Thus, its speed is $v + v = 2v$.
- For the bottommost point Q, the tangential velocity is opposite to the linear velocity, resulting in a net speed of $v - v = 0$.

Thus, point P moves faster than point Q.

Quick Tip

For a wheel rolling without slipping:

- Topmost point speed = $2v$ (linear speed + rotational speed).

- Bottommost point speed = 0 (linear speed - rotational speed).

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2. 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

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

Solution: The spectral lines of hydrogen follow the Balmer series. Using the wavelengths given:

- Transition $n_2 = 3 \to n_1 = 2$ corresponds to 656.3 nm (III).
- Transition $n_2 = 4 \to n_1 = 2$ corresponds to 486.1 nm (IV).
- Transition $n_2 = 5 \to n_1 = 2$ corresponds to 434.1 nm (II).
- Transition $n_2 = 6 \to n_1 = 2$ corresponds to 410.2 nm (I).

Quick Tip

For the Balmer series, the spectral transitions correspond to visible light, and the wavelength decreases as n_2 increases.

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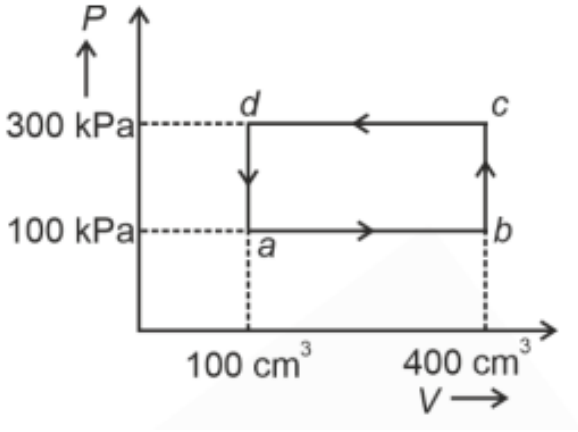
3. A thermodynamic system is taken through the cycle $abcd$. The work done by the gas along the path bc is:



(A) $30\,\text{J}$

(B) $-90\,\text{J}$

(C) $-60\,\text{J}$

(D) 0

Correct Answer: (4) 0

Solution: Work done along bc is calculated using the formula $W = P\Delta V$.

- Here, the volume remains constant along bc ($\Delta V = 0$).
- Therefore, $W = 0$.

Quick Tip

For isochoric processes ($\Delta V = 0$), no work is done as the gas volume does not change.

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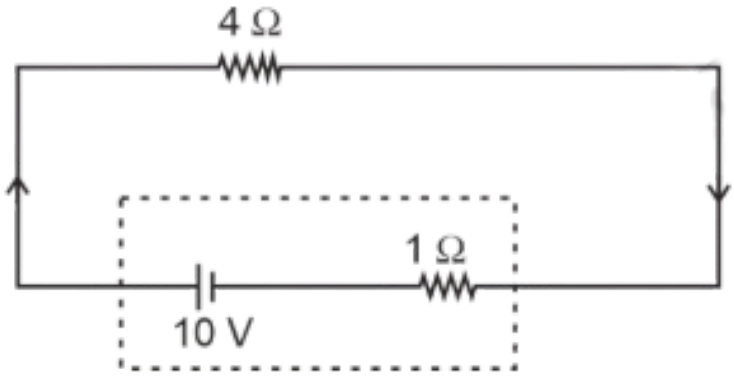
4. The terminal voltage of the battery, whose emf is $10\,\text{V}$ and internal resistance $1\,\Omega$, when connected through an external resistance of $4\,\Omega$ as shown in the figure is:



(A) $6\,\text{V}$

(B) $8\,\text{V}$

(C) $10\,\text{V}$

(D) $4\,\text{V}$

Correct Answer: (2) $8\,\text{V}$

Solution: The terminal voltage is given by:

$$V_{\text{terminal}} = E - Ir$$

where E is the emf, I is the current, and r is the internal resistance.

- Total resistance, $R_{\text{total}} = 4\,\Omega + 1\,\Omega = 5\,\Omega$.
- Current, $I = \frac{E}{R_{\text{total}}} = \frac{10}{5} = 2\,\text{A}$.
- Terminal voltage, $V_{\text{terminal}} = 10 - 2 \times 1 = 8\,\text{V}$.

Quick Tip

To calculate terminal voltage, remember: external resistance affects current flow, and Ir represents the voltage drop inside the battery.

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5. 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: In an ideal transformer, the voltage ratio is directly proportional to the turns ratio:

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

Given $\frac{N_P}{N_S} = \frac{1}{2}$, it follows that $\frac{V_S}{V_P} = 2$. Hence, $V_S : V_P = 2 : 1$.

Quick Tip

For an ideal transformer:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}, \quad \frac{I_S}{I_P} = \frac{N_P}{N_S}.$$

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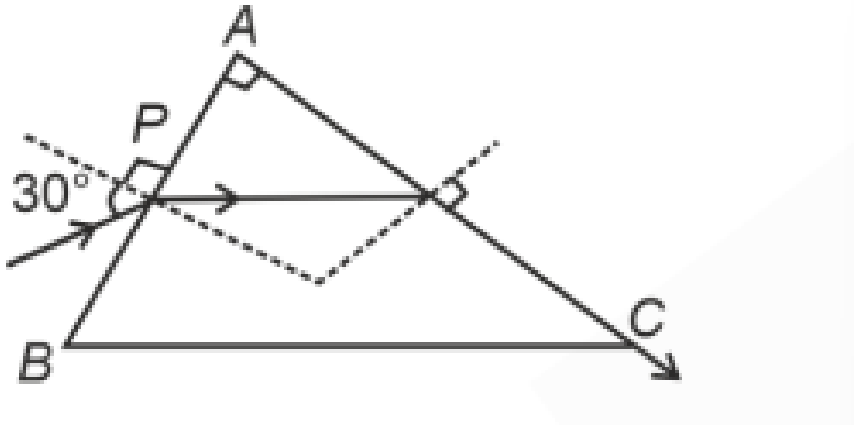
6. A light ray enters through a right-angled prism at point P with an angle of incidence 30° as shown in the figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is:



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

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

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

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

Solution:

In a prism, the relationship between the angles is given by:

$$r_1 + c = A \quad (1)$$

where: - r_1 is the angle of refraction inside the prism, - c is the angle of incidence on the face of the prism, - A is the angle of the prism.

Also, from geometry, we have:

$$r_1 = 90^\circ - c \quad (2)$$

Applying Snell's Law

On the incidence surface, applying Snell's law gives:

$$\mu = \frac{\sin i}{\sin r_1}$$

Given that the angle of incidence $i = 30^\circ$ and the angle of refraction is $r_1 = 90^\circ - c$, we substitute into Snell's law:

$$1 \cdot \sin(30^\circ) = \mu \cdot \sin(90^\circ - c)$$

Since $\sin(30^\circ) = \frac{1}{2}$ and $\sin(90^\circ - c) = \cos(c)$, we have:

$$\frac{1}{2} = \mu \cdot \cos(c)$$

Rearranging this equation:

$$\mu = \frac{1}{2\cos(c)} \quad (3)$$

Squaring the equation

Now, we square both sides of equation (3):

$$\mu^2 = \frac{1}{4\cos^2(c)}$$

Next, applying the relationship for μ, we substitute into equation (1) and simplify:

$$\mu^2 = \frac{5}{4} \quad \Rightarrow \quad \mu = \frac{\sqrt{5}}{2}$$

Thus, the refractive index of the prism is:

$$\mu = \frac{\sqrt{5}}{2}$$

Quick Tip

For light to travel parallel to the base of a prism, calculate the refractive index using Snell's law and geometric constraints.

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7. The quantities that have the same dimensions as those of a solid angle are:

(A) stress and angle

(B) strain and arc

(C) angular speed and stress

(D) strain and angle

Correct Answer: (4) strain and angle

Solution: Solid angle is dimensionless, as are strain (change in dimensions) and angle (arc length to radius ratio).

Quick Tip

Dimensionless quantities such as strain and angle are unitless and often used for ratios or relative measures.

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8. A thin flat circular disc of radius 4.5 cm is placed gently over the surface of water. If the surface tension of water is 0.07 N/m, 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: Excess force is calculated as:

$$F = 2\pi r \cdot T = 2\pi(0.045)(0.07) = 19.8\,\text{mN}.$$

Quick Tip

Use $F = 2\pi r \cdot T$ to calculate the force due to surface tension for circular objects.

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9. Given below are two statements:

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

Reason R: $V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$**, where** r **is the distance of the axial point.**

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: (2) A is true but R is false

Solution: Substitute values into $V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$:

$$V = \pm \frac{2(4 \times 10^{-6})}{4\pi(9 \times 10^9)(2)^2} = \pm 9 \times 10^3 \text{ V}.$$

Assertion A is true, but Reason R fails to consider directionality.

Quick Tip

For dipole potential calculations, use $V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$ for axial points and $\frac{P}{4\pi\epsilon_0 r^3}$ for equatorial points.

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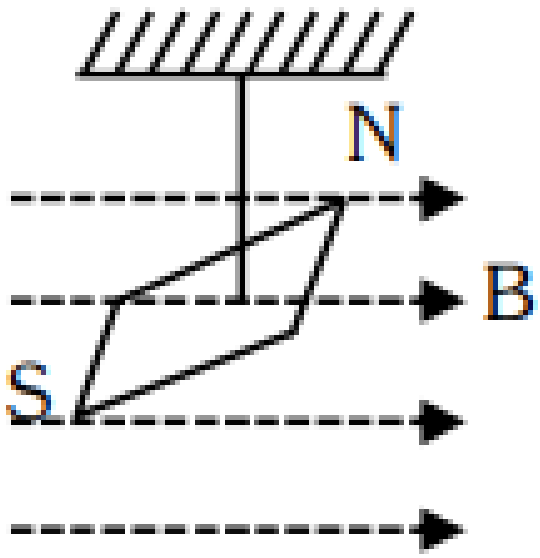
10. In a uniform magnetic field of 0.049 **T, a magnetic needle performs** 20 **oscillations in** 5 **seconds. The moment of inertia of the needle is** 9.8×10^{-6} **kg** $\cdot$ **m**^{2}**. If the magnitude of the magnetic moment of the needle is** $x \times 10^{-5}$ **Am**^{2}**, the value of** x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



(A) $128\pi^2$

(B) $50\pi^2$

(C) $1280\pi^2$

(D) $5\pi^2$

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

Solution: Using the formula for oscillation frequency:

$$T = 2\pi\sqrt{\frac{I}{MB}}, \quad M = \frac{4\pi^2 I}{T^2 B}.$$

Substitute values:

$$M = \frac{4\pi^2(9.8 \times 10^{-6})}{(5/20)^2(0.049)} = 1280\pi^2 \times 10^{-5}.$$

Quick Tip

For magnetic moment calculations, remember $M = \frac{4\pi^2 I}{T^2 B}$ for harmonic motion in a magnetic field.

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

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

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

(C) All bright fringes will be of equal width

(D) Interference pattern will disappear

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

Solution: With white light, all wavelengths interfere. The central fringe is white due to constructive interference, while other fringes are coloured due to wavelength dependence.

Quick Tip

In white light interference, the central fringe is white, and other fringes are coloured because of wavelength-specific path differences.

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12. Given below are two statements:

Statement I: Atoms are electrically neutral as they contain equal numbers 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 correct answer from the options given below:

(A) Both Statement I and Statement II are incorrect

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

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

(D) Both Statement I and Statement II are correct

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

Solution: Atoms are neutral due to balanced charges, making Statement I correct. However, not all atoms are stable; only specific configurations (e.g., inert gases) are stable, making Statement II incorrect.

Quick Tip

Remember: Neutrality refers to charge balance, but stability depends on the electronic configuration.

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

(A) 0.4 mm

(B) 40 mm

(C) 8 mm

(D) 4 mm

Correct Answer: (4) 4 mm

Solution: Maximum elongation is calculated using $\Delta L = \frac{\sigma L}{Y}$. Substituting values:

$$\Delta L = \frac{8 \times 10^8 \times 1}{2 \times 10^{11}} = 4\,\text{mm}.$$

Quick Tip

Use $\Delta L = \frac{\sigma L}{Y}$ to calculate elongation under stress. Ensure all units are consistent.

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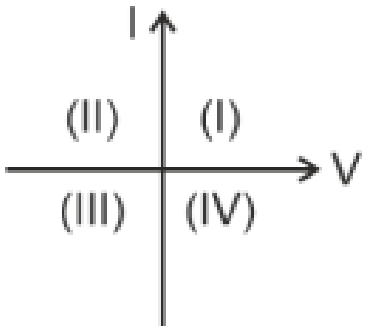
14. Consider the following statements:



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.

(A) A is incorrect but B is correct

(B) Both A and B are correct

(C) Both A and B are incorrect

(D) A is correct but B is incorrect

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

Solution: For solar cells, the I-V characteristics are in the IV quadrant due to negative current and positive voltage. In a reverse-biased pn diode, current arises from minority carriers.

Quick Tip

Solar cell currents are negative under load conditions; reverse-biased currents in diodes are due to minority carriers.

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

(A) Constant acceleration

(B) Constant velocity but varying acceleration

(C) Varying velocity and varying acceleration

(D) Constant velocity

Correct Answer: (3) Varying velocity and varying acceleration

Solution: In circular motion, the direction of velocity changes continuously, causing varying acceleration despite uniform speed.

Quick Tip

In uniform circular motion, velocity varies due to direction change, resulting in centripetal acceleration.

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16. If c is the velocity of light in free space, the correct statements about photons 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.

(A) A, B, C and D only

(B) A, C and D only

(C) A, B, D and E only

(D) A and B only

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

Solution: Photons are chargeless (eliminating E) and follow $E = h\nu$ and $p = \frac{h\nu}{c}$, with energy and momentum conserved in collisions.

Quick Tip

Photon properties: $E = h\nu$, $p = \frac{h\nu}{c}$, no charge, and energy-momentum conservation.

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17. Two bodies A and B of the same mass undergo completely inelastic one-dimensional collision. Body A moves with velocity v_1 while body B is at rest. After collision, the velocity ratio $v_1 : v_2$ is:

(1) $2 : 1$

(2) $4 : 1$

(3) $1 : 4$

(4) $1 : 2$

Correct Answer: (1)

Solution: Using momentum conservation:

$$v_2 = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2} = \frac{v_1}{2}.$$

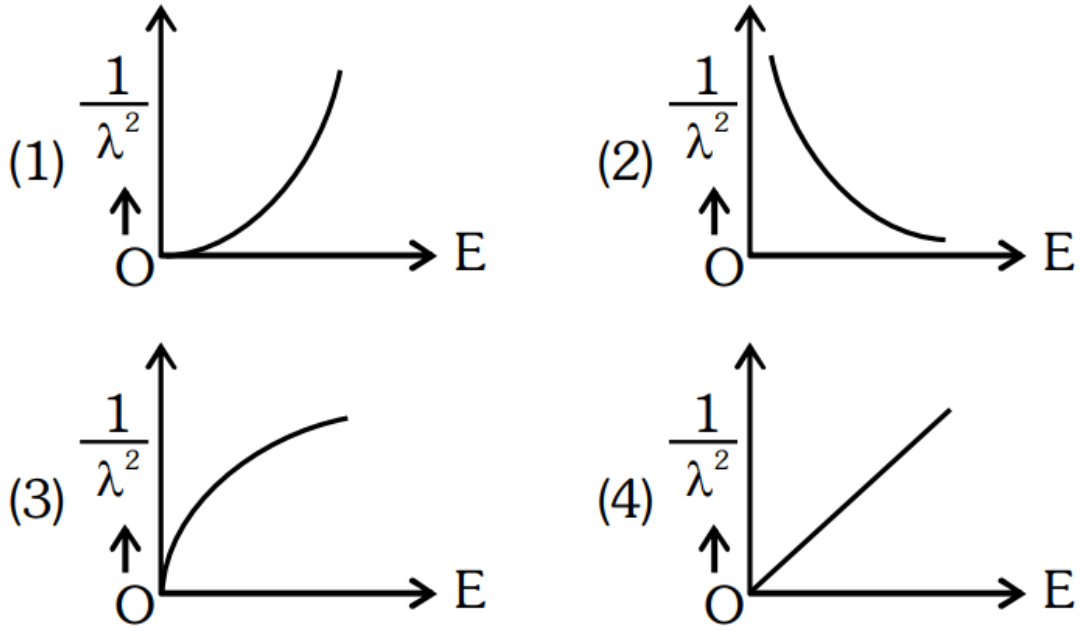
Thus, $v_1 : v_2 = 2 : 1$.

Quick Tip

In inelastic collisions, combine momentum conservation with shared mass velocities.

18.

The graph showing the variation of $\frac{1}{\lambda^2}$ with kinetic energy E of a free particle is:



Correct Answer: (3)

Solution: Using $\lambda = \frac{h}{\sqrt{2mE}}$, we find $\frac{1}{\lambda^2} \propto E$, yielding a linear graph.

Quick Tip

The relation $\frac{1}{\lambda^2} \propto E$ ensures a straight-line graph for free particles.

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19. 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)

Solution: At Brewster's angle, the reflected light becomes completely polarised perpendicular to the plane of incidence. This happens because the angle between the reflected and refracted rays becomes 90°. The refracted light, however, remains partially polarised because it contains components of both polarisation states.

Quick Tip

The Brewster angle is given by $\tan i = n$, where i is the Brewster angle and n is the refractive index of the medium.

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20. At any instant of time t, the displacement of a particle is given by $x = 2t - 1$ (SI unit) under the influence of a force of 5 N. The instantaneous power is: (1) 5

(2) 7

(3) 6

(4) 10

Correct Answer: (4)

Solution: The velocity is given by the derivative of displacement with respect to time:

$$v = \frac{dx}{dt} = \frac{d(2t-1)}{dt} = 2\,\text{m/s}.$$

The instantaneous power is calculated as:

$$P = F \cdot v = 5 \times 2 = 10\,\text{W}.$$

Quick Tip

Instantaneous power is calculated using $P = F \cdot v$, where F is the applied force, and v is the instantaneous velocity.

21. A tightly wound 100-turn coil of radius 10 cm carries a current of 7 A. The magnetic field at the centre is: (Take $\mu_0 = 4\pi \times 10^{-7}$ SI units)

(A) 4.4 T

(B) 4.4 mT

(C) 44 T

(D) 44 mT

Correct Answer: (2) 4.4 mT

Solution: The magnetic field at the centre of a circular coil is given by:

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

where N is the number of turns, I is the current, R is the radius, and μ_0 is the permeability of free space. Substituting the values:

$$B = \frac{(4\pi \times 10^{-7}) \times 100 \times 7}{2 \times 0.1} = 4.4\,\text{mT}.$$

Quick Tip

For a solenoid or circular coil, the magnetic field strength is proportional to the number of turns and current.

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22. The moment of inertia of a thin rod about an axis passing through its midpoint and perpendicular to the rod is $2400\,\text{g cm}^2$. The length of the rod is:

(A) $17.5\,\text{cm}$

(B) $20.7\,\text{cm}$

(C) $72.0\,\text{cm}$

(D) $8.5\,\text{cm}$

Correct Answer: (4) $8.5\,\text{cm}$

Solution: The moment of inertia of a rod is given by:

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

Here, $I = 2400\,\text{g cm}^2 = 2400 \times 10^{-7}\,\text{kg m}^2$, $M = 400\,\text{g} = 0.4\,\text{kg}$. Rearrange to find L:

$$L = \sqrt{\frac{12I}{M}} = \sqrt{\frac{12 \times 2400 \times 10^{-7}}{0.4}} = 8.5\,\text{cm}.$$

Quick Tip

For rods, use $I = \frac{1}{12} ML^2$ when the axis is perpendicular and passes through the centre.

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23. A bob is whirled in a horizontal plane at an initial speed ω. The tension in the string is T. If the speed doubles, the tension becomes:

(A) $4T$

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

(C) $\sqrt{2}T$

(D) T

Correct Answer: (1) $4T$

Solution: Tension in the string is proportional to the square of the velocity:

$$T \propto v^2.$$

If $v \to 2v$, then $T \to 4T$.

Quick Tip

In circular motion, tension or centripetal force varies with the square of the velocity: $F_c = m\frac{v^2}{r}$.

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24. 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.	$\chi >> 1$
D.	Non-magnetic	IV.	$0 < \chi < \varepsilon$ (a small positive number)

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

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

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

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

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

Solution: Magnetic materials are characterised by their susceptibility:

- Diamagnetic: $\chi = 0$.

- Ferromagnetic: $\chi \gg 1$.

- Paramagnetic: $0 < \chi \ll 1$.

- Non-magnetic: $0 < \chi < \epsilon$.

Quick Tip

Material susceptibilities help classify substances into diamagnetic, paramagnetic, and ferromagnetic.

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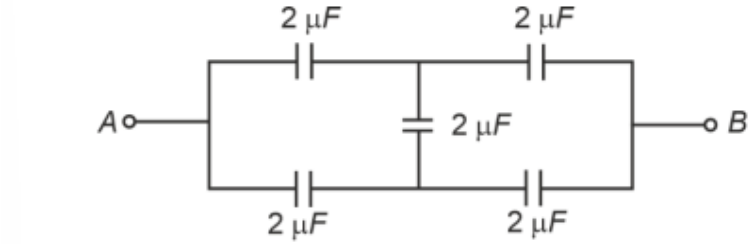
25. In the circuit, the equivalent capacitance between terminals A and B is:



(A) $1\,\mu F$

(B) $0.5\,\mu F$

(C) $4\,\mu F$

(D) $2\,\mu F$

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

Solution: The equivalent capacitance is calculated as:

- First, combine series capacitors: $C_s = \frac{1}{\frac{1}{2}+\frac{1}{2}} = 1\,\mu F$.

- Combine with parallel capacitors: $C_p = 1 + 1 = 2\,\mu F$.

Quick Tip

For capacitors in series, use $C_s = \frac{1}{\sum \frac{1}{C}}$. For capacitors in parallel, use $C_p = \sum C$.

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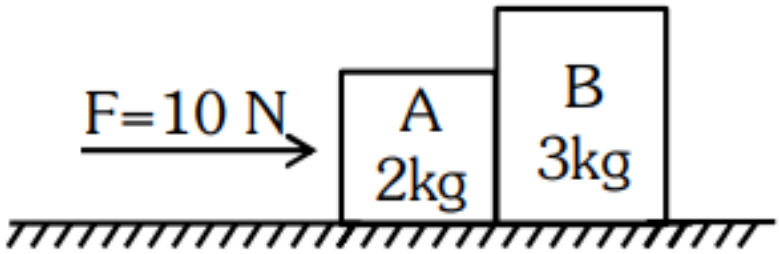
26. A horizontal force $10\,\text{N}$ is applied to a block A as shown. The mass of blocks A and B are $2\,\text{kg}$ and $3\,\text{kg}$ respectively. The blocks slide over a frictionless surface. The force exerted by block A on block B is:



(A) $4\,\text{N}$

(B) $6\,\text{N}$

(C) $10\,\text{N}$

(D) Zero

Correct Answer: (2) $6\,\text{N}$

Solution: The total acceleration of the system is:

$$a = \frac{F}{m_A + m_B} = \frac{10}{2+3} = 2\,\text{m/s}^2.$$

The force exerted by A on B is:

$$F_{\text{AB}} = m_B \cdot a = 3 \times 2 = 6\,\text{N}.$$

Quick Tip

Use $F = ma$ to calculate forces between objects in systems with known acceleration.

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27. In the nuclear emission stated, the mass number and atomic number of the product Q are:

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

1. $286, 80$

2. $288, 82$

3. $286, 81$

4. $280, 81$

Correct Answer: (3) $286, 81$

Solution:

- After α decay, mass number reduces by 4, atomic number by 2: $286, 80$.

- After β^+ emission, atomic number reduces by 1: $286, 79$.

- After β^- emission, atomic number increases by 1: $286, 80$.

- After electron capture, atomic number reduces by 1: $286, 81$.

Quick Tip

In nuclear reactions, track changes in mass and atomic numbers systematically for each decay step.

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

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

(B) $\frac{100}{N}$

(C) $10(N + 1)$

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

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

Solution: The vernier constant is defined as the difference in length between one main scale division (MSD) and one vernier scale division (VSD).

Given:

- $N + 1$ divisions of the vernier scale coincide with N divisions of the main scale.

- 1 MSD represents 0.1 mm.

Step 1: The total length corresponding to N divisions of the main scale is

$N \times 0.1$ mm $= 0.1N$ mm.

Step 2: The total length corresponding to $N + 1$ divisions of the vernier scale is

$(N + 1) \times$ VSD.

Step 3: Since both lengths are equal (as the $N + 1$ divisions of the vernier scale coincide with N divisions of the main scale), we have:

$$0.1N = (N + 1) \times \text{VSD}$$

Step 4: Solve for the VSD:

$$\text{VSD} = \frac{0.1N}{N + 1}$$

Step 5: The vernier constant is the difference between 1 MSD and 1 VSD:

$$\text{Vernier constant} = \text{MSD} - \text{VSD} = 0.1\,\text{mm} - \frac{0.1N}{N+1}\,\text{mm}$$

$$\text{Vernier constant} = \frac{1}{100(N+1)}\,\text{cm}$$

Thus, the vernier constant is $\frac{1}{100(N+1)}$ cm.

Quick Tip

Vernier constant: Subtract one vernier scale division from one main scale division to find the least count.

---

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

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

(B) $5\,\text{cm}, 1\,\text{s}$

(C) $5\,\text{m}, 1\,\text{s}$

(D) $5\,\text{cm}, 2\,\text{s}$

Correct Answer: (1) $5\,\text{m}, 2\,\text{s}$

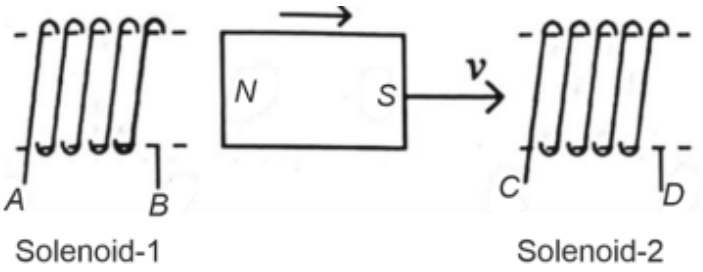
Solution: The amplitude is the coefficient of $\sin$: $5\,\text{m}$. The angular frequency $\omega = \pi$, and time period $T = \frac{2\pi}{\omega} = \frac{2\pi}{\pi} = 2\,\text{s}$.

Quick Tip

In SHM, amplitude is the maximum displacement, and $T = \frac{2\pi}{\omega}$ determines the period.

---

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



(A) BA and CD

(B) AB and CD

(C) BA and DC

(D) AB and DC

Correct Answer: (4) AB and DC

Solution: Using Lenz's law: - In solenoid-1, induced current opposes the motion of the magnet, flowing AB. - In solenoid-2, induced current supports the approach of the magnet, flowing DC.

Quick Tip

Apply Lenz's law: Induced current always opposes the cause of its generation.

---

31. A logic circuit provides the output Y as per the 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) $A\overline{B} + \overline{A}$

(B) $\overline{B}$

(C) B

(D) $A\overline{B} + \overline{A}$

Correct Answer: (2) $\overline{B}$

Solution: From the truth table:

- When $A = 0, B = 0$, $Y = 1$.

- When $A = 0, B = 1, Y = 0$.

- When $A = 1, B = 0, Y = 1$.

- When $A = 1, B = 1, Y = 0$.

From the table, Y is 1 when $B = 0$, irrespective of A. This indicates $Y = \overline{B}$.

Thus, the Boolean expression for Y is $\overline{B}$.

Quick Tip

For truth tables, write expressions by observing the conditions under which output is 1 or 0.

---

32. A wire of length l and resistance $100\,\Omega$ 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) $52\,\Omega$

(B) $55\,\Omega$

(C) $60\,\Omega$

(D) $26\,\Omega$

Correct Answer: (1) $52\,\Omega$

Solution: Each part of the wire has resistance $R_1 = \frac{100}{10} = 10\,\Omega$.

- The first 5 parts connected in series:

$$R_s = 5 \cdot 10 = 50\,\Omega.$$

- The next 5 parts connected in parallel:

$$R_p = \frac{10}{5} = 2\,\Omega.$$

- Total resistance:

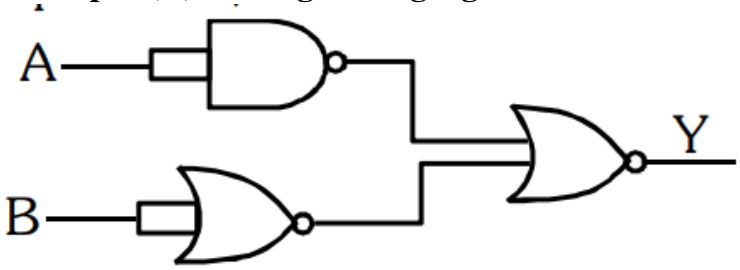
$$R_{\text{total}} = R_s + R_p = 50 + 2 = 52\,\Omega.$$

Quick Tip

For series combinations, add resistances. For parallel combinations, use $R_p = \frac{R}{n}$ for identical resistors.

---

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



(A) NOR gate

(B) OR gate

(C) AND gate

(D) NAND gate

Correct Answer: (3) AND gate

Solution: To analyze the given circuit, let's break it step-by-step:

1. The circuit consists of two logic gates connected to form the output Y.

2. The input signals A and B are passed through an OR gate, producing $A + B$.

3. The output of the OR gate is then inverted (NOT gate), resulting in $\overline{A + B}$.

4. Finally, $\overline{A + B}$ is passed through another OR gate with the input $A \cdot B$, which gives:

$$Y = (A \cdot B) \cdot (\overline{A + B}).$$

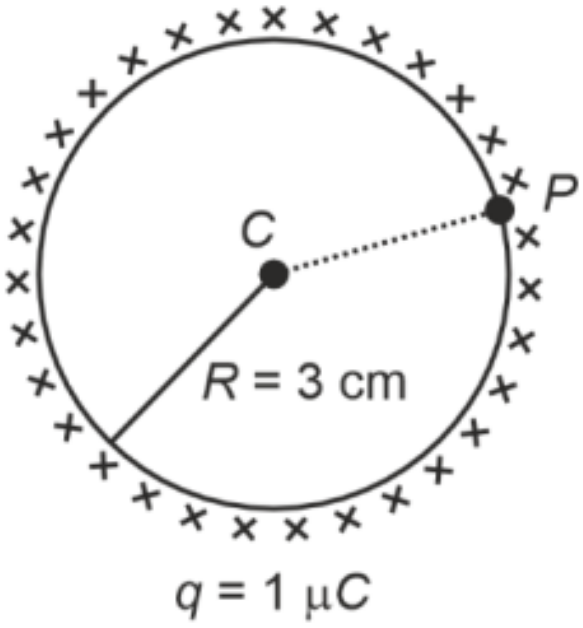
The resulting operation is equivalent to the output of an AND gate.

Quick Tip

Logic gates can often be simplified by analyzing their truth tables step-by-step.

---

34. A thin spherical shell is charged by some source. The potential difference between two points C and P (in V) is:



(A) 1×10^5

(B) 0.5×10^5

(C) Zero

(D) 3×10^5

Correct Answer: (3) Zero

Solution: - A charged spherical shell has the same potential at all points inside the shell and on its surface. This property arises because the electric field inside the shell is zero.

- The potential V at any point inside the shell (including the center C) and on the surface P is given by:

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

where $q = 1\,\mu C = 1 \times 10^{-6}\,C$, $R = 3\,\text{cm} = 0.03\,\text{m}$, and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ SI units.

- Since the potential V is the same at both points C and P, the potential difference $\Delta V = V_P - V_C = 0$.

Thus, the potential difference between C and P is **Zero**.

Quick Tip

The potential inside a spherical shell is constant, regardless of the position.

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

(A) $9.8\,\text{m/s}^2$

(B) $4.9\,\text{m/s}^2$

(C) $3.92\,\text{m/s}^2$

(D) $19.6\,\text{m/s}^2$

Correct Answer: (3) $3.92\,\text{m/s}^2$

Solution: The acceleration due to gravity (g) on a planet is given by the formula:

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

Where:

- G is the gravitational constant,

- M is the mass of the planet,

- R is the radius of the planet.

Step 1: Let the mass of the planet be $\frac{1}{10}$ that of Earth. So, if the mass of Earth is M_{Earth}, then:

$$M_{\text{planet}} = \frac{1}{10} M_{\text{Earth}}$$

Step 2: The diameter of the planet is half that of Earth, so the radius of the planet is:

$$R_{\text{planet}} = \frac{1}{2} R_{\text{Earth}}$$

Since the acceleration due to gravity is inversely proportional to the square of the radius, the radius term in the formula becomes:

$$R_{\text{planet}}^2 = \left(\frac{1}{2} R_{\text{Earth}}\right)^2 = \frac{1}{4} R_{\text{Earth}}^2$$

Step 3: Now, substituting into the formula for gravity:

$$g_{\text{planet}} = \frac{G \times \frac{1}{10} M_{\text{Earth}}}{\left(\frac{1}{2} R_{\text{Earth}}\right)^2} = \frac{G \times \frac{1}{10} M_{\text{Earth}}}{\frac{1}{4} R_{\text{Earth}}^2} = \frac{4}{10} \times \frac{G M_{\text{Earth}}}{R_{\text{Earth}}^2}$$

Step 4: The acceleration due to gravity on Earth is $g_{\text{Earth}} = \frac{G M_{\text{Earth}}}{R_{\text{Earth}}^2} = 9.8\,\text{m/s}^2$, so:

$$g_{\text{planet}} = \frac{4}{10} \times 9.8\,\text{m/s}^2 = 3.92\,\text{m/s}^2$$

Thus, the acceleration due to gravity on the planet is $3.92\,\text{m/s}^2$.

Quick Tip

Gravity depends directly on mass and inversely on the square of the radius.

---

36. The minimum energy required to launch a satellite into a circular orbit at $2R$ altitude is:

(A) $\frac{2GMm}{3R}$

(B) $\frac{GMm}{2R}$

(C) $\frac{GMm}{3R}$

(D) $\frac{5GMm}{6R}$

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

Solution: The total energy in orbit is:

$$E = \frac{-GMm}{2r} = \frac{-GMm}{2(3R)} = \frac{-GMm}{6R}.$$

Minimum energy to escape is:

$$\Delta E = \frac{GMm}{R} - \frac{GMm}{6R} = \frac{5GMm}{6R}.$$

Quick Tip

The minimum energy to launch includes the escape velocity and potential energy change.

---

37. A telescope with an objective focal length of 140 cm and eyepiece focal length 5 cm has magnifying power:

(A) 28

(B) 17

(C) 32

(D) 34

Correct Answer: (1) 28

Solution: The magnifying power M of a telescope for a distant object is given by the formula:

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

where: - $f_o = 140\,\text{cm}$ is the focal length of the objective lens.

- $f_e = 5.0\,\text{cm}$ is the focal length of the eyepiece.

Substituting the values:

$$M = \frac{140}{5.0} = 28.$$

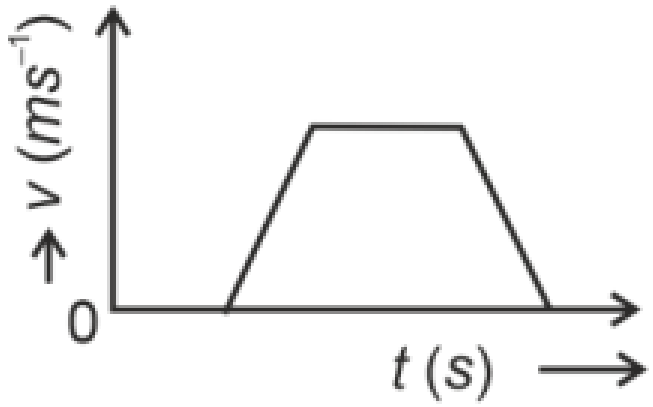
Thus, the magnifying power of the telescope is 28.

Quick Tip

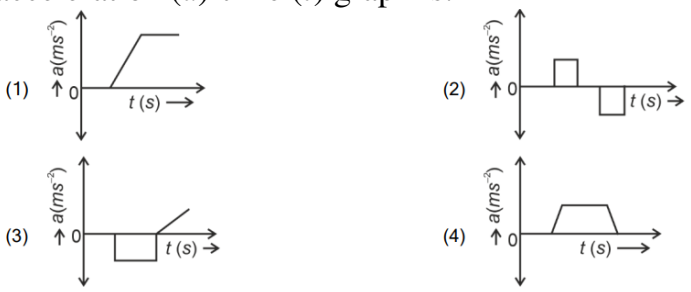
For distant objects, magnifying power is the ratio of objective to eyepiece focal lengths.

---

38. The velocity (v)-time (t) plot of a body is shown.



The acceleration (a)-time (t) graph is:



Correct Answer: (2)

Solution: From the $v - t$ graph, acceleration is the slope. During intervals, slope is constant and changes in steps, matching the stepped graph.

Quick Tip

Acceleration is the slope of velocity-time graphs; look for constancy or changes.

39. Two heaters A and B have power ratings of $1\,\text{kW}$ and $2\,\text{kW}$, respectively. They are connected in series and then in parallel. The power ratio is:

(A) $2:9$

(B) $1:2$

(C) $2:3$

(D) $1:1$

Correct Answer: (1) $2:9$

Solution:

Let the resistances of the heaters A and B be R_A and R_B, respectively. From the formula for power $P = \frac{V^2}{R}$, the resistance can be expressed as:

$$R = \frac{V^2}{P}.$$

So:

$$R_A = \frac{V^2}{1\,\text{kW}} \quad \text{and} \quad R_B = \frac{V^2}{2\,\text{kW}}.$$

1. **Case 1: Series Connection**

The total resistance in series is:

$$R_{\text{series}} = R_A + R_B.$$

The power output is inversely proportional to the resistance, so:

$$P_{\text{series}} = \frac{V^2}{R_{\text{series}}} = \frac{V^2}{R_A + R_B}.$$

2. **Case 2: Parallel Connection**

The total resistance in parallel is:

$$R_{\text{parallel}} = \frac{R_A R_B}{R_A + R_B}.$$

The power output for parallel connection is:

$$P_{\text{parallel}} = \frac{V^2}{R_{\text{parallel}}} = \frac{V^2}{\frac{R_A R_B}{R_A + R_B}} = \frac{V^2(R_A + R_B)}{R_A R_B}.$$

3. **Ratio of Power Outputs**

The ratio of power outputs for series and parallel connections is:

$$\frac{P_{\text{series}}}{P_{\text{parallel}}} = \frac{\frac{V^2}{R_A+R_B}}{\frac{V^2(R_A+R_B)}{R_AR_B}} = \frac{R_AR_B}{(R_A+R_B)^2}.$$

Substituting $R_A = \frac{V^2}{1}$ and $R_B = \frac{V^2}{2}$:

$$\frac{P_{\text{series}}}{P_{\text{parallel}}} = \frac{\left(\frac{V^2}{1}\right)\left(\frac{V^2}{2}\right)}{\left(\frac{V^2}{1}+\frac{V^2}{2}\right)^2} = \frac{\frac{V^4}{2}}{\left(\frac{3V^2}{2}\right)^2}.$$

Simplifying:

$$\frac{P_{\text{series}}}{P_{\text{parallel}}} = \frac{\frac{1}{2}}{\frac{9}{4}} = \frac{2}{9}.$$

Thus, the ratio of power outputs is $2:9$.

Quick Tip

Power in series is inversely proportional, while power in parallel is directly proportional to resistance.

---

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

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

(B) $\alpha\beta t$

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

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

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

Solution: For $\frac{\alpha t}{\beta}$ to be dimensionless: - Dimensions of α: $[\text{F}] \cdot [t]^{-2} = \frac{\text{MLT}^{-2}}{\text{T}^2} = \text{MLT}^{-4}$.

- Dimensions of β: $[\text{F}] \cdot [t]^{-1} = \frac{\text{MLT}^{-2}}{\text{T}} = \text{MLT}^{-3}$.

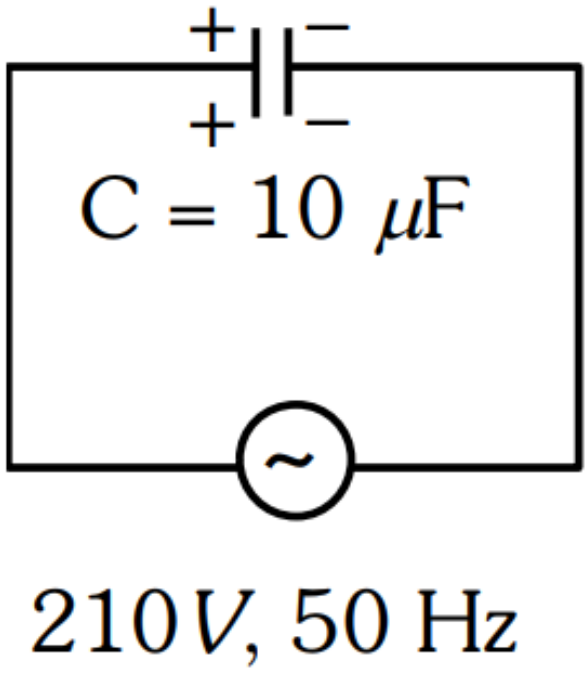
- $\frac{\alpha t}{\beta}$ is dimensionless since $\frac{\text{MLT}^{-4}\cdot\text{T}}{\text{MLT}^{-3}} = 1$.

Quick Tip

To check for dimensionless quantities, ensure all units cancel out in the given ratio.

---

41. A $10\,\mu F$ capacitor is connected to a $210\,\text{V}, 50\,\text{Hz}$ source. The peak current in the circuit is:



(A) $0.93\,\text{A}$

(B) $1.20\,\text{A}$

(C) $0.35\,\text{A}$

(D) $0.58\,\text{A}$

Correct Answer: (1)

Solution: The capacitive reactance is given by:

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

Substituting values:

$$X_c = \frac{1}{2 \cdot 3.14 \cdot 50 \cdot 10 \cdot 10^{-6}} = 318.31\,\Omega.$$

The peak current:

$$I_{\text{peak}} = \frac{V_{\text{peak}}}{X_c} = \frac{210\sqrt{2}}{318.31} \approx 0.93\,\text{A}.$$

Quick Tip

For AC circuits, use $X_c = \frac{1}{\omega C}$ to find capacitive reactance and peak current.

42. A metallic bar of Young's modulus 0.5×10^{11} N/m^2 and coefficient of linear expansion $10^{-5},^{\circ} C^{-1}$, heated from 0°C to $100^{\circ}C$. The compressive force developed is:

(A) 50×10^3 N

(B) 100×10^3 N

(C) 2×10^3 N

(D) 5×10^3 N

Correct Answer: (1)

Solution: Thermal stress is:

$$\text{Stress} = Y \cdot \alpha \cdot \Delta T.$$

The force is:

$$F = \text{Stress} \cdot A = Y \cdot \alpha \cdot \Delta T \cdot A.$$

Substituting values:

$$F = 0.5 \times 10^{11} \cdot 10^{-5} \cdot 100 \cdot 10^{-3} = 50 \times 10^3 \text{ N}.$$

Quick Tip

Thermal stress depends on Young's modulus, thermal expansion coefficient, and temperature change.

---

43. A parallel plate capacitor is charged through a resistor. If I is the current, then in the gap between the plates:

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

(B) Displacement current of magnitude equal to I flows in the opposite direction.

(C) Displacement current greater than I flows in any direction.

(D) There is no current.

Correct Answer: (1)

Solution: - When a parallel plate capacitor is connected to a battery, current flows in the circuit, and the capacitor starts charging.

- In the gap between the plates of the capacitor, a **displacement current** flows. This current

arises due to the changing electric field and is given by:

$$I_d = \epsilon_0 \frac{d\Phi_E}{dt},$$

where I_d is the displacement current, ϵ_0 is the permittivity of free space, and Φ_E is the electric flux.

- In a charging capacitor, the displacement current I_d is equal in magnitude to the conduction current I in the external circuit and flows in the same direction as I.

Thus, the displacement current is of the same magnitude as I and flows in the same direction.

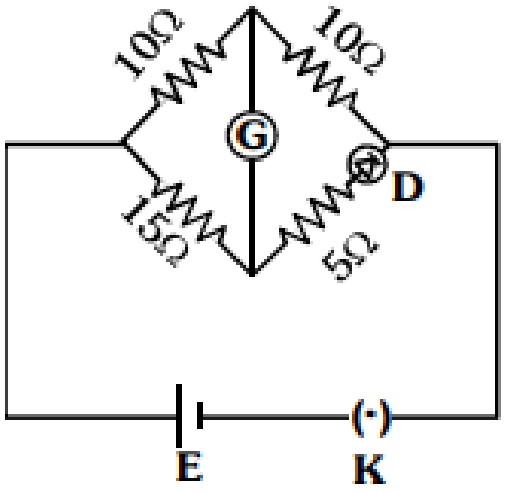
Quick Tip

For capacitors, displacement current bridges the gap between the plates, maintaining continuity.

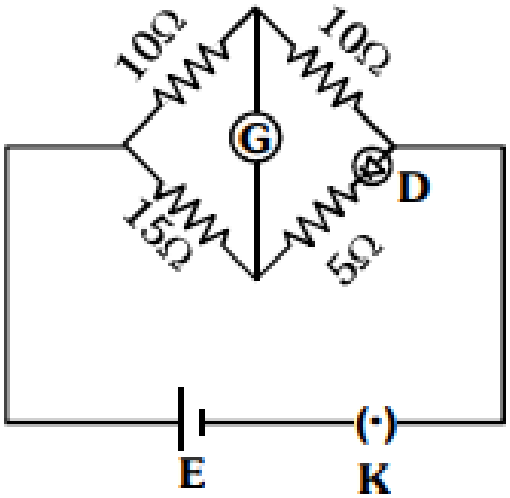
---

44. Choose the correct circuit which achieves bridge balance:

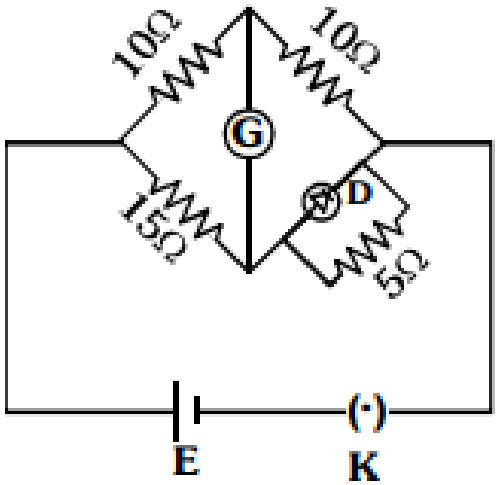
(1)


10Ω
10Ω
G
D
15Ω
5Ω
E
K

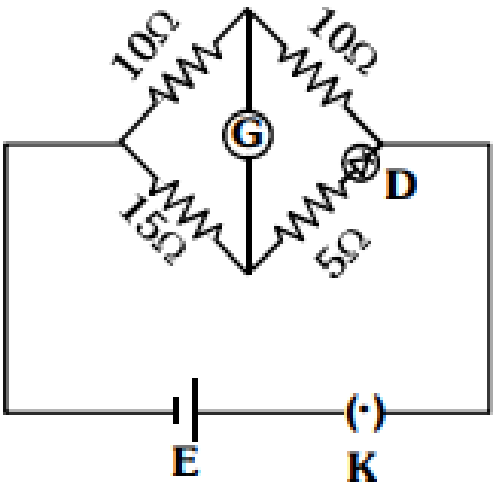
(2)


10Ω
10Ω
G
D
15Ω
5Ω
E
K

(3)


10Ω
10Ω
G
D
15Ω
5Ω
E
K

(4)


10Ω
10Ω
G
D
15Ω
5Ω
E
K

Correct Answer: (4)

Solution: The condition for a Wheatstone bridge to be balanced is:

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

where R_1, R_2, R_3, and R_4 are the resistances in the respective branches of the bridge.

Analyzing each circuit:

1. In Circuit (1): The ratio $\frac{R_1}{R_2}$ is not equal to $\frac{R_3}{R_4}$.
2. In Circuit (2): Similarly, the ratios are not equal.
3. In Circuit (3): The ratios are not balanced, and hence the bridge does not balance.
4. In Circuit (4): The ratio of resistances satisfies the balance condition:

$$\frac{10\,\Omega}{15\,\Omega} = \frac{10\,\Omega}{15\,\Omega}.$$

Therefore, the bridge is balanced in this configuration.

Hence, the correct answer is Circuit (4).

Quick Tip

In a balanced Wheatstone bridge, the ratio of resistances in one branch equals the other.

---

45. A sheet is placed near a 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: Analyzing the force on a magnetic sheet.

- If the sheet is magnetic, there will be an attractive force due to the magnetic field at the pole. This force must be counteracted to keep the sheet held in place. Hence, option A is correct.

Analyzing the force on a non-magnetic sheet.

- A non-magnetic sheet would not experience any significant force in the vicinity of the magnetic pole unless it is conducting. Therefore, option B is incorrect.

Force on a conducting sheet.

- If the sheet is conducting, a current will be induced in it due to the magnetic field. This current will interact with the magnetic field and create a force that would oppose the motion of the sheet. To move it away with uniform velocity, a force is required, making option C correct.

Force on a non-conducting, non-polar sheet.

- A non-conducting and non-polar sheet would not interact with the magnetic field in any significant way. Therefore, there is no need for a force to move the sheet with uniform velocity, making option D incorrect.

Thus, the correct statements are A and C only.

Quick Tip

Magnetic or conducting materials near a magnetic field experience forces due to induced currents or direct attraction.

---

46. If plates of a parallel plate capacitor connected to a battery are moved closer:

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: When the plates of a parallel plate capacitor connected to a battery are moved closer:

- The capacitance C of the capacitor increases because $C = \frac{\epsilon_0 A}{d}$, where d is the separation between the plates, and d decreases.
- Since the capacitor is connected to a battery, the voltage V remains constant. The increased capacitance leads to an increase in the charge $Q = CV$.
- The product of charge and voltage, $Q \cdot V$, increases as the charge Q increases.

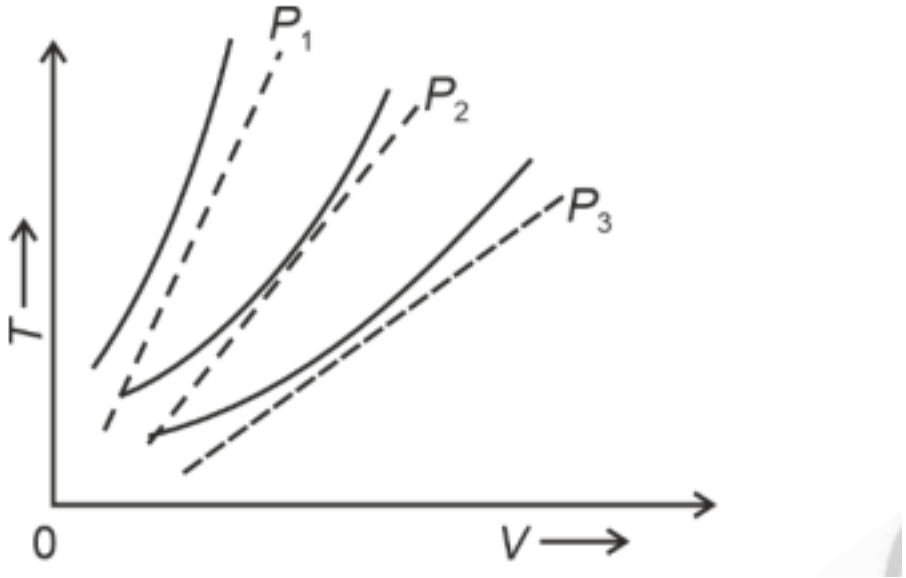
Thus, statements A, C, and E are correct.

Quick Tip

Capacitance depends inversely on plate separation; reducing separation increases charge.

---

47. 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, and P_3, compared with Charles's law (dotted lines). Then the correct relation is:



(A) $P_1 > P_3 > P_2$

(B) $P_2 > P_1 > P_3$

(C) $P_1 > P_2 > P_3$

(D) $P_3 > P_2 > P_1$

Correct Answer: (3)

Solution: According to the ideal gas law:

$$PV = nRT \implies V = \frac{nRT}{P}.$$

For a fixed number of moles, $V \propto T/P$. At a given temperature, as pressure increases, the slope of the $T - V$ curve (from the origin) decreases. Thus:

$$P_1 > P_2 > P_3 \quad \text{(higher pressure corresponds to a steeper curve).}$$

Quick Tip

In $T - V$ graphs, higher pressure corresponds to steeper curves because $V \propto \frac{1}{P}$ at constant T.

---

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

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

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

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

(D) They are transverse in nature.

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

Solution: Electromagnetic waves are generated by charges undergoing acceleration, not by charges moving with uniform speed. All other properties are characteristics of electromagnetic waves:

- Energy densities of electric and magnetic fields are equal.
- Their speed is $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$.
- They are transverse waves.

Quick Tip

Electromagnetic waves are produced by accelerated charges, not by charges in uniform motion.

---

49. An iron bar of length L has magnetic moment M. It is bent at the middle to make two arms at an angle 60°. The magnetic moment of this new magnet is:

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

(B) $2M$

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

(D) M

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

Solution: The magnetic moment M of the original iron bar is given by:

$$M = I \times A$$

where I is the current (or the effective magnetic pole strength), and A is the area of the magnetic loop.

Effect of bending the bar.

When the iron bar is bent at the middle to form two arms, the magnetic moment is distributed across the two arms. The two arms are now at an angle of 60° to each other, and their contributions to the magnetic moment are combined vectorially.

Since the arms are at an angle, the effective magnetic moment becomes:

$$M' = M \times \cos(30^\circ) = M \times \frac{1}{2}$$

Conclusion.

Thus, the magnetic moment of the new magnet after bending is $\frac{M}{2}$, which corresponds to option (A).

Quick Tip

When a magnetic bar is bent, the magnetic moment depends on the angle between the arms.

50. If the mass of a simple pendulum's bob is increased to thrice its original mass, and its length is halved, the new time period is $\frac{x}{2}$ times the original. Find x:

(A) $\sqrt{2}$

(B) $2\sqrt{3}$

(C) 4

(D) $\sqrt{3}$

Correct Answer: (1)

Solution: The time period of a pendulum is:

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

If the length L is halved, the new time period becomes:

$$T_{\text{new}} = 2\pi\sqrt{\frac{L/2}{g}} = 2\pi \cdot \frac{1}{\sqrt{2}}\sqrt{\frac{L}{g}} = \frac{T}{\sqrt{2}}.$$

Comparing with $\frac{x}{2}$:

$$\frac{T}{\sqrt{2}} = \frac{x}{2}T \implies x = \sqrt{2}.$$

Quick Tip

Time period depends on pendulum length, not mass. Changes in length directly affect T.

Chemistry

51. 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. $NaHSO_3$ (1) A and D

(2) B and E

(3) E and D

(4) B and C

Correct Answer: (2)

Solution: - Glucose reacts with Tollen's reagent (A), HCN (C), and NH_2OH (D) to form characteristic products.

- It does not react with Schiff's reagent (B) because it is a mild oxidizing agent, and glucose is a reducing sugar.

- Sodium bisulfite ($NaHSO_3$) (E) does not react with glucose.

Thus, glucose does not react with B and E.

Quick Tip

For organic chemistry questions, remember the functional group reactivity of glucose. Reducing sugars generally react with oxidizing agents, but Schiff's reagent and bisulfite don't show reactions with glucose.

---

52. The energy of an electron in the ground state ($n = 1$) for He^+ ion is $-x$ J. Then, that 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)

Solution: The energy of an electron in a hydrogen-like atom is given by:

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

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

For He^+, $Z = 2$, and for Be^{3+}, $Z = 4$. The ratio of energies in the ground state and $n = 2$ for Be^{3+} gives:

$$E = -\frac{x}{1} = -x.$$

Quick Tip

For calculating energy levels in hydrogen-like atoms, always consider Z^2 dependence for different atoms. Divide by n^2 for excited states.

---

53. 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)

Solution: - A redox reaction involves the transfer of electrons, leading to oxidation and reduction.

- In option (3), there is no change in oxidation states of elements; it is a simple double displacement reaction.

- In other options, electron transfer occurs, qualifying them as redox reactions.

Quick Tip

Always check the oxidation states of elements before and after a reaction to identify if it is redox. No change in oxidation states means no redox.

---

54. Match List-I with List-II:

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

(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)

Solution: - Isothermal: Temperature constant $\rightarrow$ II

- Isochoric: Volume constant $\rightarrow$ III

- Isobaric: Pressure constant $\rightarrow$ IV

- Adiabatic: No heat exchange $\rightarrow$ I

Thus, the correct matching is $A - II, B - III, C - IV, D - I$.

Quick Tip

For thermodynamic processes, remember the definitions: - Iso- refers to "constant," and the suffix determines the variable (temperature, volume, or pressure).

---

55. For the reaction $2A \rightleftharpoons B + C$, $K_c = 4 \times 10^{-3}$. At a given time, $[A] = [B] = [C] = 2 \times 10^{-3}$. 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: The reaction quotient Q_c is calculated as:

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

Since $Q_c > K_c$, the reaction will shift in the backward direction to establish equilibrium.

Quick Tip

Compare Q_c and K_c:

- $Q_c > K_c$: Reaction moves backward.

- $Q_c < K_c$: Reaction moves forward.

- $Q_c = K_c$: Reaction is at equilibrium.

---

56. Match List I with List II:

	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

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

Solution: - Complex A exhibits ionization isomerism because NO_2^- can ionize.

- Complex B shows solvate isomerism due to SO_4^{2-} exchange with water molecules.

- Complex C shows coordination isomerism between the two metal centers.

- Complex D shows linkage isomerism because Cl^- can bind in multiple ways.

Quick Tip

For identifying isomerism in complexes, focus on possible ligand exchanges or binding modes: solvate, linkage, ionization, or coordination.

---

57. In which of the following processes entropy increases?

A. A liquid evaporates to vapour.

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

(2) A, C and D

(3) C and D

(4) A and C

Correct Answer: (2)

Solution: - A: A liquid evaporating to vapor increases entropy because gas has higher randomness.

- C: Decomposition of $NaHCO_3$ increases entropy as solid converts to gases (CO_2, H_2O).

- D: Dissociation of Cl_2 into 2Cl increases entropy due to an increase in the number of particles.

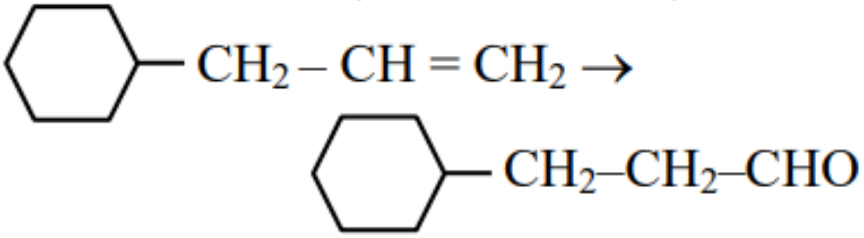
- B: Lowering temperature decreases entropy as randomness decreases.

Quick Tip

Entropy increases in processes involving phase changes (solid to liquid to gas) or an increase in the number of gaseous molecules.

---

58. 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: - BH_3 performs hydroboration of the double bond.

- H_2O_2/OH^- oxidizes the boron intermediate to an alcohol.

- PCC selectively oxidizes the alcohol to an aldehyde.

Quick Tip

For transformations involving aldehydes, use PCC for controlled oxidation of primary alcohols. Hydroboration ensures anti-Markovnikov addition.

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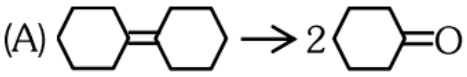
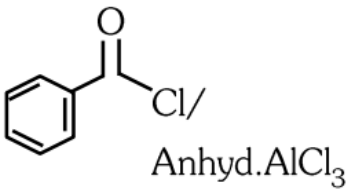
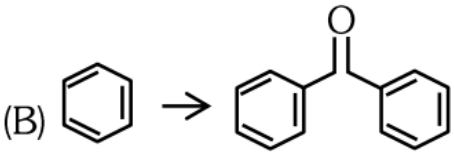
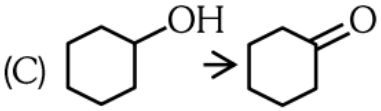
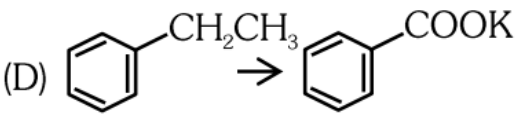
59. Match List I with List II:

List I (Reaction)	**List II (Reagents/Condition)**
(A) 	(I) 
(B) 	(II) CrO_3
(C) 	(III) $KMnO_4/KOH,\Delta$
(D) 	(IV) (i) O_3 (ii) Zn-H_2O

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

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

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

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

Correct Answer: (2)

Solution: - Reaction A uses $KMnO_4$/KOH for oxidation.

- Reaction B uses CrO_3 for oxidation of aldehydes.

- Reaction C involves Friedel-Crafts alkylation with $AlCl_3$.

- Reaction D involves ozonolysis.

Quick Tip

Remember common reagents for oxidation ($KMnO_4$, CrO_3) and special conditions for Friedel-Crafts and ozonolysis.

---

60. 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)

Solution: - $K_p = K_c(RT)^{\Delta n}$, where Δn = moles of gas products − moles of gas reactants.

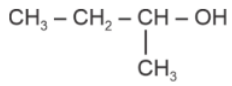
- For equilibrium (4), $\Delta n \neq 0$, hence $K_p \neq K_c$.

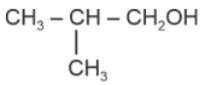
Quick Tip

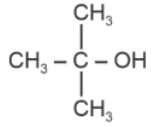
For $K_p = K_c$, ensure $\Delta n = 0$. If not, the values will differ.

---

61. Which one of the following alcohols reacts instantaneously with Lucas reagent?

(1) 

(2) 

(3) 

(4) $CH_3 - CH_2 - CH_2 - CH_2OH$

Correct Answer: (3)

Solution: Tertiary alcohols react instantly with Lucas reagent due to the formation of a

stable tertiary carbocation intermediate.

Quick Tip

Lucas test distinguishes alcohols: tertiary (instant), secondary (few minutes), and primary (no reaction or very slow).

---

62. 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 spherical shape, reducing surface area and intermolecular forces, thereby lowering the boiling point.

In light of the above statements, choose the correct option:

(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)

Solution:

1. The boiling point decreases with increased branching because branched-chain alkanes have less surface area for intermolecular forces.
2. Statement II accurately explains the phenomenon of lower boiling points in branched isomers.

Quick Tip

Boiling points of isomers depend on the degree of branching. More branching leads to reduced surface area, weaker van der Waals forces, and lower boiling points.

---

63. Given below are two statements:

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

Statement II: Aniline cannot be prepared through Gabriel synthesis.

Choose the correct answer:

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

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

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

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

Correct Answer: (4)

Solution:

1. Aniline does not undergo Friedel-Crafts alkylation because the NH_2 group forms a complex with the Lewis acid ($AlCl_3$), deactivating the reaction.

2. Gabriel synthesis cannot prepare aniline because it involves alkyl halides, and aryl halides like chlorobenzene do not undergo this reaction.

Quick Tip

Always consider steric and electronic factors when analyzing why a compound does not participate in a reaction.

---

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

(1) $d^5 \rightarrow d^2$ configuration.

(2) $d^4 \rightarrow d^5$ configuration.

(3) $d^3 \rightarrow d^5$ configuration.

(4) $d^5 \rightarrow d^4$ configuration.

Correct Answer: (2)

Solution:

1. Mn^{3+} has a d^4 configuration, which upon reduction to Mn^{2+} becomes d^5, a half-filled stable configuration.

2. This stability contributes to the more positive E° value for Mn^{3+}/Mn^{2+} compared to Cr or Fe.

Quick Tip

Reduction potential increases for transitions leading to half-filled or fully filled stable configurations.

---

65. On heating, some solid substances change directly to vapor without passing through the liquid state. This technique is called:

(1) Sublimation.

(2) Distillation.

(3) Chromatography.

(4) Crystallization.

Correct Answer: (1)

Solution:

1. Sublimation is the direct transition from solid to vapor, bypassing the liquid phase.
2. Examples include iodine and naphthalene.

Quick Tip

Sublimation is a quick method for purifying substances like camphor and iodine that sublime upon heating.

---

66. Fehling's solution 'A' is:

(1) Alkaline copper sulfate.

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

(3) Aqueous sodium citrate.

(4) Aqueous copper sulfate.

Correct Answer: (4)

Solution:

1. Fehling's solution is a mixture of Fehling's solution A (aqueous copper sulfate) and Fehling's solution B (alkaline potassium sodium tartrate).
2. It is used for testing aldehydes, which reduce Cu^{2+} to Cu_2O.

Quick Tip

Fehling's test is commonly used to detect reducing sugars like glucose and fructose.

---

67. Match List I with List II:

	List I (Molecule)		List II (Number and types of bond/s between two carbon atoms)
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

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

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

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

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

Correct Answer: (2)

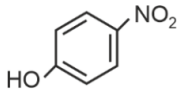
Solution:

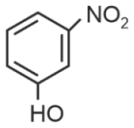
1. Ethane has a single σ-bond.
2. Ethene has one σ-bond and one π-bond.
3. C_2 has two π-bonds due to unique bonding.
4. Ethyne has one σ-bond and two π-bonds.

Quick Tip

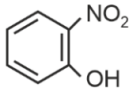
For hydrocarbons, identify bond types by analyzing hybridization: single bonds are σ, and double or triple bonds include π.

68. Intramolecular hydrogen bonding is present in:

(1) 

(2) 

(3) HF

(4) 

Correct Answer: (4)

Solution:

1. Intramolecular hydrogen bonding occurs when a hydrogen atom forms a bond within the same molecule between a donor (e.g., OH, NH) and an acceptor (e.g., NO_2, CO).
2. Option (4) has OH and NO_2 groups in close proximity, allowing intramolecular hydrogen bonding.
3. The other options lack this spatial arrangement.

Quick Tip

To identify intramolecular hydrogen bonding, look for groups that are geometrically close within a molecule and can form H-bonds.

---

69. 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)

Solution:

1. 4 u of helium corresponds to one atom of helium (atomic mass unit).
2. 4 g of helium corresponds to 1 mole, which is 6.022×10^{23} atoms.

3. At STP, 1 mole of helium occupies 22.4 L. Hence, 2.271098 L corresponds to approximately 0.1 mol, or 6.022×10^{22} atoms.

4. 4 moles of helium correspond to $4 \times 6.022 \times 10^{23}$, the highest number of atoms.

Quick Tip

Remember: 1 mole = 6.022×10^{23} particles. Use Avogadro's number for quick calculations.

---

70. 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

(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)

Solution:

1. For $H_2O \rightarrow O_2$, 4 electrons are needed per oxygen atom. Hence, 2 moles of H_2O require 4F for 1 mole of O_2.

2. For $MnO_4^- \rightarrow Mn^{2+}$, 5 electrons per mole are required, so 5F.

3. For $CaCl_2$, 2 electrons are required per Ca, so 1.5 moles require 3F.

4. For $FeO \rightarrow Fe_2O_3$, 2 moles of FeO require 2F.

Quick Tip

Faraday calculations depend on electrons transferred in redox reactions. Use $Q = n \cdot F$, where n is the number of moles of electrons.

---

71. Among Group 16 elements, which one does NOT show -2 oxidation state?

(1) Se

(2) Te

(3) Po

(4) O

Correct Answer: (3)

Solution: Step 1: Oxygen (O), Selenium (Se), and Tellurium (Te) commonly show a -2 oxidation state due to their high electronegativity.

Step 2: Polonium (Po), being a metal, prefers to show positive oxidation states (+2, +4) and does not exhibit -2.

Quick Tip

For oxidation states, remember non-metals in Group 16 show -2, while metallic members like Polonium prefer positive oxidation states.

---

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

A. Ti^{3+}

B. Cr^{2+}

C. Mn^{2+}

D. Fe^{2+}

E. Sc^{3+}

Choose the correct answer:

(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: Magnetic moment is calculated as:

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

where n is the number of unpaired electrons.

Step 2: For Cr^{2+} (d^4) and Fe^{2+} (d^6), $n = 4$. Both ions have the same spin-only magnetic moment: $\mu = \sqrt{4(4+2)} = 4.90\,\text{BM}$.

Quick Tip

Use the magnetic moment formula for ions: $\mu = \sqrt{n(n+2)}$. Identify n from the unpaired electrons in the electronic configuration.

---

73. 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)

Solution: Step 1: Two tertiary carbons imply two carbons bonded to three other carbons each.

Step 2: Among the options, 2,3-dimethylbutane has two tertiary carbons at C2 and C3.

Step 3: Other options do not satisfy this condition.

Quick Tip

For identifying tertiary carbons, look for carbons bonded to three other carbons. Verify with the molecular structure.

---

74. 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)

Solution: Step 1: Solubility is inversely proportional to K_H. Lower K_H implies higher solubility.

Step 2: K_H values: A = 145, B = 2×10^{-5}, C = 35.

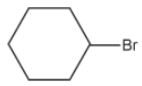
Step 3: Order of solubility: B (lowest K_H) $> C >$ A.

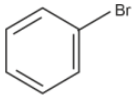
Quick Tip

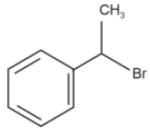
Remember: Solubility $\propto \frac{1}{K_H}$. Smaller K_H implies higher solubility in water.

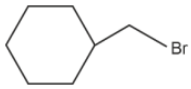
---

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

(1) 

(2) 

(3) 

(4) 

Correct Answer: (3)

Solution: Step 1: S_N1 rate depends on carbocation stability. A more stable carbocation leads to a faster reaction.

Step 2: 2-Methylbenzyl bromide forms a resonance-stabilized benzyl carbocation, enhanced by the methyl group.

Step 3: Other compounds form less stable carbocations.

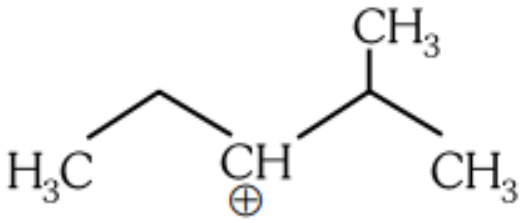
Quick Tip

In S_N1 reactions, prioritize the stability of the intermediate carbocation. Resonance and hyperconjugation increase stability.

---

76. The most stable carbocation among the following is:

(1)



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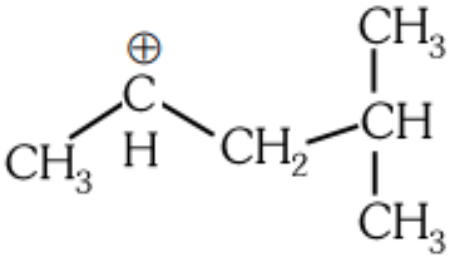

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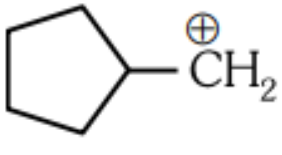
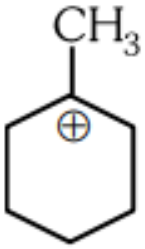


(4)



Correct Answer: (3)

Solution: Step 1: Carbocation stability increases with resonance and hyperconjugation.

Step 2: Option (3) forms a cyclopropylmethyl carbocation stabilized by resonance (non-classical carbocation).

Step 3: Other options lack equivalent stabilization.

Quick Tip

Carbocation stability: Benzyl $>$ $Allyl$ $>$ $Tertiary$ $>$ $Secondary$ $>$ $Primary$ $>$Methyl.

---

77. 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.

Choose the correct answer:

(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)

Solution: Step 1: $[Co(NH_3)_6]^{3+}$ has a low-spin configuration as NH_3 is a strong field ligand. All electrons pair up, making it diamagnetic.

Step 2: $[CoF_6]^{3-}$ has a high-spin configuration as F^- is a weak field ligand, resulting in unpaired electrons and paramagnetic behavior.

Step 3: Both complexes are octahedral but differ in magnetic properties due to the nature of ligands.

Quick Tip

To determine magnetic behavior, check the ligand strength using the spectrochemical series. Strong field ligands induce pairing (low spin), while weak field ligands do not (high spin).

---

78. 1 gram of sodium hydroxide was treated with 25 mL of 0.75 M HCl solution. The mass of sodium hydroxide left unreacted is equal to:

(1) 250 mg

(2) Zero mg

(3) 200 mg

(4) 750 mg

Correct Answer: (1)

Solution: Step 1: The reaction is: $NaOH + HCl \rightarrow NaCl + H_2O$.

Step 2: Moles of HCl = $0.75\,\text{M} \times 0.025\,\text{L} = 0.01875\,\text{mol}$.

Step 3: Moles of NaOH = $\frac{1}{40} = 0.025$ mol.

Step 4: HCl reacts with 0.01875 mol of NaOH, leaving $0.025 - 0.01875 = 0.00625$ mol of NaOH.

Step 5: Mass of unreacted NaOH = $0.00625 \times 40 = 250$ mg.

Quick Tip

Always calculate the limiting reagent in stoichiometry problems to determine the amount left unreacted.

---

79. 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: H_2O has the highest boiling point due to extensive hydrogen bonding.

Choose the correct answer:

(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)

Solution: Step 1: The boiling point order is determined by molecular mass and hydrogen bonding.

Step 2: H_2O has extensive hydrogen bonding, giving it the highest boiling point.

Step 3: Heavier hydrides (H_2Te, H_2Se, H_2S) follow boiling point trends based on molecular mass.

Quick Tip

Hydrogen bonding significantly increases boiling points in hydrides like H_2O. For heavier hydrides, molecular mass dictates boiling points.

---

80. Arrange the following elements in increasing order of first ionization enthalpy:

Li, Be, B, C, N.

(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)

Solution: Step 1: Ionization enthalpy increases across a period due to increased nuclear charge.

Step 2: The anomaly: $B < Be$ because Be has a fully filled $2s^2$ configuration, making it more stable.

Step 3: Final order: $Li < B < Be < C < N$.

Quick Tip

For ionization enthalpy trends, consider stability of electronic configurations: fully filled and half-filled orbitals are more stable.

---

81. 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)

Solution: Step 1: Activation energy is calculated using the Arrhenius equation:

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

where k is the rate constant, E_a is the activation energy, R is the gas constant, and T is the temperature.

Step 2: By taking the natural logarithm at two different temperatures:

$$\ln \frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right),$$

one can calculate E_a if k_1 and k_2 are known.

Quick Tip

To calculate activation energy, always use rate constants at two different temperatures with the Arrhenius equation.

---

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

N, O, F, C, Si.

(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)

Solution: Step 1: Electronegativity increases across a period and decreases down a group in the periodic table.

Step 2: Silicon (Si) has the lowest electronegativity, while fluorine (F) has the highest.

Step 3: Order: $Si < C < N < O < F$.

Quick Tip

Remember: Electronegativity increases left to right in a period and decreases down a group.

---

83. 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

(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)

Solution: Step 1: Principal quantum number (n) gives the size of the orbital.

Step 2: Azimuthal quantum number (l) gives the shape of the orbital.

Step 3: Magnetic quantum number (m) gives the orientation of the orbital.

Step 4: Spin quantum number (m_s) gives the orientation of the spin of the electron.

Quick Tip

Learn the significance of quantum numbers: n (size), l (shape), m (orientation), m_s (spin).

---

84. Match List I with List II:

	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

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

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

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

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

Correct Answer: (4)

Solution: Step 1: NH_3 is trigonal pyramidal due to lone pair repulsion.

Step 2: BrF_5 is square pyramidal with one lone pair.

Step 3: XeF_4 is square planar due to two lone pairs.

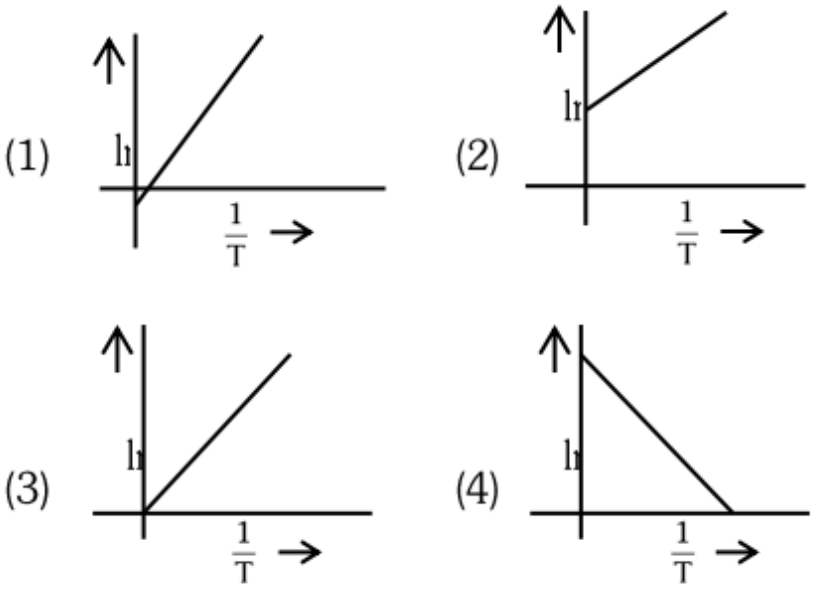
Step 4: SF_6 is octahedral with no lone pairs.

Quick Tip

Use VSEPR theory to determine molecular geometries based on lone pairs and bond pairs.

---

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



Correct Answer: (3)

Solution: Step 1: The Arrhenius equation is:

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

Step 2: A plot of $\ln k$ vs $\frac{1}{T}$ yields a straight line with a negative slope ($-E_a/R$).

Step 3: The graph is linear and decreases as $\frac{1}{T}$ increases.

Quick Tip

Arrhenius plot is always a straight line with a negative slope for typical reactions.

---

86. The work done during reversible isothermal expansion of one mole of hydrogen gas at $25^\circ C$ from a pressure of 20 atm to 10 atm is:

(Given $R = 2.0$ cal K^{-1} mol^{-1})

(1) -413.14 calories

(2) 413.14 calories

(3) 100 calories

(4) 0 calorie

Correct Answer: (1)

Solution: Step 1: For isothermal expansion, work done is calculated as:

$$W = -nRT \ln \frac{P_2}{P_1}.$$

Step 2: Substituting the given values:

$$W = -(1) \cdot (2.0) \cdot (298) \cdot \ln \left(\frac{10}{20} \right).$$

Step 3: Simplify:

$$W = -596 \cdot \ln(0.5) = -596 \cdot (-0.693) \approx -413.14 \, \text{calories}.$$

Quick Tip

For isothermal processes, always use $-nRT \ln \frac{V_2}{V_1}$ or $-nRT \ln \frac{P_2}{P_1}$. Be careful with the logarithm base (natural log in this case).

---

87. 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)

Solution: Step 1: BF_3 is planar and symmetric, so it has zero dipole moment.

Step 2: Dipole moment of NH_3 is greater than that of NF_3 due to opposite polarity.

Step 3: CO_3^{2-} ion has three equivalent resonance structures:

$$\text{O=C-O}^- \leftrightarrow \text{O-C=O}^- \leftrightarrow \text{-C(O)-O}^-.$$

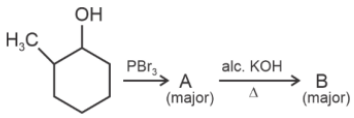
Step 4: Ozone (O_3) has only two resonance structures.

Quick Tip

Canonical forms represent different valid structures for resonance-stabilized molecules. Count only valid equivalent structures.

---

88. Major products A and B formed in the following reaction sequence are:



(1) A = ; B =

(2) A = ; B =

(3) A = ; B =

(4) A = ; B =

Correct Answer: (4)

Solution: Step 1: In the first step, PBr_3 replaces $-OH$ with $-Br$:

$$CH_3CH(OH)CH_2CH_3 \rightarrow CH_3CH(Br)CH_2CH_3 \,(A).$$

Step 2: In the second step, alcoholic KOH causes elimination of HBr:

$$CH_3CH(Br)CH_2CH_3 \rightarrow CH_3CH = CH_2 \,(B).$$

Quick Tip

In elimination reactions, alcoholic KOH promotes dehydrohalogenation to form alkenes.

---

89. 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)

Solution: Step 1: Diamagnetic ions have no unpaired electrons.

Step 2: Ce^{4+} ($[Xe]$) has no unpaired electrons.

Step 3: Yb^{2+} ($[Xe]4f^{14}$) has fully paired $4f$-orbitals.

Step 4: Other options involve ions with unpaired electrons, making them paramagnetic.

Quick Tip

Identify the electron configurations of lanthanoid ions to determine whether electrons are paired or unpaired.

---

90. A compound X contains 32% of A, 20% of B, and the remaining percentage of C. The empirical formula of X is:

(Given atomic masses of $A = 64$, $B = 40$, $C = 32$)

(1) ABC_3

(2) AB_2C_2

(3) ABC_4

(4) A_2BC_2

Correct Answer: (1)

Solution: Step 1: Calculate moles of each element:

$$\text{Moles of } A = \frac{\text{Mass of } A}{\text{Atomic Mass of } A} = \frac{32}{64} = 0.5.$$

$$\text{Moles of } B = \frac{\text{Mass of } B}{\text{Atomic Mass of } B} = \frac{20}{40} = 0.5.$$

$$\text{Moles of } C = \frac{\text{Mass of } C}{\text{Atomic Mass of } C} = \frac{48}{32} = 1.5.$$

Step 2: Divide by the smallest mole value:

$$\text{Ratio: } \frac{0.5}{0.5} : \frac{0.5}{0.5} : \frac{1.5}{0.5} = 1 : 1 : 3.$$

Step 3: Empirical formula:

$$\text{Empirical Formula: } ABC_3.$$

Quick Tip

To calculate the empirical formula, always divide by the smallest number of moles to get a whole number ratio.

---

91. Given below are certain cations. Arrange them 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 following// (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)

Solution: Step 1: Assign group numbers based on periodic table positions:

B(Cu^{2+}): Group I, A(Al^{3+}): Group III,

D(Co^{2+}): Group V, C(Ba^{2+}): Group II,

E(Mg^{2+}): Group VI.

Step 2: Arrange in increasing group number:

Order: $B < A < D < C < E$.

Quick Tip

Refer to periodic table trends and positions to quickly assign group numbers.

---

92. Consider the following reaction in a sealed vessel at equilibrium with concentrations of

$$N_2 = 3.0 \times 10^{-3}\,\text{M},\ O_2 = 4.2 \times 10^{-3}\,\text{M},\ \text{and}\ NO = 2.8 \times 10^{-3}\,\text{M}.$$

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

If 0.1 mol L^{-1} of NO 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) 0.0089

Correct Answer: (3) 0.717

Solution: Let the degree of dissociation of NO be α.

Initially, the concentration of NO is 0.1 mol L^{-1}, and the concentrations of N_2 and O_2 are 0.

At equilibrium, the dissociation of $2NO$ will produce N_2 and O_2 as:

$$NO \rightleftharpoons \frac{1}{2}N_2 + \frac{1}{2}O_2$$

Using the ICE (Initial, Change, Equilibrium) table:

Species	Initial (mol/L)	Change (mol/L)	Equilibrium (mol/L)
NO	0.1	-2α	$0.1 - 2\alpha$
N_2	0	$+\alpha$	α
O_2	0	$+\alpha$	α

At equilibrium, the concentrations are:

- $[NO] = 0.1 - 2\alpha$
- $[N_2] = \alpha$
- $[O_2] = \alpha$

Using the equilibrium expression:

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

Substituting the known values:

$$K_c = \frac{(\alpha)(\alpha)}{(0.1 - 2\alpha)^2}$$

Using the known equilibrium concentrations, solve for α:

$$K_c = \frac{(3.0 \times 10^{-3})(4.2 \times 10^{-3})}{(2.8 \times 10^{-3})^2}$$

Thus, solving the equation gives the value of $\alpha = 0.717$.

Quick Tip

The degree of dissociation α is calculated by comparing the equilibrium concentrations using the ICE table and equilibrium constant expression.

---

93. The rate of a reaction quadruples when temperature changes from $27°C$ to $57°C$. Calculate the energy of activation.

(1) 380.4 kJ/mol

(2) 3.80 kJ/mol

(3) 3804 kJ/mol

(4) 38.04 kJ/mol

Correct Answer: (4)

Solution: Step 1: Use the Arrhenius equation:

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{T_2 - T_1}{T_1 T_2}\right).$$

Step 2: Plug values:

$$\ln 4 = \frac{E_a}{8.314} \times \frac{30}{300 \times 330}.$$

Step 3: Solve for E_a:

$$E_a = 38.04\,\text{kJ/mol}.$$

Quick Tip

Convert temperatures to Kelvin and use logarithmic tables or calculators for accurate results.

---

94. During the preparation of Mohr's salt solution (Ferrous ammonium sulphate), which of the following acid is added to prevent hydrolysis of Fe^{2+}:

(1) Concentrated H_2SO_4

(2) Dilute HNO_3

(3) Dilute H_2SO_4

(4) Dilute HCl

Correct Answer: (3)

Solution: Step 1: Hydrolysis of Fe^{2+}:

Dilute H_2SO_4 is used as it prevents hydrolysis and oxidation.

Quick Tip

Always use dilute H_2SO_4 for stabilizing Fe^{2+} ions in aqueous solutions.

---

95. Identify the major product C formed in the following reaction sequence:

$$CH_3 - CH_2 - CH_2 - I \xrightarrow{\text{NaCN}} A \xrightarrow{\text{Partial Hydrolysis}} B \xrightarrow{\text{NaOH, } Br_2} C$$

(1) Butylamine

(2) Butanamide

(3) α-bromobutanoic acid

(4) Propylamine

Correct Answer: (4)

Solution: Step 1: Reaction with NaCN:

$$CH_3 - CH_2 - CH_2 - I + NaCN \rightarrow CH_3 - CH_2 - CH_2 - CN\,(A).$$

Step 2: Partial hydrolysis of nitrile:

$$CH_3 - CH_2 - CH_2 - CN + H_2O \rightarrow CH_3 - CH_2 - CH_2 - CONH_2\,(B).$$

Step 3: Hofmann degradation:

$$CH_3 - CH_2 - CH_2 - CONH_2 + NaOH + Br_2 \rightarrow CH_3 - CH_2 - CH_2 - NH_2\,(C).$$

Thus, the major product is propylamine.

Quick Tip

In Hofmann degradation, amides are converted into primary amines with one carbon atom less than the parent compound.

---

96. Mass of copper deposited by passing 9.6487 A of current through copper sulfate solution for 100 seconds is:

Given: Molar mass of Cu = 63 g/mol, 1 F = 96487 C

(1) $0.315\,\text{g}$

(2) $31.5\,\text{g}$

(3) $0.0315\,\text{g}$

(4) $3.15\,\text{g}$

Correct Answer: (1)

Solution: Step 1: Faraday's second law of electrolysis:

$$\text{Mass of Cu deposited} = \frac{I \times t \times M}{n \times F},$$

where $M =$ Molar mass of Cu, $n =$ Number of electrons, $F =$ Faraday's constant.

Step 2: Substituting values:

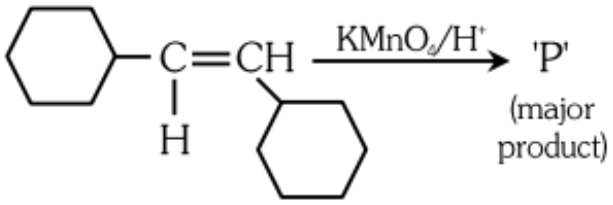
$$\text{Mass} = \frac{9.6487 \times 100 \times 63}{2 \times 96487} = 0.315\,\text{g}.$$

Quick Tip

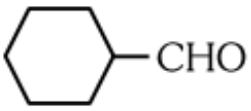
To solve Faraday's law problems, remember: Mass $\propto$ Charge, where Charge $= I \times t$.

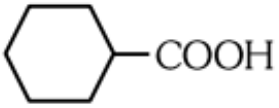
---

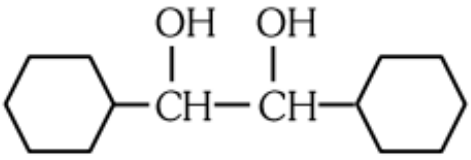
97. For the given reaction:

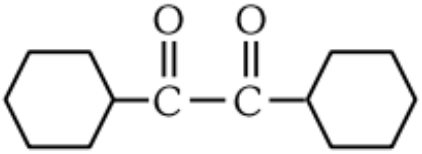


'P' is

(1) 

(2) 

(3) 

(4) 

Correct Answer: (1)

Solution: Step 1: The oxidation of alkenes with $KMnO_4$ under acidic conditions results in

cleavage of the double bond, forming carboxylic acids or ketones depending on the substituents.

Step 2: In this reaction, the double bond in cyclohexene is cleaved, producing cyclohexane carboxylic acid as the product.

Quick Tip

For alkene reactions with $KMnO_4/H^+$, remember: - Terminal alkenes form carboxylic acids. - Internal alkenes form ketones or acids based on substitution.

---

98. Given statements: Statement I: $[Co(NH_3)_6]^{3+}$ is homoleptic, while $[Co(NH_3)_4Cl_2]^+$ is heteroleptic.

Statement II: $[Co(NH_3)_6]^{3+}$ has one type of ligand, whereas $[Co(NH_3)_4Cl_2]^+$ has more than one type.

(1) Both false

(2) Statement I true, Statement II false

(3) Statement I false, Statement II true

(4) Both true

Correct Answer: (4)

Solution: Step 1: A homoleptic complex contains identical ligands, e.g., $[Co(NH_3)_6]^{3+}$, with only NH_3.

Step 2: A heteroleptic complex contains different ligands, e.g., $[Co(NH_3)_4Cl_2]^+$, with NH_3 and Cl^-.

Step 3: Both statements are true.

Quick Tip

Homoleptic complexes have identical ligands; heteroleptic ones have a combination. Check the ligands to classify.

---

99. The plot of osmotic pressure () 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

(Use 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)

Solution: Step 1: Using $R = 0.083$, calculate:

$$T = \frac{25.73}{0.083} = 310\,\text{K}.$$

Step 2: Convert temperature to Celsius:

$$T = 310 - 273 = 37^\circ\text{C}.$$

Quick Tip

To solve osmotic pressure problems:

$$\Pi = CRT \quad \text{and} \quad T(K) = \text{slope}/R.$$

---

100. Reaction sequence:

$$3ROH + PCl_3 \rightarrow 3RCl + A \quad \text{and} \quad ROH + PCl_5 \rightarrow RCl + HCl + B.$$

(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)

Solution: Step 1: The first reaction produces H_3PO_3 (phosphorous acid) as a by-product with RCl.

Step 2: The second reaction produces $POCl_3$ (phosphoryl chloride) with RCl and HCl.

Quick Tip

For PCl_3, think of H_3PO_3; for PCl_5, think of $POCl_3$.

Botany

Section A

101. 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)

Solution: Auxins are plant hormones that play a crucial role in regulating growth and development in plants. When applied in high concentrations, auxins cause abnormal growth in plants, especially dicots, leading to the death of these plants. However, monocotyledonous plants, such as grasses, are less affected by auxins. This is because monocots have a different structure and metabolic response compared to dicots, making them less susceptible to the growth-disrupting effects of auxins. Therefore, when gardeners use auxins to eliminate weeds, the herbicide harms the dicot weeds but does not damage the monocot grass, allowing the lawn to remain unaffected.

Quick Tip

Auxins are selective in their action. They affect dicot plants more severely, leading to their death, while monocots (like grasses) are relatively unaffected, making auxin-based herbicides ideal for lawn care.

---

102. 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)

Solution: Lecithin is a type of phospholipid, which is a class of lipids that are a major component of all biological membranes. Phospholipids like lecithin have both hydrophilic and hydrophobic properties, making them essential in membrane structure. Lecithin is commonly found in cell membranes and in biological tissues.

Quick Tip

Lecithin is specifically a phospholipid because it contains both a phosphate group and a lipid molecule. This combination is critical for its role in cellular membrane structure.

---

103. 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 F_1 progeny with homozygous recessive parent	II.	Ploidy
C.	Cross of F_1 progeny with any of the parents	III.	Allele
D.	Number of chromosome sets in plant	IV.	Test cross

(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)

Solution: Step 1: A refers to ”two or more alternative forms of a gene,” which are called **alleles** (III).

Step 2: B refers to ”cross of F1 progeny with homozygous recessive parent,” which is known as a **test cross** (IV).

Step 3: C refers to ”cross of F1 progeny with any of the parents,” typically called a **back cross** (I).

Step 4: D refers to ”number of chromosome sets in plant,” which is **ploidy** (II).

Quick Tip

A test cross helps to determine the genotype of an individual showing a dominant phenotype by crossing it with a homozygous recessive individual.

---

104. 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 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.

(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)

Solution: Step 1: A is incorrect because the flowers of Vallisneria are not colorful and do not produce nectar; they are typically small and unnoticeable.

Step 2: B is correct because water lilies are pollinated by insects, not by water.

Step 3: C is correct; in water-pollinated species, pollen grains often have special adaptations to prevent wetting, such as being hydrophobic.

Step 4: D is correct; some hydrophytes have long, ribbon-like pollen grains that help them to float.

Step 5: E is correct; in some hydrophytes, pollen grains are passively carried by the water to fertilize the flowers.

Quick Tip

Water-pollinated species often have specialized pollen grains that can either float on water or are protected from moisture to ensure successful fertilization.

---

105. The list of endangered species was released by:

(1) WWF

(2) FOAM

(3) IUCN

(4) GEAC

Correct Answer: (3)

Solution: The **International Union for Conservation of Nature (IUCN)** is responsible for compiling and releasing the list of endangered species. This list, known as the IUCN Red List, categorizes species based on their risk of extinction and provides critical data for conservation efforts worldwide.

Quick Tip

The IUCN Red List is an essential tool in conservation biology, helping to raise awareness about endangered species and drive conservation actions.

---

106. What is the fate of a piece of DNA carrying only the 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: When a piece of DNA carrying a gene of interest is transferred into an alien

organism, it may integrate into the recipient's genome. This process ensures that the new genetic material is passed on to progeny cells. Alternatively, the DNA may replicate independently, but the key factor for long-term inheritance is its integration into the host's genetic material.

Quick Tip

Gene transfer into alien organisms typically requires integration into the genome for stable inheritance, which is the basis of genetic engineering.

---

107. Which of the following are required for the dark reaction of photosynthesis?

A. Light

B. Chlorophyll

C. CO_2

D. ATP

E. NADPH

(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)

Solution: The dark reaction (also known as the Calvin cycle) of photosynthesis requires CO_2, ATP, and NADPH as key inputs. These molecules are used to convert carbon dioxide into glucose. Light and chlorophyll are required for the light-dependent reactions, not the dark reactions.

Quick Tip

The dark reaction does not require light directly, but relies on the products of the light reactions (ATP and NADPH).

---

108. 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)

Solution: The correct term for the conservation method described in the question is **Biodiversity conservation**, where endangered species are removed from their natural habitat and given special care, usually in controlled environments such as zoos or botanical gardens. This approach aims to protect the species while also allowing for research and breeding programs.

Quick Tip

Biodiversity conservation encompasses both in-situ and ex-situ methods, including the protection of species in controlled environments.

---

109. Given below are two statements:

Statement I: Bt toxins are insect group-specific and coded by the gene cry IAc.

Statement II: Bt toxin exists as inactive protoxin in *B. thuringiensis*. However, after ingestion by the insect, the inactive protoxin gets converted into its active form due to the acidic pH of the insect gut.

(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)

Solution: Step 1: Statement I is true because Bt toxins are specific to different insect groups, and the cry IAc gene in *Bacillus thuringiensis* codes for one such toxin.

Step 2: Statement II is false because although the Bt toxin exists as an inactive protoxin, it is

the alkaline pH of the insect gut (not acidic) that activates it.

Quick Tip

The activation of Bt toxins occurs in the alkaline pH of the insect's gut, not acidic, which allows it to disrupt the insect's digestive system.

---

110. A transcription unit in DNA is defined primarily by 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)

Solution: A transcription unit in DNA consists of three regions:

- The **promoter**, which initiates transcription.

- The **structural gene**, which codes for a protein.

- The **terminator**, which signals the end of transcription.

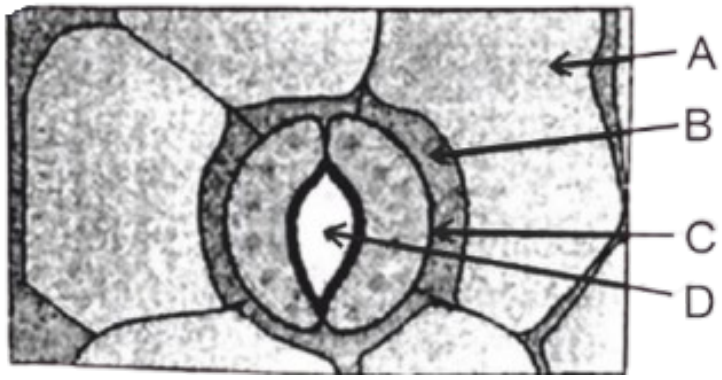
These three components are key to the transcription process in both prokaryotes and eukaryotes.

Quick Tip

The transcription unit is defined by its promoter, structural gene, and terminator, which regulate the process of gene expression.

---

111. In the given figure, which component has thin outer walls and highly thickened



inner walls?

(1) D

(2) A

(3) B

(4) C

Correct Answer: (4)

Solution:

Guard cells are specialized cells found in the epidermis of plant leaves and stems. These cells control the opening and closing of stomata, which are pores on the surface of the plant that allow gas exchange (oxygen and carbon dioxide) and water vapor to pass in and out. The unique structure of the guard cells plays a crucial role in this function. Guard cells have **thin outer walls** and **thickened inner walls**. This differential wall thickness is essential for the opening and closing mechanism of the stomata.

- The **thin outer walls** of the guard cells are more flexible, allowing the cells to stretch and bend outward as they accumulate water and become turgid.
- The **thickened inner walls** are more rigid and less flexible, which helps create a ”bowing” effect when the cells swell. As water enters the guard cells, the thick inner walls prevent them from expanding evenly. Instead, the outer walls expand more, and the inner thickened walls restrict this movement, causing the stomata to open. When the guard cells lose water, the inner walls’ rigidity causes the cells to collapse, closing the stomatal pore.

This mechanism helps regulate water loss through transpiration while allowing necessary gas exchange for photosynthesis and respiration.

Quick Tip

The differential thickness of the guard cells' walls (thin outer, thickened inner) is key to their ability to control stomatal opening and closing effectively, balancing gas exchange and water conservation.

---

112. Hind II always cuts DNA molecules at a particular point called recognition sequence and it consists of:

(1) 6 bp

(2) 4 bp

(3) 10 bp

(4) 8 bp

Correct Answer: (1)

Solution:

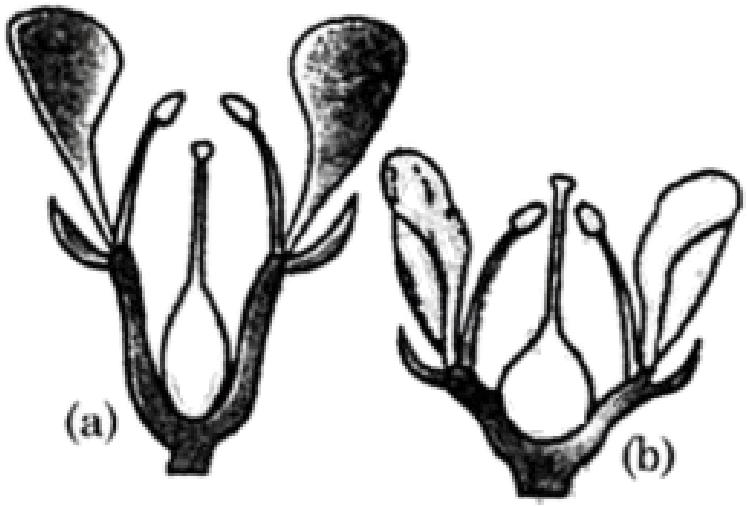
Hind II is a restriction enzyme that cuts DNA at a specific recognition sequence, which is 6 base pairs (bp) long. The recognition site for Hind II is the palindromic sequence `AAGCTT`, which is a 6 bp sequence. This enzyme cuts the DNA at the specific sequence, allowing scientists to manipulate DNA for cloning, sequencing, and other molecular biology techniques.

Quick Tip

Restriction enzymes like Hind II are specific to their recognition sequences, which are usually palindromic and range from 4-8 base pairs.

---

113. 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)

Solution:

In the perigynous condition, the gynoecium (female reproductive organ) is located in the center of the flower, while the other parts of the flower, such as the stamens, petals, and sepals, are positioned around it on the rim of the thalamus (receptacle). All the floral parts (including stamens, petals, and sepals) are situated at the same level and appear to be attached to a common structure called the hypanthium.

This arrangement contrasts with other flower types, such as hypogynous and epigynous flowers, where the position of the gynoecium is either above or below the other floral parts, respectively. In perigynous flowers, the ovary is typically superior (above the point of attachment of other parts).

Quick Tip

In perigynous flowers, the floral parts arise from the same level on the rim of the thalamus, surrounding the central gynoecium. The ovary is superior, making the structure distinct.

114. Which of the following is an example of an actinomorphic flower?

(1) Cassia

(2) Pisum

(3) Sesbania

(4) Datura

Correct Answer: (4)

Solution:

Actinomorphic flowers, also known as radial symmetry flowers, can be divided into two equal halves in multiple planes. Datura is an example of an actinomorphic flower, as its flower structure exhibits radial symmetry.

The other options (Cassia, Pisum, and Sesbania) have zygomorphic (bilateral symmetry) flowers, which can only be divided into two equal halves along one plane.

Quick Tip

Actinomorphic flowers have a symmetrical structure, allowing them to be divided equally in multiple planes, while zygomorphic flowers are symmetric in just one plane.

---

115. 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)

Solution:

Fungi classification is primarily based on the mode of spore formation, fruiting body structure, and the morphology of the mycelium.

The mode of nutrition is not typically used as a primary criterion for classification because fungi are generally classified based on their reproductive structures. Most fungi are heterotrophic (absorptive nutrition), but the classification depends more on the structural aspects of reproduction and growth.

Quick Tip

Fungi classification focuses on their reproductive structures, such as spore formation and fruiting bodies, rather than the mode of nutrition.

---

116. 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)

Solution:

The Verhulst-Pearl logistic growth model is used to describe population growth in a limited environment.

In this equation, K represents the **carrying capacity**, which is the maximum population size that the environment can support based on available resources.

When the population reaches this limit, the growth rate slows down and stabilizes.

Quick Tip

In the logistic growth equation, K is the carrying capacity, which determines the upper limit of population size in a given environment.

---

117. 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 the characters appear as such in F_2 generation.

C. Factors occur in pairs in normal diploid plants.

D. The discrete unit controlling a particular character is called 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)

Solution:

Mendel's Law of Dominance states that when two different alleles are present for a trait, the dominant allele will mask the expression of the recessive allele in the heterozygous condition.

- A is true because one factor (allele) is dominant and the other recessive.

- C is true because Mendel's experiments confirmed that alleles occur in pairs in diploid organisms.

- D is true because Mendel referred to the units controlling traits as "factors," which are now known as genes.

- E is true because in a monohybrid cross, only the dominant trait is expressed in the F_1 generation.

Quick Tip

Mendel's Law of Dominance explains that in a heterozygous organism, the dominant allele masks the effect of the recessive allele.

---

118. Match List I with List II:

	List-I		List-II
A.	*Rhizopus*	I.	Mushroom
B.	*Ustilago*	II.	Smut fungus
C.	*Puccinia*	III.	Bread mould
D.	*Agaricus*	IV.	Rust fungus

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

(2) A-IV, B-III, 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)

Solution:

- A. Rhizopus is commonly known as bread mould (III).

- B. Ustilago is a smut fungus (II).

- C. Puccinia is a rust fungus (IV).

- D. Agaricus is a type of mushroom (I).

So, the correct matching is A-III, B-II, C-IV, D-I.

Quick Tip

Fungal classifications often rely on the type of reproduction and the structure of the fruiting bodies. Smut and rust fungi are parasitic, while mushrooms are examples of edible fungi.

---

119. 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)

Solution:

Malonate is a competitive inhibitor of the enzyme succinic dehydrogenase. It competes with the substrate, succinate, for the active site of the enzyme.

In competitive inhibition, the inhibitor resembles the substrate and binds to the enzyme's active site, preventing the normal substrate from binding.

Quick Tip

Competitive inhibition occurs when an inhibitor competes with the substrate for the enzyme's active site, blocking the normal reaction.

---

120. Formation of interfascicular cambium from fully developed parenchyma cells is an example of:

(1) Redifferentiation

(2) Dedifferentiation

(3) Maturation

(4) Differentiation

Correct Answer: (2)

Solution:

Dedifferentiation is the process where mature, differentiated cells lose their specialized functions and revert to a more meristematic state, capable of dividing and forming new tissues.

In this case, parenchyma cells in the vascular bundle region dedifferentiate to form interfascicular cambium, which is responsible for secondary growth in plants.

Quick Tip

Dedifferentiation allows mature cells to revert to a less specialized state, enabling them to participate in new tissue formation, such as cambium in plants.

---

121. 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)

Solution:

In Snapdragon plants, flower color follows incomplete dominance, where the red allele (R) and the pink allele (R') both contribute to flower color.

- If a pink flowered plant (R'R') is crossed with a red flowered plant (RR), the F1 progeny will inherit one red allele (R) from the red parent and one pink allele (R') from the pink parent. This results in red and pink flowered plants in the progeny.

- Red flowered plants will occur when two red alleles (RR) are inherited, while pink flowered plants will be the result of inheriting one red allele and one pink allele (R'R).

Quick Tip

In incomplete dominance, the heterozygote exhibits a blend of both parental traits. In Snapdragon, red and pink flower colors mix to form pink flowers in the F1 generation.

---

122. 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)

Solution:

To determine the genotype of a black-seeded plant (BB/Bb), a test cross should be performed with a homozygous recessive (bb) plant. This is because the recessive genotype (bb) will allow the expression of the recessive trait if the black-seeded plant is heterozygous (Bb).

- If the black-seeded plant is homozygous dominant (BB), all progeny will show black seeds.
- If the plant is heterozygous (Bb), 50% of the progeny will have black seeds and 50% will have white seeds.

Quick Tip

A test cross with a recessive plant (bb) helps determine whether the black-seeded plant is homozygous (BB) or heterozygous (Bb).

---

123. 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

(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)

Solution:

- A. Clostridium butylicum is responsible for the production of butyric acid (III).
- B. Saccharomyces cerevisiae is used in the fermentation process to produce ethanol (I).
- C. Trichoderma polysporum produces cyclosporin-A (IV), an immunosuppressant.
- D. Streptococcus sp. is known for producing streptokinase (II), which is used as a clot-busting enzyme in medicine.

Quick Tip

Know the microbial products—Saccharomyces cerevisiae is involved in ethanol production, and Clostridium butylicum for butyric acid.

---

124. How many molecules of ATP and NADPH are required for every molecule of CO_2 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)

Solution:

In the Calvin cycle, for every molecule of CO_2 fixed, 3 molecules of ATP and 2 molecules of NADPH are required to convert 3-phosphoglycerate (3-PGA) into G3P (Glyceraldehyde-3-phosphate).

- ATP provides the energy necessary for the phosphorylation steps, while NADPH provides the reducing power for the reduction steps.

Quick Tip

In the Calvin cycle, 3 ATP and 2 NADPH are used for the fixation of each CO_2 molecule to form sugars.

---

125. 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)

Solution:

Totipotency refers to the ability of a single plant cell to give rise to a whole new plant. This ability is a key feature in plant tissue culture and micropropagation, where cells are induced to regenerate into an entire plant.

- Micropropagation is the technique of growing plants from small tissues or cells, and somatic hybridization involves the fusion of somatic cells to create hybrid plants.

Quick Tip

Totipotency is the ability of plant cells to regenerate into a complete organism, which is used in plant tissue culture for cloning.

---

126. Tropical regions show 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)

Solution:

Tropical regions have remained relatively undisturbed over millions of years, which has provided more time for species to evolve and diversify.

The constant availability of solar energy in these regions supports a high rate of photosynthesis, which in turn supports diverse ecosystems.

Furthermore, the predictable and constant environmental conditions in the tropics allow species to specialize in particular niches, enhancing species richness. Seasonal variability is less pronounced in the tropics compared to temperate zones, making environments more stable for long-term survival. Hence, the combination of all these factors (A, C, D, and E) leads to greater species richness.

Quick Tip

Tropical regions have been stable for millions of years, which has allowed for a high rate of species diversification.

---

127. 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

(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)

Solution:

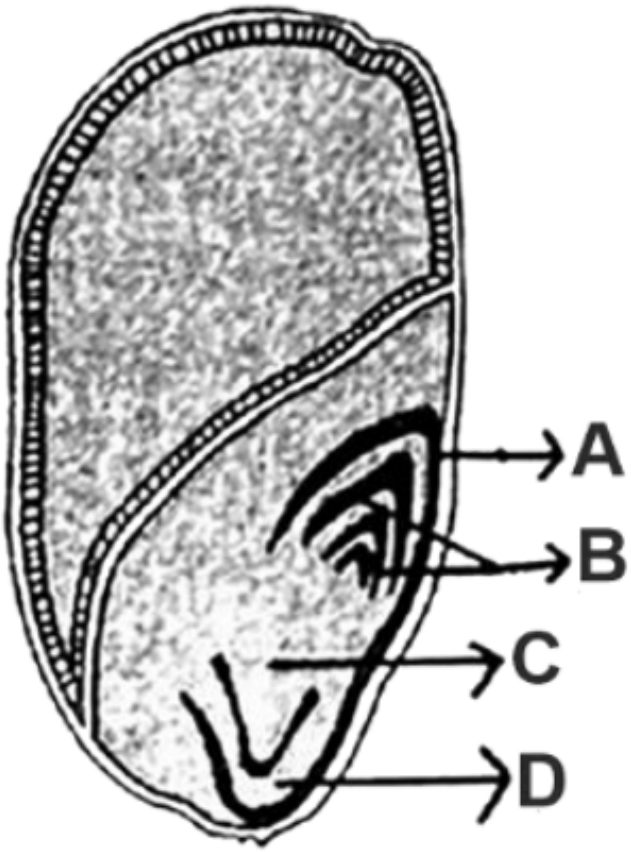
- A. Nucleolus is the site for active ribosomal RNA synthesis (III).
- B. Centriole has an organization like the cartwheel (II).
- C. Leucoplasts are for storing nutrients (IV).
- D. Golgi apparatus is the site of formation of glycolipids (I).

Quick Tip

The nucleolus is where ribosomal RNA is synthesized, while the Golgi apparatus is involved in lipid and protein processing.

---

128. Identify the part of the seed from the given figure which is destined to form root when the seed germinates.



(1) B

(2) C

(3) D

(4) A

Correct Answer: (2)

Solution:

The radicle is the part of the seedling that is destined to form the root. It is the first part of the embryo that grows and anchors the plant in the soil. In the given diagram, 'C' represents the radicle.

Quick Tip

The radicle develops into the primary root of the plant, which later gives rise to lateral roots, ensuring a stable root system for nutrient absorption.

---

129. Spindle fibers attach to kinetochores of chromosomes during:

(1) Metaphase

(2) Anaphase

(3) Telophase

(4) Prophase

Correct Answer: (1)

Solution:

During metaphase of mitosis, the chromosomes align at the metaphase plate in the center of the cell. The spindle fibers, which are microtubules, attach to the kinetochores on the centromere of each chromosome. This attachment is crucial for the proper separation of chromatids during anaphase.

Quick Tip

The kinetochores are specialized protein complexes where the spindle fibers attach to the chromosomes.

---

130. Given below are two statements:

Statement I: Chromosomes become gradually visible under light microscope during leptotene stage.

Statement II: The beginning of diplotene stage is recognized by dissolution of synaptonemal complex.

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)

Solution:

During leptotene (early prophase I), chromosomes begin to condense and become visible under the light microscope.

In the diplotene stage, which is a later phase of prophase I, the synaptonemal complex (a protein structure that helps align homologous chromosomes) dissolves, signaling the

beginning of this phase.

Quick Tip

In leptotene, chromosomes become visible, and in diplotene, the synaptonemal complex dissolves.

---

131. 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)

Solution:

Statement I is incorrect because both parenchyma and collenchyma are living tissues. Parenchyma cells are responsible for metabolic functions, while collenchyma provides structural support, especially in growing plant parts.

Statement II is true because gymnosperms (like conifers) lack xylem vessels, a characteristic of angiosperms (flowering plants). Gymnosperms have tracheids instead of xylem vessels.

Quick Tip

Parenchyma and collenchyma are living tissues, but gymnosperms lack xylem vessels.

---

132. 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)

Solution:

Overexploitation, co-extinction, and habitat loss/fragmentation are major anthropogenic (human-caused) factors leading to biodiversity loss.

Overexploitation occurs when species are harvested at unsustainable rates, while habitat loss and fragmentation reduce the amount of available natural habitat.

Co-extinction happens when one species' extinction leads to the extinction of another species dependent on it.

Mutation and migration, however, are natural processes that do not directly cause biodiversity loss.

Quick Tip

Overexploitation and habitat fragmentation are the main contributors to biodiversity loss.

---

133. 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)

Solution:

Permease is a membrane-bound protein that facilitates the transport of lactose into bacterial

cells.

It is part of the lactose operon system in bacteria, which also includes beta-galactosidase (which breaks down lactose inside the cell) and transacetylase.

Acetylase and polymerase are involved in different metabolic processes.

Quick Tip

Permease is responsible for lactose transport across the bacterial membrane.

---

134. 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)

Solution:

Bulliform cells are specialized epidermal cells in monocot plants. They play a key role in water conservation by causing the leaf to curl inward during periods of water stress, reducing water loss through transpiration.

Quick Tip

Bulliform cells help plants conserve water by causing leaf curling under stress.

---

135. The cofactor of the enzyme carboxypeptidase is:

(1) Niacin

(2) Flavin

(3) Haem

(4) Zinc

Correct Answer: (4)

Solution:

Zinc acts as a cofactor for the enzyme carboxypeptidase, which catalyzes the hydrolysis of

peptide bonds at the carboxyl terminal of proteins.

Zinc ions facilitate the enzyme's function by coordinating with the substrate during catalysis.

Quick Tip

Zinc is essential for many enzymes, including carboxypeptidase, which breaks down proteins.

---

136. Read the following statements and choose the set of correct statements:

In the members of 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 and carotenoids and xanthophyll.

E. Vegetative cells have a cellulosic wall, usually covered on the outside by 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)

Solution:

Phaeophyceae, or brown algae, typically reproduce asexually through biflagellate zoospores.

Their sexual reproduction is oogamous, where the male gamete is smaller and motile.

The stored carbohydrates are mannitol and laminarin, and their major pigments include chlorophyll a, c, carotenoids, and xanthophylls.

Their cell walls are made of cellulose and are often covered by a gelatinous coating of algin.

Quick Tip

Brown algae store food as mannitol and laminarin and have cell walls with algin.

137. Match List I with List II:

List I		List II	
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)

Solution:

- Robert May is associated with the global species diversity estimate of around 7 million species.
- Alexander von Humboldt is known for the species-area relationship.
- Paul Ehrlich is linked to the Rivet popper hypothesis of biodiversity.
- David Tilman is known for his long-term ecosystem experiments, which assess biodiversity and ecosystem function.

Quick Tip

The Rivet popper hypothesis suggests that each species contributes a unique function to an ecosystem.

---

138. Given below are two statements:

Statement I: In C3 plants, some O2 binds to RuBisCO, hence CO2 fixation is decreased.

Statement II: In C4 plants, mesophyll cells show very little photorespiration while bundle sheath cells do not show photorespiration.

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)

Solution:

- In C3 plants, RuBisCO can bind oxygen instead of carbon dioxide, leading to photorespiration and reduced CO2 fixation.

- In C4 plants, mesophyll cells indeed have low photorespiration, but the bundle sheath cells also show some degree of photorespiration, contrary to the second statement.

Quick Tip

C4 plants have a mechanism to reduce photorespiration by spatial separation of carbon fixation and Calvin cycle.

---

139. 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)

Solution:

Chloroplasts contain their own DNA, which is circular and double-stranded, similar to the DNA found in prokaryotes.

This DNA is responsible for encoding some of the proteins necessary for photosynthesis.

Quick Tip

Chloroplast DNA is circular and double-stranded, inherited maternally in most plants.

---

140. 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 GPP (Gross Primary Productivity) of the third trophic level of the same ecosystem?

(1) x(kcal m^{-2} yr^{-1})

(2) 10x (kcal m^{-2} yr^{-1})

(3) $\frac{100x}{3x}$ (kcal m^{-2} yr^{-1}

(4) $\frac{x}{10} kcal m^{-2yr^{-1}}$

Correct Answer: (2)

Solution:

The Gross Primary Productivity (GPP) at higher trophic levels (like the third trophic level) is typically much lower than that at the first trophic level due to the loss of energy between trophic levels.

Assuming a 10% energy transfer efficiency, the GPP at the third trophic level would be 10x kcal m–2 yr–1.

Quick Tip

Energy decreases at each trophic level due to inefficiencies in energy transfer.

---

141. 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:

Somatic hybridization involves the fusion of protoplasts (cells without a cell wall) from two different plant varieties.

This technique is used to create hybrid plants with desired traits.

Quick Tip

Protoplast fusion is a key technique in plant genetic engineering for creating somatic hybrids.

142. Match List I with List II:

	List I		List II
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

Choose the correct answer from the options given below:

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

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

Solution:

The Citric acid cycle (Krebs cycle) occurs in the mitochondrial matrix where acetyl-CoA is oxidized to produce ATP, NADH, and $FADH_2$.

Glycolysis takes place in the cytoplasm of the cell, where glucose is broken down into pyruvate, generating ATP and NADH in the process.

The Electron transport system is located on the inner mitochondrial membrane, where NADH and $FADH_2$ donate electrons to generate a proton gradient.

The Proton gradient is found in the intermembrane space of mitochondria, driving ATP synthesis through ATP synthase.

Quick Tip

The citric acid cycle and electron transport chain both take place in the mitochondria, but in different regions.

143. Match List I with List II:

	List I		List II
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:

Frederick Griffith discovered transformation, which is the process where bacteria take up foreign DNA.

Jacob and Monod worked on the Lac operon model, explaining gene regulation.

Har Gobind Khorana contributed to understanding the genetic code and protein synthesis.

Meselson and Stahl proved the semi-conservative mode of DNA replication using isotopic labeling.

Quick Tip

Griffith's experiment with Streptococcus pneumoniae demonstrated the process of transformation.

---

144. 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:

Monoadelphous stamens are found in species like China rose, where all the filaments are fused into a single bundle.

Diadelphous stamens are characteristic of plants like pea, where the stamens are fused in two groups.

Polyadelphous stamens are found in citrus, where the filaments are fused into several groups.

Epiphyllous stamens, which are borne on the surface of the leaves, are found in species like the lily.

Quick Tip

Diadelphous stamens are a distinguishing feature of the pea plant.

---

145. 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:

The diagram depicts a wind-pollinated plant with a compact inflorescence and well-exposed

stamens.

1. Compact Inflorescence: A dense cluster of flowers helps increase the chance of pollen being carried by the wind. This arrangement maximizes pollen exposure to the environment.

2. Well-exposed Stamens: The male reproductive organs are exposed to facilitate the release of pollen into the air.

3. Autogamy and Exposure: Although autogamy refers to self-pollination, the exposed stamens ensure pollen release for cross-pollination, reducing self-pollination and promoting genetic diversity.

Quick Tip

Wind-pollinated plants typically have exposed stamens, lightweight pollen, and compact inflorescences to maximize cross-pollination efficiency.

---

146. Match List I with List II:

List-I		List-II	
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:

- GLUT-4 is a glucose transporter protein responsible for facilitating glucose uptake into muscle and adipose tissue cells.
- Insulin is a hormone secreted by the pancreas to regulate blood glucose levels.
- Trypsin is an enzyme that digests proteins in the small intestine.
- Collagen is a structural protein found in intercellular ground substances, providing tissue support.

Quick Tip

GLUT-4 is crucial for insulin-mediated glucose uptake, a key process in glucose metabolism.

---

147. Identify the step in the tricarboxylic acid cycle that does not involve oxidation of the substrate:

(1) Succinic acid → Malic acid

(2) Succinyl-CoA → Succinic acid

(3) Isocitrate → -ketoglutaric acid

(4) Malic acid → Oxaloacetic acid

Correct Answer: (2) Succinyl-CoA → Succinic acid

Solution:

In the tricarboxylic acid (TCA) cycle, the conversion of Succinyl-CoA to succinic acid does not involve oxidation but occurs via substrate-level phosphorylation.

This step generates ATP or GTP depending on the organism, contrasting other steps that involve oxidation reactions.

Quick Tip

Substrate-level phosphorylation generates ATP directly, without requiring an electron transport chain.

---

148. Spraying sugarcane crops with which plant growth regulator increases the length of stems, thereby enhancing yield?

(1) Gibberellin

(2) Cytokinin

(3) Abscisic acid

(4) Auxin

Correct Answer: (1) Gibberellin

Solution:

Gibberellins are plant hormones that promote stem elongation and overall growth.

When sprayed on sugarcane, gibberellins increase stem length, enhancing yield.

Other growth regulators like cytokinin promote cell division, auxins influence root growth, and abscisic acid is associated with stress responses.

Quick Tip

Gibberellins are widely used in agriculture to boost stem growth and increase crop productivity.

---

149. Match List I with List II:

	List I		List II
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:

- Rose has twisted aestivation, where petals overlap in a twisted manner.

- Pea exhibits a perigynous flower arrangement, where the ovary is at the center, surrounded by floral parts.

- Cotton has marginal placentation, with ovules attached along the ovary's edges.

- Mango is classified as a drupe fruit with a hard endocarp surrounding the seed.

Quick Tip

Twisted aestivation is typical in roses, while marginal placentation is common in cotton.

---

150. Which of the following statements is correct regarding the process of replication in

E.coli?

(1) The DNA-dependent RNA polymerase catalyzes polymerization in one direction, 5' → 3'.

(2) The DNA-dependent DNA polymerase catalyzes polymerization in both 5' → 3' and 3' → 5' directions.

(3) The DNA-dependent DNA polymerase catalyzes polymerization in the 5' → 3' direction.

(4) The DNA-dependent DNA polymerase catalyzes polymerization in one direction, 3' → 5'.

Correct Answer: (3) The DNA-dependent DNA polymerase catalyzes polymerization in the 5' → 3' direction.

Solution:

In E. coli, DNA replication is catalyzed by DNA-dependent DNA polymerase, which synthesizes new DNA in the 5' → 3' direction.

The template strand is read in the opposite 3' → 5' direction. RNA polymerase catalyzes transcription but is not involved in DNA synthesis.

Quick Tip

DNA polymerase extends the DNA strand in the 5' → 3' direction, reading the template strand in the 3' → 5' direction.

---

151. 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:

- The Pons (A) connects different regions of the brain (III).
- The Hypothalamus (B) contains neurosecretory cells (IV) responsible for hormone regulation.
- The Medulla (C) controls respiration and gastric secretions (II).
- The Cerebellum (D) provides additional space for neurons and regulates posture and balance (I).

Quick Tip

The brainstem, which includes the Pons and Medulla, controls vital functions like breathing and heart rate.

---

152. Which of the following is not a component of Fallopian tube?

(1) Isthmus

(2) Infundibulum

(3) Ampulla

(4) Uterine fundus

Correct Answer: (4) Uterine fundus

Solution:

- The Fallopian tube consists of the Isthmus, Infundibulum, and Ampulla.
- The Uterine fundus is part of the uterus, not the Fallopian tube.

Quick Tip

The Uterine fundus is the upper portion of the uterus, not the Fallopian tube.

---

153. 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:

- The Ti plasmid stands for Tumor Inducing Plasmid.

- It is responsible for the ability of *Agrobacterium tumefaciens* to cause crown gall disease in plants.

Quick Tip

Ti plasmids are used in genetic engineering to introduce foreign genes into plants.

---

154. 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:

- Expiratory capacity (A) is the sum of Expiratory reserve volume and Tidal volume (II).

- Functional residual capacity (B) is the sum of Expiratory reserve volume and Residual volume (IV).

- Vital capacity (C) is the sum of Tidal volume, Inspiratory reserve volume, and Expiratory reserve volume (I).

- Inspiratory capacity (D) is the sum of Tidal volume and Inspiratory reserve volume (III).

Quick Tip

Vital capacity refers to the total volume of air that can be exhaled after a maximum inhalation.

---

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

Assertion A: FSH acts upon ovarian follicles in females and Leydig cells in males.

Reason R: Growing ovarian follicles secrete estrogen in females while interstitial cells secrete androgen in male human beings.

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:

- FSH (Follicle Stimulating Hormone) indeed acts upon ovarian follicles in females, but it does not directly act on Leydig cells. LH is the hormone that stimulates Leydig cells.
- Growing ovarian follicles secrete estrogen in females, and Leydig cells secrete androgens in males, making Reason R true.

Quick Tip

FSH targets ovarian follicles in females, while LH stimulates Leydig cells in males.

---

156. 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:

- Lipase (A) acts on the ester bond in lipids (II).
- Nuclease (B) cleaves the phosphodiester bond in nucleic acids (IV).
- Protease (C) breaks down peptide bonds in proteins (I).
- Amylase (D) acts on the glycosidic bond in carbohydrates (III).

Quick Tip

Each enzyme targets a specific type of bond, depending on the molecule it acts upon.

---

157. 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:

- The correct sequence of human evolution from past to present is: Homo habilis (A), Homo erectus (D), Homo neanderthalensis (C), and finally Homo sapiens (B).

Quick Tip

Homo habilis is one of the earliest members of the genus Homo, often referred to as the ”handy man” for using tools.

---

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:

- Myasthenia gravis, Rheumatoid arthritis, and Systemic Lupus Erythematosus (SLE) are all autoimmune disorders where the body’s immune system attacks its own tissues.

- Gout and Muscular dystrophy are not autoimmune disorders.

Quick Tip

Autoimmune diseases occur when the immune system mistakenly targets the body's own tissues as harmful.

---

159. Match List I with List II:

	List I		List II
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:

- Common cold is caused by Rhinoviruses (III).

- Haemozoin is a product of Plasmodium (I), the parasite responsible for malaria.

- Widal test is used for diagnosing Typhoid (II).

- Allergy is triggered by Dust mites (IV).

Quick Tip

Widal test detects the presence of antibodies against *Salmonella typhi* in typhoid infection.

---

160. Match List I with List II:

	List I		List II
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:

- Axoneme is found in Cilia and flagella (II).

- Cartwheel pattern is a feature of the Centriole (I).

- Crista is found in the Mitochondria (IV).

- Satellite is associated with Chromosome (III).

Quick Tip

The axoneme is a structural component of cilia and flagella, responsible for their movement.

---

161. 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:

- Pleurobrachia is a type of Ctenophora (II).

- Radula is found in Mollusca (I).

- Stomochord is present in Hemichordata (IV).

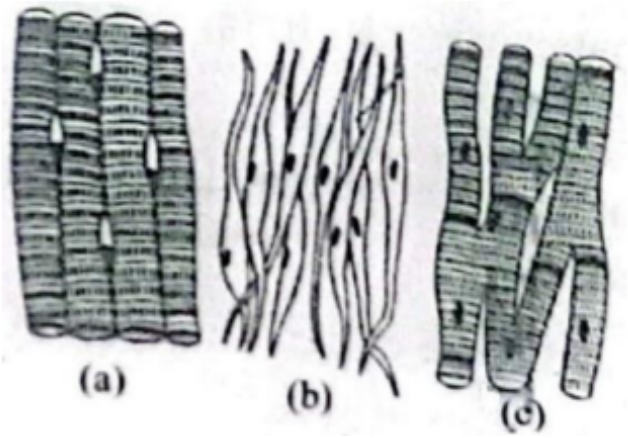
- Air bladder is characteristic of Osteichthyes (III).

Quick Tip

The radula is a feeding organ in mollusks used for scraping or cutting food.

---

162. 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) Skeletal muscle – Triceps and Biceps

Solution:

- Figure (a) shows skeletal muscles attached to bones like triceps and biceps, enabling voluntary movements.
- Figure (b) shows smooth muscles, which are non-striated and found in internal organs like the stomach wall.
- Figure (c) shows cardiac muscles, which are striated and involuntary, located in the heart wall.

Quick Tip

Skeletal muscles are voluntary, smooth muscles are involuntary, and cardiac muscles are striated but involuntary.

---

163. 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:

- Diakinesis involves the completion of terminalization of chiasmata (II).
- Pachytene is characterized by the appearance of recombination nodules (IV).
- Zygotene is marked by the formation of the synaptonemal complex (I).
- Leptotene is distinguished by chromosomes appearing as thin threads (III).

Quick Tip

Diakinesis is the final stage of prophase I, where crossing over is complete and chromosomes are prepared for metaphase.

164.

	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:

- Down's syndrome is caused by trisomy of chromosome 21 (III).
- α-Thalassemia is linked with chromosome 16 (IV).
- β-Thalassemia is associated with chromosome 11 (I).
- Klinefelter's syndrome results from an XXY chromosome pattern (II).

Quick Tip

Down's syndrome occurs due to an extra copy of chromosome 21, leading to developmental and intellectual delays.

---

165. Which of the following statements is incorrect?

(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:

- Bio-reactors are primarily used for large-scale cultivation of microorganisms or cells, not small-scale cultures.

- They are equipped with agitators, oxygen delivery systems, and foam control systems to maintain optimal growth conditions.

Quick Tip

Bio-reactors are essential in industrial biotechnology for mass production of products like vaccines, enzymes, and antibiotics.

---

166. Match List I with List II:

	List I		List II
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:

- Pterophyllum is commonly known as Angelfish (III).

- Myxine is also called Hagfish (I).

- Pristis is the Sawfish (II).

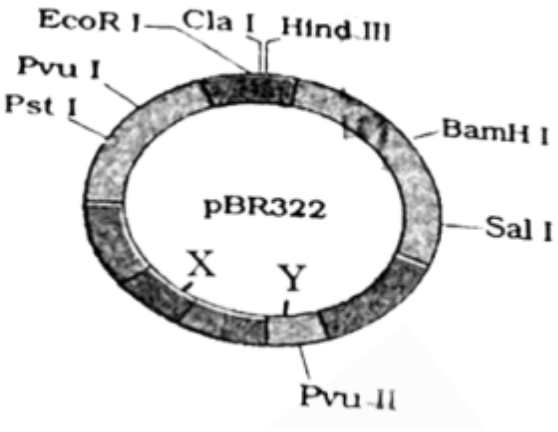
- Exocoetus is known as the Flying fish (IV).

Quick Tip

Angelfish (Pterophyllum) is a popular aquarium fish, while Exocoetus (Flying fish) is known for its ability to glide above the water surface.

---

167. 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 the protein involved in the replication of plasmid.

(2) The gene 'X' is for the protein involved in the 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 the 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 the protein involved in the replication of plasmid.

Solution:

- 'X' represents *ori* (Origin of Replication), which controls the copy number of the linked DNA.
- 'Y' represents *rop*, a gene coding for a protein involved in plasmid replication.
- Together, *ori* and *rop* ensure proper replication and maintenance of plasmids in the host cell.

Quick Tip

The *ori* region determines the number of plasmids within a cell, while the *rop* gene helps regulate plasmid replication.

---

168. Given below are two statements:

Statement I: The presence or absence of 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:

- Statement I is true. The presence or absence of the hymen is not a reliable indicator of virginity because it can be torn due to various activities like exercise, tampon use, or injury.

- Statement II is false. The hymen can remain intact even after coitus or may tear due to non-sexual activities.

Quick Tip

The hymen is not a definitive marker of virginity; it can be stretched or torn for reasons unrelated to sexual activity.

---

169. 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:

- A. Annelids are true coelomates – True. They have a body cavity completely lined by mesoderm.

- B. Poriferans are pseudocoelomates – False. Poriferans are acoelomates.

- C. Aschelminthes are acoelomates – False. Aschelminthes are pseudocoelomates.

- D. Platyhelminthes are pseudocoelomates – False. Platyhelminthes are acoelomates.

Quick Tip

Among the listed groups, Annelids are the only true coelomates.

---

170. 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, which increases the surface area for reabsorption.

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: (1) Both Statement I and Statement II are false

Solution:

- Statement I is false. The descending limb of the loop of Henle is permeable to water but impermeable to electrolytes.

- Statement II is false. The proximal convoluted tubule is lined by simple cuboidal

epithelium with a brush border, not columnar epithelium.

Quick Tip

The descending limb of the loop of Henle absorbs water, while the ascending limb absorbs electrolytes.

---

171. 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:

The correct sequence of stages in cell division is:

- E. Gap 1 phase (first phase where the cell grows).
- C. Synthesis phase (DNA replication occurs).
- A. Gap 2 phase (preparation for cell division).
- D. Karyokinesis (division of the nucleus).
- B. Cytokinesis (division of the cytoplasm).

Quick Tip

Karyokinesis is the division of the nucleus, while cytokinesis refers to the division of the cytoplasm.

---

172. 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)

Solution:

In cockroaches, a pair of anal cerci is present on the 10th abdominal segment. These cerci help in sensing changes in the environment, particularly detecting air currents.

Quick Tip

Anal cerci are sensory structures that help cockroaches detect changes in their surroundings.

---

173. Match List I with List II:

	List I		List II
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:

- Fibrous joints (A): These joints are immovable, as seen in the skull, so the correct match is A-III.

- Cartilaginous joints (B): These joints allow limited movement, like between adjacent vertebrae, so B-I is correct.

- Hinge joints (C): These allow movement like in the knee, so C-IV is correct.

- Ball and socket joints (D): These joints allow rotational movement, as seen between the humerus and the pectoral girdle, so D-II is correct.

Quick Tip

Ball and socket joints allow rotational movement, while hinge joints allow movement in one plane.

---

174. Which of the following is not a steroid hormone?

(1) Testosterone

(2) Progesterone

(3) Glucagon

(4) Cortisol

Correct Answer: (3) Glucagon

Solution:

- Testosterone, Progesterone, and Cortisol are steroid hormones derived from cholesterol and are lipophilic, allowing them to cross cell membranes easily.

- Glucagon, however, is a peptide hormone, not a steroid hormone. It is synthesized from amino acids and works by binding to receptors on the cell surface.

Quick Tip

Steroid hormones are derived from cholesterol, while peptide hormones like glucagon are made from amino acids.

---

175. Following are the stages of pathway for conduction of an action potential through the heart:

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:

The correct sequence for the conduction of an action potential through the heart is:

- E. SA node initiates the action potential.
- C. AV node delays the impulse to allow ventricles time to fill.
- A. AV bundle transmits the impulse down the septum.
- D. Bundle branches carry the impulse to the Purkinje fibers.
- B. Purkinje fibers distribute the impulse to the ventricles, causing contraction.

Quick Tip

The SA node is the pacemaker of the heart and starts the conduction of the action potential.

---

176. 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 options 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:

- A. Non-medicated IUD: The Lippes loop is a type of non-medicated intrauterine device. Thus, A-III.

- B. Copper releasing IUD: Multiload 375 is a copper-releasing IUD. Thus, B-I.

- C. Hormone releasing IUD: LNG-20 is a hormone-releasing IUD. Thus, C-IV.

- D. Implants: These release progestogens, a class of hormones. Thus, D-II.

Quick Tip

IUDs can be non-medicated (copper-based) or hormone-releasing, preventing pregnancy by altering the uterine environment.

---

177. 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:

- Periodic abstinence: Avoiding sexual intercourse during the fertile phase of the menstrual cycle.

- Lactational amenorrhea: A natural infertility method during breastfeeding.

- Vaults: Artificial contraceptive methods involving physical barriers.

- Coitus interruptus: The withdrawal method, which is a natural contraceptive method.

Quick Tip

Vaults are artificial contraceptives, unlike natural methods like abstinence or lactational amenorrhea.

---

178. Which one is the correct product of DNA-dependent RNA polymerase for the given template?

3'TACATGGCAAATATCCATTCA5'

(1) 5’AUGUAAAGUUUAUAGGUAAGU3’

(2) 5’AUGUACCGUUUAUAGGGAAGU3’

(3) 5’ATGTACCGTTTATAGGTAAGT3’

(4) 5’AUGUACCGUUUAUAGGUAAGU3’

Correct Answer: (4) 5’AUGUACCGUUUAUAGGUAAGU3’

Solution:

DNA-dependent RNA polymerase synthesizes RNA in the 5’ to 3’ direction, complementary to the DNA template.

For the given template strand: 3’TACATGGCAAATATCCATTCA5’, the complementary RNA strand is: 5’AUGUACCGUUUAUAGGUAAGU3’.

Quick Tip

RNA synthesis replaces thymine (T) in DNA with uracil (U) in RNA.

---

179. 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:

The Hardy-Weinberg equilibrium assumes that allele frequencies in a population remain constant unless disturbed by factors such as:

- Genetic drift: Random changes in allele frequencies.
- Gene migration: Movement of alleles between populations.
- Genetic recombination: Introducing new combinations of alleles.

A constant gene pool does not disturb the equilibrium, maintaining allele frequencies.

Quick Tip

Hardy-Weinberg equilibrium assumes no allele frequency changes due to mutations, selection, or migration.

---

180. Match List I with List II:

	List I		List II
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-IV, B-I, C-III, D-II

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

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

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

Solution:

- Cocaine is derived from the Erythroxylum plant. (III)

- Heroin is synthesized from morphine, which comes from the opium poppy (Papaver somniferum). (IV)

- Morphine is used as an effective sedative in surgery. (I)

- Marijuana comes from Cannabis sativa. (II)

Quick Tip

Heroin and morphine are opiate derivatives, while cocaine and marijuana come from different plant families.

---

181. 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

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

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

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

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

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

Solution:

- A. Typhoid is caused by *Salmonella typhi*, a bacterium.

- B. Leishmaniasis is caused by *Leishmania*, a protozoan parasite.

- C. Ringworm is a fungal infection caused by various types of fungi.

- D. Filariasis is caused by *Wuchereria bancrofti*, a nematode (roundworm).

Quick Tip

Typhoid is bacterial, Leishmaniasis is protozoal, Ringworm is fungal, and Filariasis is caused by a nematode.

---

182. 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

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

(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:

- A. α–I antitrypsin: Deficiency causes emphysema (III).

- B. Cry IAb: Used for ADA deficiency (IV).

- C. Cry IAc: Toxin effective against cotton bollworm (I).

- D. Enzyme replacement therapy: Toxin effective against corn borer (II).

Quick Tip

Enzyme replacement therapy is used to treat genetic disorders like ADA deficiency.

---

183. Assertion-Reason Question:

Assertion (A): Breastfeeding during the initial period of infant growth is recommended by doctors for a healthy baby.

Reason (R): Colostrum contains several antibodies essential for developing resistance in the newborn baby.

(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:

- Breastfeeding is essential for infant growth as it provides vital nutrients and immune protection.

- Colostrum, the first milk, is rich in antibodies that protect the baby from infections.

Quick Tip

Colostrum is rich in immunoglobulins, especially IgA, which protects newborns from infections.

---

184. The flippers of Penguins and Dolphins are examples of:

(1) Natural selection

(2) Convergent evolution

(3) Divergent evolution

(4) Adaptive radiation

Correct Answer: (2) Convergent evolution

Solution:

- Convergent evolution occurs when unrelated species evolve similar traits due to similar environmental pressures.

- Penguins (birds) and Dolphins (mammals) evolved flippers independently as adaptations for swimming.

Quick Tip

Convergent evolution results in similar traits in unrelated species due to similar ecological niches.

---

185. Which of the following factors favor the formation of oxyhemoglobin 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:

- High pO_2 in alveoli enhances oxygen binding to hemoglobin.

- Lesser H^+ concentration (less acidity) increases hemoglobin's oxygen affinity by reducing the Bohr effect.

Quick Tip

In alveoli, high oxygen levels (pO_2) and low acidity promote efficient oxygen binding to hemoglobin.

186. 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

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

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

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

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

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

Solution:

- A. Unicellular glandular epithelium: Found as goblet cells in the alimentary canal (III).

- B. Compound epithelium: Present on the moist surface of the buccal cavity (IV).

- C. Multicellular glandular epithelium: Found in glands like salivary glands (I).

- D. Endocrine glandular epithelium: Found in glands like the pancreas, which release hormones (II).

Quick Tip

Unicellular goblet cells secrete mucus, while multicellular glands like salivary glands secrete enzymes and other substances.

---

187. Choose the correct statement regarding juxtamedullary nephrons:

(1) Renal corpuscle of juxtamedullary nephron lies in the outer portion of the renal medulla.

(2) Loop of Henle of juxtamedullary nephron runs deep into the medulla.

(3) Juxtamedullary nephrons outnumber cortical nephrons.

(4) Juxtamedullary nephrons are located in the columns of Bertini.

Correct Answer: (2) Loop of Henle of juxtamedullary nephron runs deep into the medulla.

Solution:

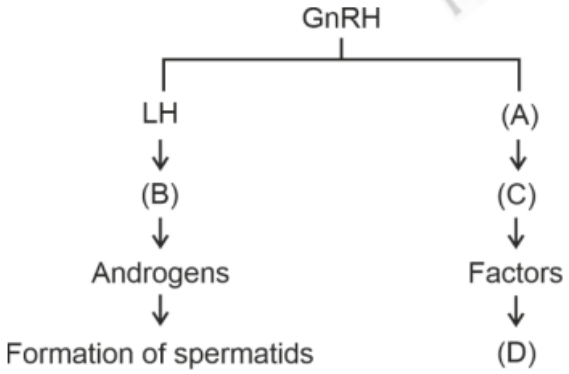
- Juxtamedullary nephrons have their renal corpuscles near the cortex-medulla boundary.
- Their Loop of Henle extends deep into the medulla, which is critical for concentrating urine.
- Juxtamedullary nephrons are fewer in number compared to cortical nephrons.
- The columns of Bertini are part of the renal medulla and do not contain nephrons.

Quick Tip

Juxtamedullary nephrons play a vital role in the production of concentrated urine due to their long loops of Henle.

---

188. Identify the correct roles of components (A), (B), (C), and (D) in 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:

- A. FSH: Stimulates Sertoli cells to nourish developing sperm.
- B. Leydig cells: Produce testosterone, essential for spermatogenesis.
- C. Sertoli cells: Provide support and nutrients to developing sperm and form the blood-testis barrier.
- D. Spermiogenesis: Final stage of spermatogenesis, where spermatids mature into spermatozoa.

Quick Tip

FSH acts on Sertoli cells, while Leydig cells secrete testosterone, crucial for spermatogenesis.

---

189. 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.

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

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

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

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

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

Solution:

- A. P wave represents atrial depolarization (I).

- B. QRS complex represents ventricular depolarization (II).

- C. T wave represents ventricular repolarization (III).

- D. T-P gap represents the electrically silent phase of the heart (IV).

Quick Tip

The P wave, QRS complex, and T wave represent the electrical activity in the heart as seen on an ECG.

---

190. 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.

(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:

- Statement I: True. Bone marrow is the primary lymphoid organ where blood cells, including lymphocytes, are produced.

- Statement II: True. Bone marrow is where T-lymphocytes originate, and the thymus is where they mature.

Quick Tip

Bone marrow is the site of blood cell production, while the thymus is essential for T-cell maturation.

---

191. 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 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)

Solution:

- Statement I is false because Gause's principle applies to species competing for the **same resources**, not different resources.

- Statement II is true because the inferior species is likely to be eliminated during competition if resources are limited.

Thus, Statement I is false, and Statement II is true, making the correct answer Option 3.

Quick Tip

Gause's principle focuses on competition for identical resources and predicts exclusion of the inferior competitor under limiting conditions.

---

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.

(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)

Solution:

- A. Exophthalmic goiter: Caused by hypersecretion of thyroid hormone, leading to protruding eyeballs (III).

- B. Acromegaly: Caused by excessive secretion of growth hormone (IV).

- C. Cushing's syndrome: Results from excess secretion of cortisol, characterized by moon face and hyperglycemia (I).

- D. Cretinism: Caused by hyposecretion of thyroid hormone, resulting in stunted growth (II).

Thus, the correct match is: A - III, B - IV, C - I, D - II.

Quick Tip

Endocrine disorders like acromegaly and Cushing's syndrome involve hormonal imbalances, while cretinism results from thyroid hormone deficiency.

---

193. 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-IV, C-II, D-III

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

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

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

Correct Answer: (3)

Solution:

- A. The crop is the structure used for storing food (IV).

- B. The gastric caeca are blind tubules at the junction of the foregut and midgut (II).

- C. Malpighian tubules are involved in excretion and osmoregulation (III).

- D. The gizzard grinds food before it enters the midgut (I).

Thus, the correct match is: A - IV, B - II, C - III, D - I.

Quick Tip

The crop stores food temporarily, while the gizzard grinds it for digestion in cockroaches.

---

194. 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:

(1) B only

(2) C & B only

(3) D & E only

(4) A only

Correct Answer: (4)

Solution:

- The father's blood group is B+, which means his genotype can be I_BI_B (homozygous) or I_Bi (heterozygous).

- The mother's blood group is A+, which means her genotype can be I_AI_A or I_Ai.

- The child's blood group is O+, which must have the genotype ii as O blood type is recessive.

- For the child to inherit ii, both parents must contribute an i allele, meaning both parents must be heterozygous: I_Bi (father) and I_Ai (mother).

Thus, the correct answer is Option (4): I_Bi, I_Ai, and ii.

Quick Tip

The O blood group (genotype ii) requires both parents to carry the recessive i allele.

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195. Match List I with List II:

	List I		List II
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

(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)

Solution:

- RNA polymerase III transcribes snRNAs and tRNA, so it matches with IV.

- Termination of transcription in prokaryotes is facilitated by the Rho factor, so it matches with III.

- Splicing of exons is carried out by snRNPs (small nuclear ribonucleoproteins), so it matches with I.

- The TATA box is a promoter sequence recognized during transcription initiation, so it matches with II.

Thus, the correct match is: A - IV, B - III, C - I, D - II.

Quick Tip

The TATA box is an essential promoter sequence for initiating transcription by RNA polymerase II.

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196. 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

(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)

Solution:

- The Mesozoic Era is known for the dominance of birds and reptiles (III).

- The Proterozoic Era saw the rise of lower invertebrates (I).

- The Cenozoic Era is recognized as the age of mammals (IV).

- The Paleozoic Era is marked by the emergence of fish and amphibians (II).

Thus, the correct match is: A - III, B - I, C - IV, D - II.

Quick Tip

The Cenozoic Era is also called the ”Age of Mammals,” while the Mesozoic Era is known as the ”Age of Reptiles.”

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197. 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.

In the light of the above statements, choose the correct 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)

Solution:

- Statement I is correct: The corpus callosum is a nerve tract that connects the two cerebral hemispheres, allowing communication between them.

- Statement II is incorrect: The brain stem consists of the medulla oblongata, pons, and midbrain, not the cerebrum. The cerebrum is part of the forebrain.

Thus, the correct answer is: Statement I is correct, Statement II is incorrect.

Quick Tip

The brainstem includes the medulla oblongata, pons, and midbrain, while the cerebrum is part of the forebrain.

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198. Regarding the 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.

(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)

Solution:

The correct order of steps in the catalytic cycle of enzyme action is:

1. Substrate binding to active site (E).
2. Substrate-enzyme complex formation (A).
3. Chemical bonds of the substrate are broken (D).
4. Release of products (C).
5. Free enzyme ready to bind with another substrate (B).

Thus, the correct sequence is: E, A, D, C, B.

Quick Tip

In enzyme catalysis, the enzyme returns to its original form after releasing the products, ready for another reaction.

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199. Given below are two statements:

Statement I: Mitochondria and chloroplasts are both double-membrane bound organelles.

Statement II: The inner membrane of mitochondria is relatively less permeable compared to chloroplasts.

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)

Solution:

- Statement I is correct: Both mitochondria and chloroplasts are double-membrane bound organelles.

- Statement II is incorrect: The inner membrane of mitochondria is relatively more permeable compared to the inner membrane of chloroplasts, which is more selectively permeable.

Thus, the correct answer is: Statement I is correct, Statement II is incorrect.

Quick Tip

Mitochondria have a highly permeable outer membrane and a selectively permeable inner membrane involved in ATP synthesis.

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200. 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)

Solution:

- Statement A is incorrect: Non-chordates generally do not have a pharynx perforated by gill slits, which is a feature of chordates.

- Statement B is correct: Non-chordates lack a notochord.

- Statement C is incorrect: Non-chordates typically have a ventral nervous system, not dorsal.

- Statement D is correct: If a heart is present in non-chordates, it is typically dorsal.

- Statement E is correct: A post-anal tail is generally absent in non-chordates.

Thus, the correct answer is: $B, D, \& E$ only.

Quick Tip

Non-chordates are characterized by the absence of a notochord and a ventral nervous system, with few exceptions.
