

NEET 2024 R1 Question Paper with Solutions

Time Allowed : 200 minutes	Maximum Marks : 720	Total questions : 200
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General Instructions

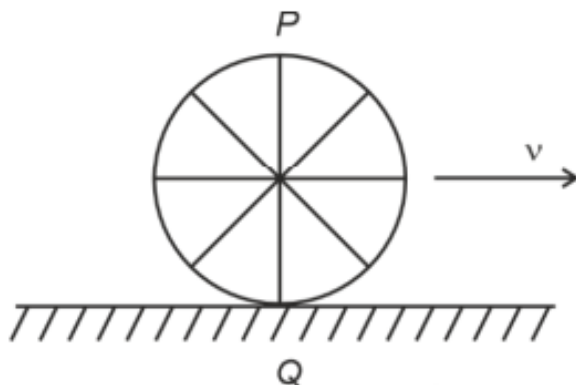
Read the following instructions very carefully and strictly follow them:

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 combination of the linear velocity of the wheel's center and the tangential velocity of the point due to its rotation.

- At the topmost point P , the tangential velocity from rotation aligns with the linear velocity. Hence, the total speed is $v + v = 2v$.
- At the bottommost point Q , the tangential velocity is opposite to the linear velocity, resulting in a net speed of $v - v = 0$.

Therefore, point P moves faster than point Q .

	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

Quick Tip

For a wheel rolling without slipping:

Speed at the topmost point = $2v$ (linear speed + rotational speed).

Speed at the bottommost point = 0 (linear speed - rotational speed).

2. Match List I with List II:

(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

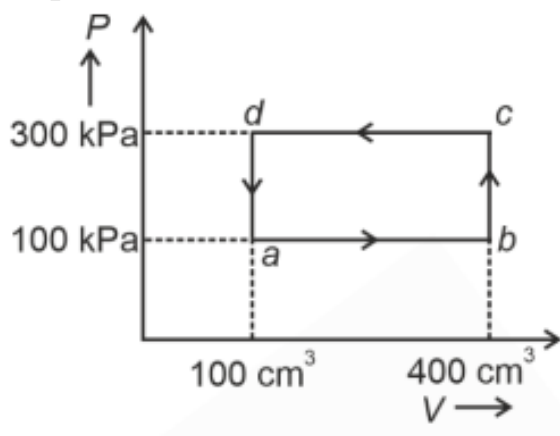
Solution: The spectral lines of hydrogen are part of the Balmer series. Based on the given wavelengths:

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

Quick Tip

In the Balmer series, spectral transitions produce visible light, with wavelengths decreasing as n_2 increases.

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



- (A) 30 J
- (B) -90 J
- (C) -60 J
- (D) 0

Correct Answer: (4) 0

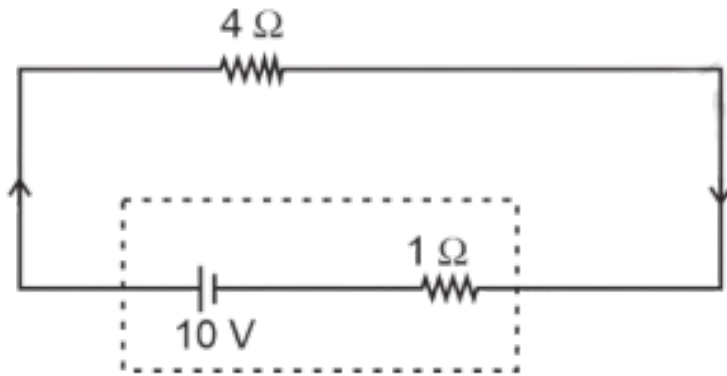
Solution: The work done along bc is determined using the equation $W = P\Delta V$.

- Since the volume remains constant along bc ($\Delta V = 0$),
- The work done is $W = 0$.

Quick Tip

In an isochoric process ($\Delta V = 0$), no work is performed because the gas volume remains unchanged.

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



- (A) 6 V
- (B) 8 V
- (C) 10 V
- (D) 4 V

Correct Answer: (2) 8 V

Solution: The terminal voltage is determined using the formula:

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

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

When calculating terminal voltage, consider the external resistance, which influences the current, and the internal resistance, which causes a voltage drop within the battery.

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 proportional to the turns ratio:

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

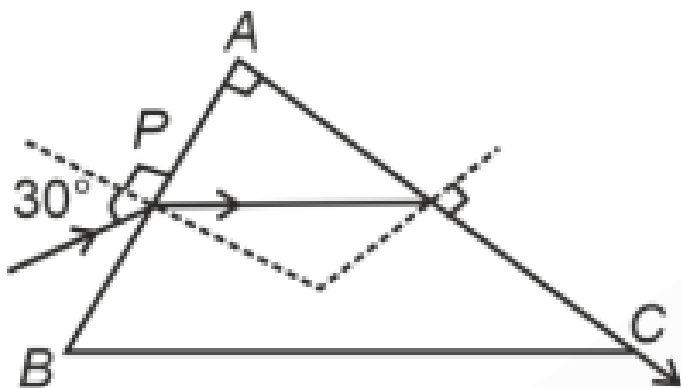
Given that $\frac{N_P}{N_S} = \frac{1}{2}$, we get $\frac{V_S}{V_P} = 2$. Thus, the voltage ratio is $V_S : V_P = 2 : 1$.

Quick Tip

For an ideal transformer:

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

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 second face of the prism,
 A is the prism angle.

From geometry, we also have:

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

Applying Snell's Law

At the incidence surface, Snell's law states:

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

Given that the angle of incidence is $i = 30^\circ$ and the refraction angle is $r_1 = 90^\circ - c$,
substituting 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 get:

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

Rearranging:

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

Squaring the Equation

Squaring both sides of equation (3):

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

Using the given 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, determine the refractive index using Snell's law and geometric constraints.

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: A solid angle is a dimensionless quantity, similar to strain (which represents a change in dimensions) and angle (expressed as the ratio of arc length to radius).

Quick Tip

Dimensionless quantities like strain and angle have no units and are commonly used to express ratios or relative measurements.

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: The excess force is determined using the formula:

$$F = 2\pi r \cdot T$$

Substituting the given values:

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

Quick Tip

For circular objects, the force due to surface tension can be calculated using $F = 2\pi r \cdot T$.

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 $4 \times 10^{-6} \text{ C} \cdot \text{m}$, is $\pm 9 \times 10^3 \text{ V}$.

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: Substituting the given values into the formula $V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$:

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

Thus, Assertion A is correct, but Reason R does not account for directionality.

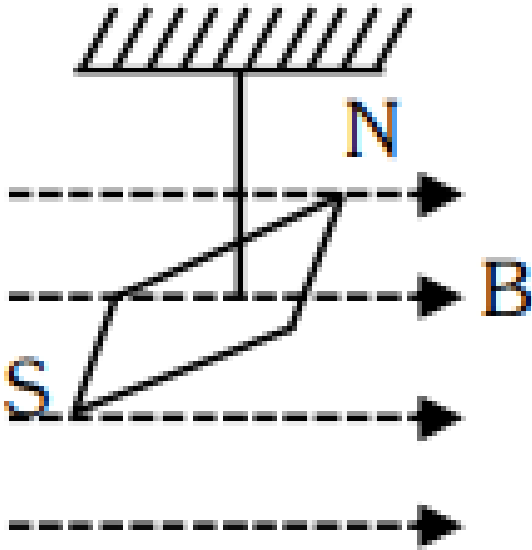
Quick Tip

For dipole potential calculations:

Use $V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$ for axial points.

Use $V = \frac{P}{4\pi\epsilon_0 r^3}$ for equatorial points.

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 $9.8 \times 10^{-6} \text{ kg} \cdot \text{m}^2$. If the magnitude of the magnetic moment of the needle is $x \times 10^{-5} \text{ Am}^2$, 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 the oscillation period:

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

Substituting the given 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 in harmonic motion within a magnetic field, use the formula:

$$M = \frac{4\pi^2 I}{T^2 B}.$$

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: When white light is used, all wavelengths participate in interference. The central fringe appears white due to constructive interference of all wavelengths, while the surrounding fringes display colors due to wavelength-dependent path differences.

Quick Tip

In white light interference, the central fringe remains white, while other fringes appear colored due to variations in wavelength-based path differences.

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 electrically neutral because they have an equal number of protons and electrons, making Statement I correct. However, stability varies among atoms—only certain configurations, such as noble gases, are inherently stable, making Statement II incorrect.

Quick Tip

Neutrality is determined by charge balance, whereas stability depends on the electronic configuration of the atom.

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

- (A) 0.4 mm
- (B) 40 mm
- (C) 8 mm
- (D) 4 mm

Correct Answer: (4) 4 mm

Solution: The maximum elongation is determined using the formula:

$$\Delta L = \frac{\sigma L}{Y}$$

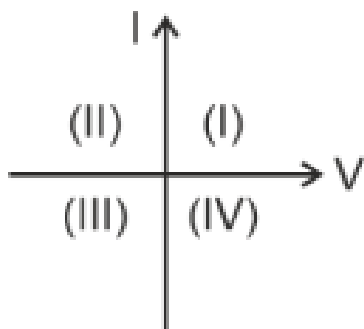
Substituting the given values:

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

Quick Tip

To calculate elongation under stress, use $\Delta L = \frac{\sigma L}{Y}$ and ensure all units are consistent.

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: The I-V characteristics of solar cells appear in the IV quadrant because they generate a negative current while maintaining a positive voltage. In a reverse-biased pn junction diode, the current is primarily due to the movement of minority carriers.

Quick Tip

Solar cells produce negative current under load conditions, while reverse-biased diodes conduct due to minority carrier movement.

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 velocity vector continuously changes direction, leading to a changing acceleration even if the speed remains constant.

Quick Tip

In uniform circular motion, the change in velocity direction results in centripetal acceleration, even when speed remains unchanged.

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 have no charge (eliminating E) and obey the relations $E = h\nu$ and $p = \frac{h\nu}{c}$. Their energy and momentum are conserved in interactions.

Quick Tip

Photon characteristics: $E = h\nu$, $p = \frac{h\nu}{c}$, no charge, and conservation of energy and momentum in collisions.

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: Applying the principle of momentum conservation:

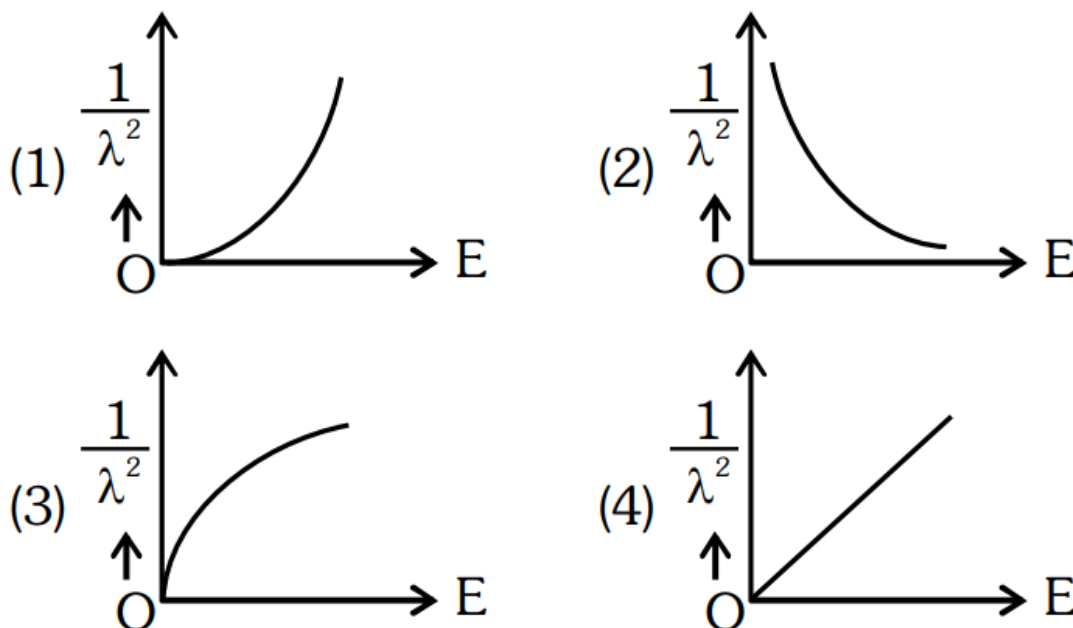
$$v_2 = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2} = \frac{v_1}{2}.$$

Hence, the velocity ratio is $v_1 : v_2 = 2 : 1$.

Quick Tip

For inelastic collisions, use momentum conservation while considering the common velocity after the collision.

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



Correct Answer: (3) Solution:

Applying the equation $\lambda = \frac{h}{\sqrt{2mE}}$, we derive the proportionality $\frac{1}{\lambda^2} \propto E$, which results in a linear graph.

Quick Tip

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

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 is completely polarized perpendicular to the plane of incidence. This occurs because the reflected and refracted rays form a 90° angle. However, the refracted light remains partially polarized, as it contains both polarization components.

Quick Tip

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

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:

Velocity is determined by differentiating displacement with respect to time:

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

The instantaneous power is then given by:

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

Quick Tip

Instantaneous power is found 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 center of a circular coil is given by:

$$B = \frac{\mu_0 NI}{2R}$$

where N is the number of turns, I is the current, R is the coil's radius, and μ_0 is the permeability of free space.

Substituting the given 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 depends on the number of turns and the current passing through it.

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

- (A) 17.5 cm
- (B) 20.7 cm
- (C) 72.0 cm
- (D) 8.5 cm

Correct Answer: (4) 8.5 cm

Solution: The moment of inertia for a rod about its center is given by:

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

Given values:

$$I = 2400 \text{ g cm}^2 = 2400 \times 10^{-7} \text{ kg m}^2, \quad M = 400 \text{ g} = 0.4 \text{ kg}.$$

Rearranging to solve for L :

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

Quick Tip

For a rod, the moment of inertia about its center is given by $I = \frac{1}{12}ML^2$, applicable when the axis is perpendicular to the rod and passes through its center.

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: The tension in the string is directly proportional to the square of the velocity:

$$T \propto v^2.$$

If the velocity doubles ($v \rightarrow 2v$), then the tension increases fourfold ($T \rightarrow 4T$).

Quick Tip

In circular motion, the tension or centripetal force depends on the square of the velocity, given by $F_c = m\frac{v^2}{r}$.

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

24. Match List-I with List-II:

- (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 classified based on their magnetic susceptibility:

Diamagnetic: $\chi = 0$

Ferromagnetic: $\chi \gg 1$

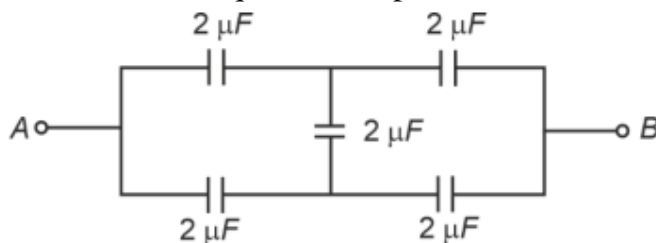
Paramagnetic: $0 < \chi \ll 1$

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

Quick Tip

Magnetic susceptibility values help distinguish materials as diamagnetic, paramagnetic, or ferromagnetic.

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 determined as follows:

First, calculate the series combination:

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

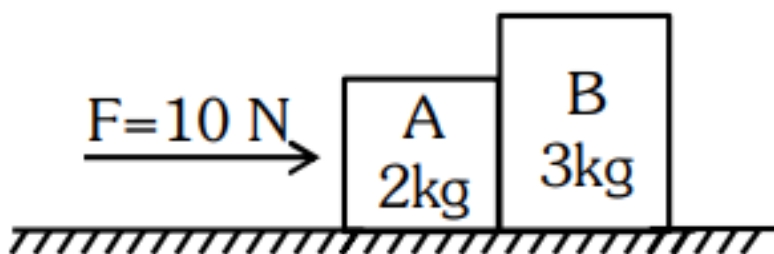
Then, add the parallel capacitors:

$$C_p = 1 + 1 = 2\ \mu F.$$

Quick Tip

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

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



(A) 4 N

(B) 6 N

(C) 10 N

(D) Zero

Correct Answer: (2) 6 N

Solution: The total acceleration of the system is given by:

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

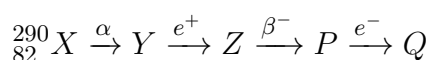
The force exerted by A on B is calculated as:

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

Quick Tip

To determine forces within a system, use $F = ma$ after calculating the system's acceleration.

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



1. 286, 80
2. 288, 82
3. 286, 81
4. 280, 81

Correct Answer: (3) 286, 81

Solution:

α decay: Mass number decreases by 4, atomic number decreases by 2 $\rightarrow$ 286, 80.

β^+ emission: Atomic number decreases by 1 $\rightarrow$ 286, 79.

β^- emission: Atomic number increases by 1 $\rightarrow$ 286, 80.

Electron capture: Atomic number decreases by 1 $\rightarrow$ 286, 81.

Quick Tip

In nuclear reactions, track changes in mass and atomic numbers carefully for each type of decay.

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 between one main scale division (MSD) and one vernier scale division (VSD).

Given:

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

One main scale division (MSD) is 0.1 mm.

Step 1: Total length of N main scale divisions

$$N \times 0.1 \text{ mm} = 0.1N \text{ mm}$$

Step 2: Total length of $N + 1$ vernier scale divisions

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

Step 3: Since both lengths are equal

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

Step 4: Solve for VSD

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

Step 5: Find the Vernier Constant

$$\text{Vernier Constant} = \text{MSD} - \text{VSD}$$

$$\begin{aligned} &= 0.1 \text{ mm} - \frac{0.1N}{N + 1} \text{ mm} \\ &= \frac{1}{100(N + 1)} \text{ cm} \end{aligned}$$

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

Quick Tip

To determine the vernier constant, subtract one vernier scale division from one main scale division to obtain 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 m, 2 s
- (B) 5 cm, 1 s
- (C) 5 m, 1 s
- (D) 5 cm, 2 s

Correct Answer: (1) 5 m, 2 s

Solution:

The amplitude is given by the coefficient of sin, which is 5 m.

The angular frequency is:

$$\omega = \pi$$

The time period is calculated as:

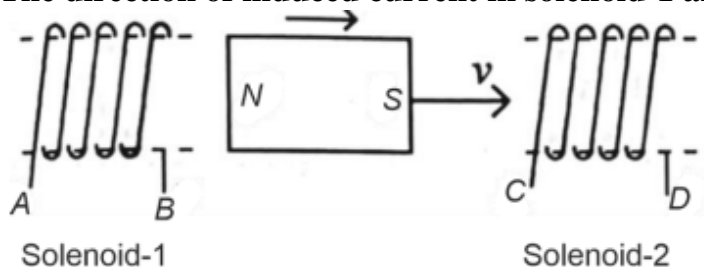
$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\pi} = 2 \text{ s.}$$

Quick Tip

In simple harmonic motion (SHM), the amplitude represents the maximum displacement, while the time period is given by $T = \frac{2\pi}{\omega}$.

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:

Applying Lenz's law:

In solenoid-1, the induced current flows along AB to oppose the motion of the magnet.

In solenoid-2, the induced current flows along DC to support the approach of the magnet.

Quick Tip

According to Lenz's law, the induced current always acts in a direction that opposes the change causing it.

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

The expression for the output Y is:

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

(B) $\bar{B}$

(C) B

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

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

Solution:

Analyzing the truth table:

For $A = 0, B = 0, Y = 1$.

For $A = 0, B = 1, Y = 0$.

For $A = 1, B = 0, Y = 1$.

For $A = 1, B = 1, Y = 0$.

From the table, Y is 1 when $B = 0$, regardless of A . This suggests that $Y = \bar{B}$.

Thus, the Boolean expression for Y is:

$$Y = \bar{B}$$

<i>A</i>	<i>B</i>	<i>Y</i>
0	0	1
0	1	0
1	0	1
1	1	0

Quick Tip

When analyzing truth tables, identify the conditions where the output is 1 or 0 to derive the Boolean expression.

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 segment of the wire has a resistance of:

$$R_1 = \frac{100}{10} = 10\ \Omega.$$

Step 1: Series Combination The first 5 segments are connected in series:

$$R_s = 5 \times 10 = 50\ \Omega.$$

Step 2: Parallel Combination The next 5 segments are connected in parallel:

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

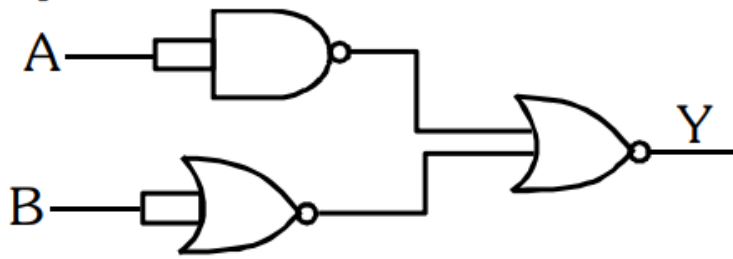
Step 3: Total Resistance

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

Quick Tip

For resistors in series, sum their values: $R_s = R_1 + R_2 + \dots$ For parallel identical resistors, use $R_p = \frac{R}{n}$, where n is the number of 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 circuit, follow these steps:

1. The circuit consists of two logic gates working together to produce the output Y .
2. The input signals A and B are first processed through an OR gate, giving $A + B$.
3. The output of the OR gate is then inverted using a NOT gate, resulting in $\overline{A + B}$.
4. This inverted output is then passed through another OR gate along with $A \cdot B$, leading to:

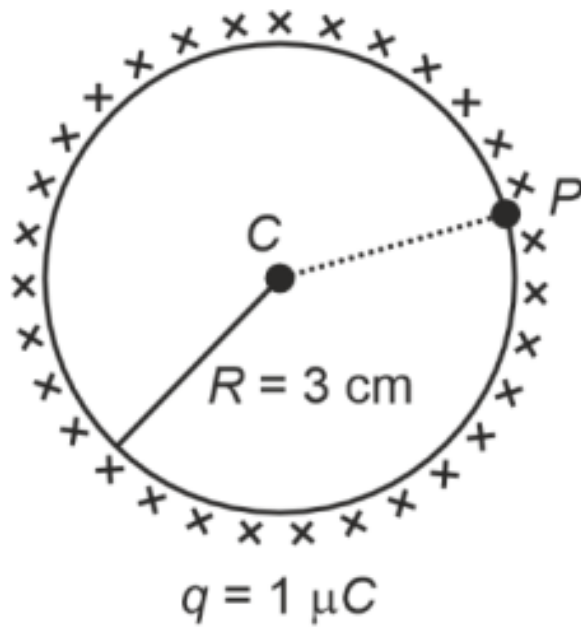
$$Y = (A \cdot B) \cdot (\overline{A + B}).$$

This final expression corresponds to the output of an AND gate.

Quick Tip

Logic gate circuits can often be simplified by systematically analyzing their truth tables and step-by-step transformations.

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 maintains the same potential at all points inside and on its surface due to the absence of an electric field inside the shell.

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

Since the potential remains the same at both points C and P , the potential difference is:

$$\Delta V = V_P - V_C = 0.$$

Thus, the potential difference between C and P is zero.

Quick Tip

Inside a charged spherical shell, the potential remains constant, irrespective of 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 m/s^2

(B) 4.9 m/s^2

(C) 3.92 m/s^2

(D) 19.6 m/s^2

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

Solution:

The acceleration due to gravity (g) on a planet is determined using the equation:

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

where:

G is the gravitational constant,

M is the planet's mass,

R is the planet's radius.

Step 1: Given that the planet's mass is one-tenth of Earth's mass:

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

Step 2: The planet's diameter is half of Earth's, meaning its radius is:

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

Squaring the radius term:

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

Step 3: Substituting these values into the gravity formula:

$$g_{\text{planet}} = \frac{G \times \frac{1}{10} M_{\text{Earth}}}{\frac{1}{4} R_{\text{Earth}}^2} = \frac{4}{10} \times \frac{GM_{\text{Earth}}}{R_{\text{Earth}}^2}$$

Step 4: Since Earth's acceleration due to gravity is $g_{\text{Earth}} = \frac{GM_{\text{Earth}}}{R_{\text{Earth}}^2} = 9.8 \text{ m/s}^2$, we calculate:

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

Thus, the acceleration due to gravity on the planet is 3.92 m/s^2 .

Quick Tip

Gravity is directly proportional to mass and inversely proportional to 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 of an object in orbit is given by:

$$E = \frac{-GMm}{2r}$$

Substituting $r = 3R$:

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

The minimum energy required for escape is:

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

Quick Tip

The energy required to escape accounts for both escape velocity and the change in potential energy.

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:

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

where:

$f_o = 140$ cm (focal length of the objective lens)

$f_e = 5.0$ cm (focal length of the eyepiece)

Substituting the values:

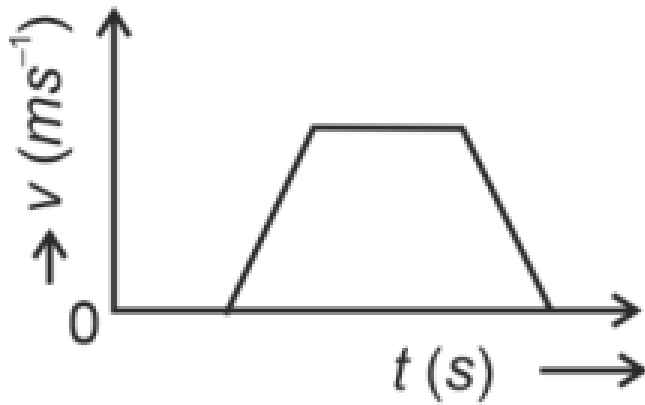
$$M = \frac{140}{5.0} = 28.$$

Thus, the magnifying power of the telescope is 28.

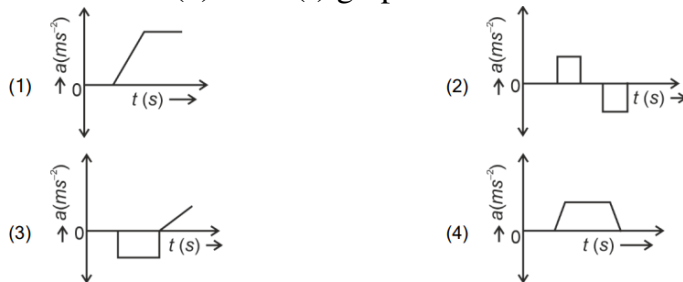
Quick Tip

For distant objects, the magnifying power of a telescope is determined by the ratio of the focal lengths of the objective and eyepiece.

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 determined by the slope. During different time intervals, the slope remains constant but changes in discrete steps, corresponding to the stepped nature of the graph.

Quick Tip

Acceleration is found from the slope of velocity-time graphs; check for consistency or variations in slope.

39. Two heaters A and B have power ratings of 1 kW and 2 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 heaters A and B be R_A and R_B , respectively. Using the power formula $P = \frac{V^2}{R}$, resistance can be written as:

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

Thus,

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

Step 1: Series Connection The total resistance in series is:

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

The power output in series is given by:

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

Step 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:

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

Step 3: Ratio of Power Outputs The ratio of power outputs in series and parallel configurations is:

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

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 power output ratio is 2 : 9.

Quick Tip

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

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, the units must cancel out completely.

Dimensions of α :

$$[F] \cdot [t]^{-2} = \frac{\text{MLT}^{-2}}{\text{T}^2} = \text{MLT}^{-4}.$$

Dimensions of β :

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

Now, checking the dimensions of $\frac{\alpha t}{\beta}$:

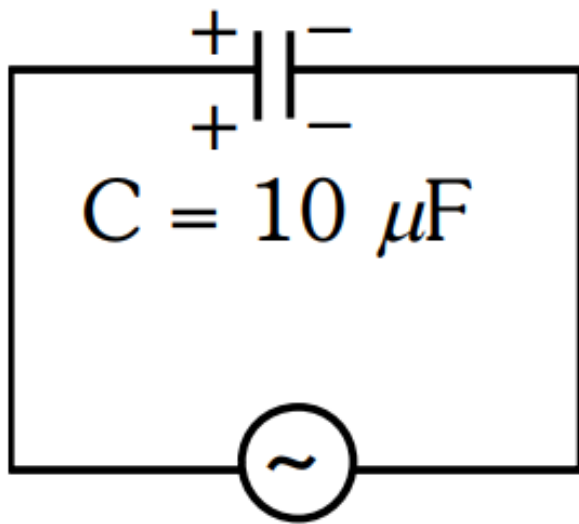
$$\frac{\text{MLT}^{-4} \cdot \text{T}}{\text{MLT}^{-3}} = 1.$$

Since all units cancel out, $\frac{\alpha t}{\beta}$ is dimensionless.

Quick Tip

To verify if a quantity is dimensionless, check if all units in the given expression cancel out completely.

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



$210\ \text{V}$, $50\ \text{Hz}$

- (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 calculated using:

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

Substituting the given values:

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

The peak current is given by:

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

Quick Tip

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

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

- (A) $50 \times 10^3 \text{ N}$
- (B) $100 \times 10^3 \text{ N}$
- (C) $2 \times 10^3 \text{ N}$
- (D) $5 \times 10^3 \text{ N}$

Correct Answer: (1)

Solution:

Thermal stress is given by:

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

The force exerted due to thermal expansion is:

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

Substituting the given 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, the coefficient of thermal expansion, and the 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, a current flows, causing the capacitor to charge.

In the space between the capacitor plates, a displacement current exists due to the changing electric field. It 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.

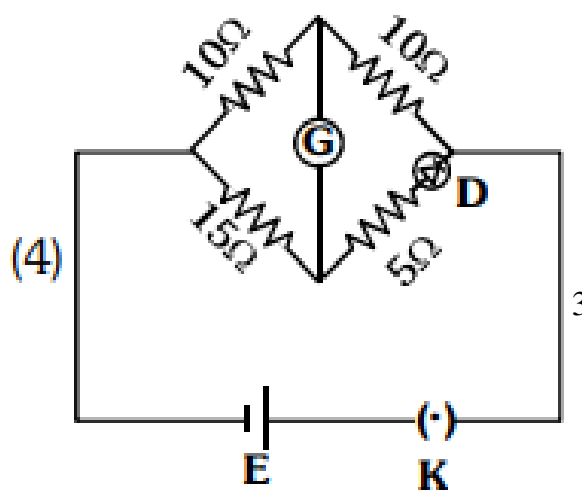
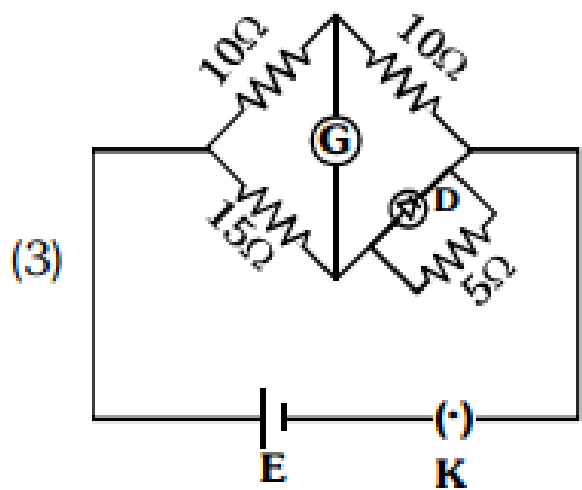
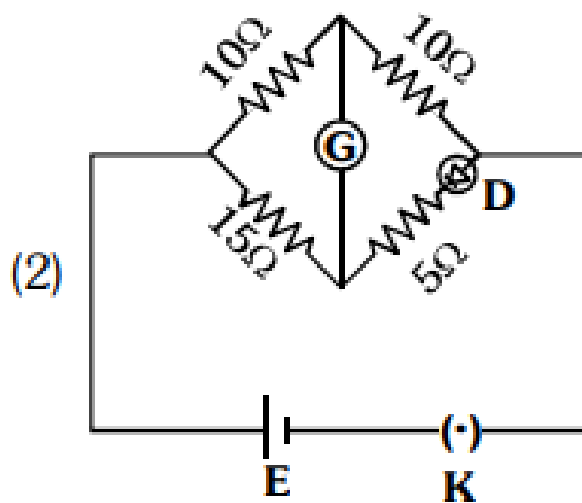
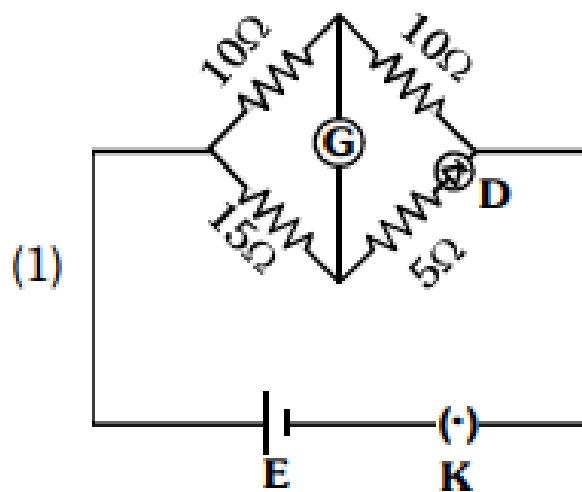
During charging, the displacement current I_d is equal in magnitude to the conduction current I in the external circuit and flows in the same direction as I .

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

Quick Tip

In capacitors, displacement current ensures continuity in the circuit by bridging the gap between the plates.

44. Choose the correct circuit which achieves bridge balance:



Correct Answer: (4)

Solution: For a Wheatstone bridge to be balanced, the following condition must be met:

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

where R_1 , R_2 , R_3 , and R_4 represent the resistances in the corresponding branches of the bridge.

Let's analyze 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, so the bridge is not balanced.
4. In Circuit (4): The ratio of resistances satisfies the balance condition:

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

Thus, the bridge is balanced in this configuration.

Therefore, the correct answer is Circuit (4).

Quick Tip

In a balanced Wheatstone bridge, the ratio of resistances in one branch is equal to that in 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:

Force on a Magnetic Sheet:

A magnetic sheet experiences an attractive force due to the magnetic field at the pole. This force must be counterbalanced to keep the sheet in place.

Hence, option A is correct.

Force on a Non-Magnetic Sheet:

A non-magnetic sheet does not experience a significant force in the presence of a magnetic pole unless it is conducting.

Therefore, option B is incorrect.

Force on a Conducting Sheet:

A conducting sheet placed in a magnetic field experiences induced currents due to electromagnetic effects.

These induced currents interact with the field, generating a force that opposes motion. To move the sheet with uniform velocity, an external force is required.

Thus, option C is correct.

Force on a Non-Conducting, Non-Polar Sheet:

A sheet that is neither conducting nor polar does not significantly interact with the magnetic field.

Since no force is needed to move it uniformly, option D is incorrect.

Thus, the correct choices are A and C.

Quick Tip

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

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 increases because it is given by:

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

Since d (plate separation) decreases, C increases.

As the capacitor remains connected to a battery, the voltage V remains constant.

The increased capacitance leads to a higher charge stored on the plates, as given by:

$$Q = CV.$$

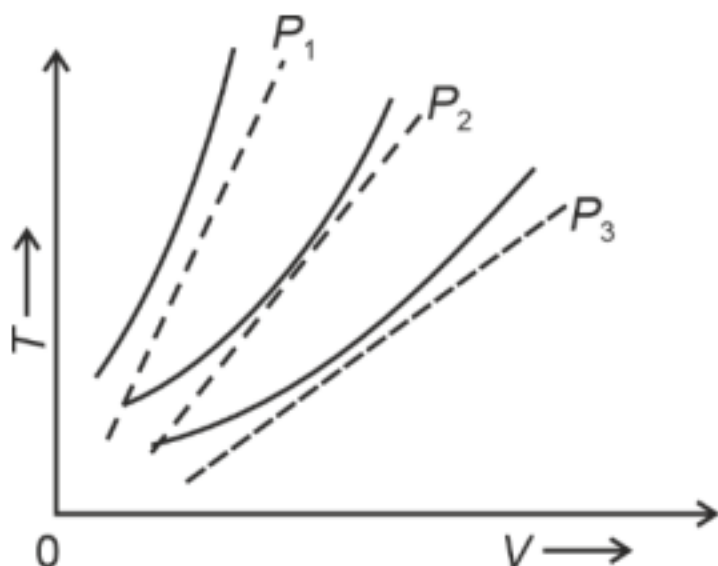
The product of charge and voltage $Q \cdot V$ increases because Q increases while V remains constant.

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

Quick Tip

Capacitance is inversely proportional to plate separation; reducing the gap increases the charge stored.

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:

Using the ideal gas law:

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

For a fixed number of moles, volume is proportional to T/P :

$$V \propto \frac{T}{P}.$$

At a given temperature, increasing pressure results in a decreased slope of the $T - V$ graph from the origin. Therefore:

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

Quick Tip

In $T - V$ graphs, higher pressure leads to steeper curves because $V \propto 1/P$ when temperature is constant.

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 produced when charges undergo acceleration, not when they move with uniform velocity.

All other given properties correctly describe electromagnetic waves:

The energy densities of the electric and magnetic fields are equal.

Their speed is given by $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$.

They are transverse waves.

Quick Tip

Electromagnetic waves are generated by accelerated charges, not by charges moving at constant speed.

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 represents 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 its midpoint to form two arms, the magnetic moment is distributed across these arms. Since the two arms form an angle of 60° , their contributions are combined vectorially.

The effective magnetic moment is calculated as:

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

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

Quick Tip

When a magnetic bar is bent, the resultant magnetic moment depends on the angle between its 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 simple pendulum is given by:

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

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 $\frac{x}{2}T$:

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

Quick Tip

The time period of a pendulum depends on its length, not its mass. Any change in length directly affects 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 hydroxylamine (NH_2OH) (D), forming characteristic products.

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

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

Thus, glucose does not react with B and E.

Quick Tip

In organic chemistry, glucose reacts with oxidizing agents but does not react with Schiff's reagent or bisulfite, as they do not form stable products 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 ($n = 1$) and excited state ($n = 2$) for Be^{3+} is:

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

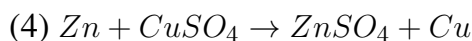
Quick Tip

For energy calculations in hydrogen-like atoms, remember that energy depends on Z^2 and decreases as $\frac{1}{n^2}$ in 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) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$



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 the elements, meaning it is simply a double displacement reaction and not a redox reaction.

In all other options, electron transfer occurs, making them redox reactions.

Quick Tip

To determine if a reaction is redox, check the oxidation states of elements before and after the reaction. If there is no change, it is not a redox reaction.

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: Constant temperature $\rightarrow$ II

Isochoric: Constant volume $\rightarrow$ III

Isobaric: Constant pressure $\rightarrow$ IV

Adiabatic: No heat exchange $\rightarrow$ I

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

Quick Tip

In thermodynamics, "iso-" means constant, and the suffix specifies the variable:

Isothermal → Constant temperature

Isochoric → Constant volume

Isobaric → Constant pressure

Adiabatic → No heat exchange

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 determined using:

$$Q_c = \frac{[B][C]}{[A]^2}$$

Substituting the given concentrations:

$$Q_c = \frac{(2 \times 10^{-3})(2 \times 10^{-3})}{(2 \times 10^{-3})^2} = 1.$$

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

Quick Tip

To determine reaction direction:

$Q_c > K_c \rightarrow$ Reaction shifts backward.

$Q_c < K_c \rightarrow$ Reaction shifts forward.

$Q_c = K_c \rightarrow$ Reaction is at equilibrium.

56. Match List I with List II:

List I (Complex)

- A. $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$
- B. $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Br}$
- C. $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$
- D. $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$

List II (Type of isomerism)

- I. Solvate isomerism
- II. Linkage isomerism
- III. Ionization isomerism
- 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 the exchange of SO_4^{2-} with water molecules.

Complex C demonstrates coordination isomerism due to the exchange of ligands between two metal centers.

Complex D exhibits linkage isomerism as Cl^- can coordinate in multiple ways.

Quick Tip

To identify isomerism in coordination complexes, check for ligand exchanges, binding modes, or metal-ligand rearrangements:

Solvate isomerism → Water or solvent exchange

Ionization isomerism → Ionizable ligand exchange

Coordination isomerism → Ligand swap between metal centers

Linkage isomerism → Different ligand binding orientations

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. $2\text{NaHCO}_{3(s)} \rightarrow \text{Na}_2\text{CO}_{3(s)} + \text{CO}_{2(g)} + \text{H}_2\text{O}_{(g)}$
- D. $\text{Cl}_{2(g)} \rightarrow 2\text{Cl}_{(g)}$

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: When a liquid evaporates into vapor, entropy increases because gases have higher randomness than liquids.

C: The decomposition of NaHCO_3 increases entropy as a solid breaks down into gaseous products (CO_2 , H_2O).

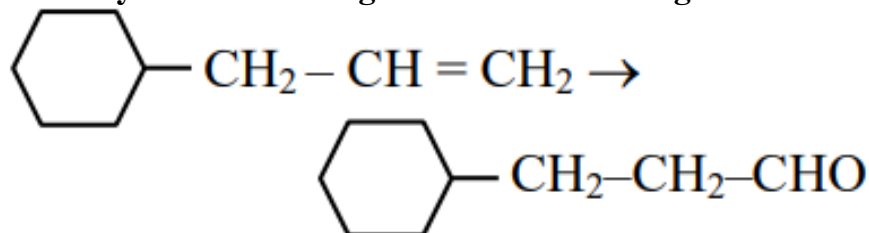
D: The dissociation of Cl_2 into two Cl atoms increases entropy due to the increase in the number of particles.

B: Lowering temperature decreases entropy as molecular randomness reduces.

Quick Tip

Entropy increases when a phase change occurs (solid $\rightarrow$ liquid $\rightarrow$ gas) or when the number of gaseous molecules increases in a reaction.

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



- (1) (i) BH_3 , (ii) $\text{H}_2\text{O}_2/\text{OH}^-$, (iii) PCC
(2) (i) BH_3 , (ii) $\text{H}_2\text{O}_2/\text{OH}^-$, (iii) alk. KMnO_4 , (iv) H_3O^+
(3) (i) $\text{H}_2\text{O}/\text{H}^+$, (ii) PCC
(4) (i) $\text{H}_2\text{O}/\text{H}^+$, (ii) CrO_3

Correct Answer: (1) (i) BH_3 , (ii) $\text{H}_2\text{O}_2/\text{OH}^-$, (iii) PCC

Solution:

BH_3 undergoes hydroboration of the double bond.

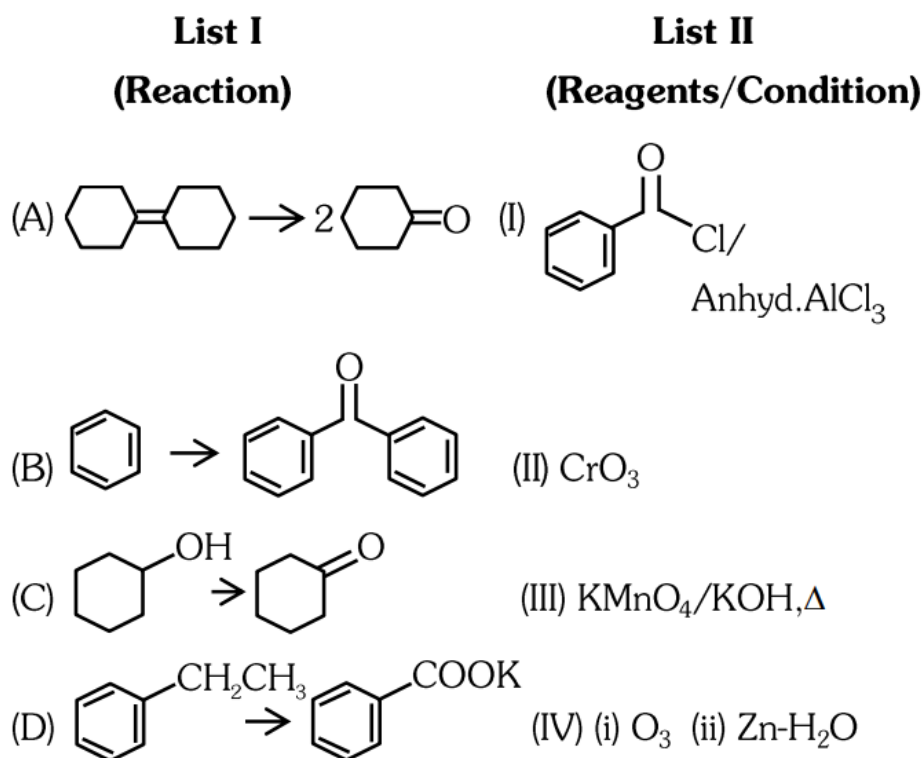
$\text{H}_2\text{O}_2/\text{OH}^-$ oxidizes the boron intermediate into an alcohol.

PCC selectively oxidizes the alcohol to an aldehyde.

Quick Tip

For controlled oxidation to aldehydes, use PCC. Hydroboration-oxidation ensures anti-Markovnikov addition, converting alkenes to primary alcohols.

59. Match List I with List II:



(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 involves oxidation using KMnO_4/KOH .

Reaction B utilizes CrO_3 for the oxidation of aldehydes.

Reaction C proceeds through Friedel-Crafts alkylation in the presence of AlCl_3 .

Reaction D undergoes ozonolysis.

Quick Tip

Common oxidation reagents include KMnO_4 and CrO_3 . Friedel-Crafts reactions require AlCl_3 , while ozonolysis breaks double bonds.

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

- (1) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
 (2) $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$
 (3) $2\text{BrCl}(\text{g}) \rightleftharpoons \text{Br}_2(\text{g}) + \text{Cl}_2(\text{g})$
 (4) $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$

Correct Answer: (4)

Solution:

The relationship between K_p and K_c is given by:

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

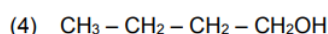
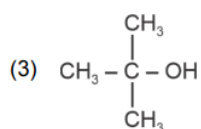
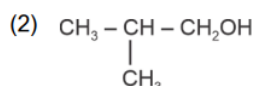
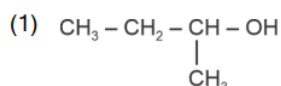
where Δn is the difference between the moles of gaseous products and gaseous reactants.

For equilibrium (4), since $\Delta n \neq 0$, it follows that $K_p \neq K_c$.

Quick Tip

For $K_p = K_c$, the condition $\Delta n = 0$ must be satisfied. Otherwise, their values will be different.

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



Correct Answer: (3)

Solution:

Tertiary alcohols react immediately with Lucas reagent because they form a highly stable tertiary carbocation intermediate.

Quick Tip

The Lucas test differentiates alcohols based on their reactivity: tertiary reacts instantly, secondary takes a few minutes, and primary shows little to no reaction.

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 as branching increases because branched-chain alkanes have a smaller surface area, leading to weaker intermolecular forces.
- 2. Statement II correctly explains why branched isomers have lower boiling points.

Quick Tip

The boiling points of isomers depend on branching. Greater branching reduces surface area, weakens van der Waals forces, and lowers the boiling point.

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 interacts with the Lewis acid ($AlCl_3$), forming a complex that deactivates the reaction.
2. Gabriel synthesis is not suitable for preparing aniline since it involves alkyl halides, whereas aryl halides like chlorobenzene do not participate in this reaction.

Quick Tip

When analyzing reaction feasibility, consider both steric hindrance and electronic effects that may prevent a compound from reacting.

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 , achieving a more stable half-filled configuration.
2. This enhanced stability contributes to the higher standard reduction potential (E°) for the Mn^{3+}/Mn^{2+} couple compared to chromium or iron.

Quick Tip

Reduction potentials tend to be more positive when the process leads to half-filled or fully filled stable electronic 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 refers to the direct conversion of a solid into vapor without passing through the liquid phase.
2. Common examples of substances that undergo sublimation include iodine and naphthalene.

Quick Tip

Sublimation is an effective purification technique for substances like camphor and iodine, which transition directly from solid to vapor when heated.

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 combination of two components: Fehling's solution A (aqueous copper sulfate) and Fehling's solution B (an alkaline solution of potassium sodium tartrate).
2. It is primarily used for detecting aldehydes, which reduce Cu^{2+} ions to Cu_2O .

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

Quick Tip

Fehling's test is frequently employed to identify reducing sugars such as glucose and fructose.

67. Match List I with List II:

- (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)

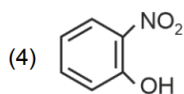
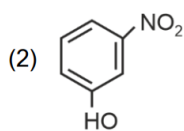
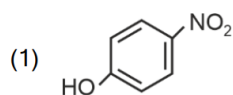
Solution:

1. Ethane contains a single σ -bond between carbon atoms.
2. Ethene has one σ -bond and one π -bond due to the double bond.
3. C_2 features two π -bonds, exhibiting unique bonding characteristics.
4. Ethyne consists of one σ -bond and two π -bonds, forming a triple bond.

Quick Tip

To determine bond types in hydrocarbons, analyze hybridization: single bonds are σ -bonds, while double and triple bonds include π -bonds.

68. Intramolecular hydrogen bonding is present in:



Correct Answer: (4)

Solution:

1. Intramolecular hydrogen bonding occurs when a hydrogen atom forms a bond within the same molecule, typically between a donor group (e.g., OH , NH) and an acceptor group (e.g., NO_2 , CO).
2. In option (4), the OH and NO_2 groups are positioned closely, enabling intramolecular hydrogen bonding.
3. The other options do not have the required spatial arrangement for this interaction.

Quick Tip

To identify intramolecular hydrogen bonding, look for functional groups that are geometrically close within a molecule and capable of forming hydrogen 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 represents a single atom of helium, as atomic mass is expressed in atomic mass units (u).
2. 4 g of helium corresponds to 1 mole, which contains 6.022×10^{23} atoms.

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

3. At STP, 1 mole of helium occupies 22.4 L. Given that 2.271098 L is provided, this corresponds to approximately 0.1 moles, or 6.022×10^{22} atoms.
4. 4 moles of helium contain $4 \times 6.022 \times 10^{23}$ atoms, making it the highest quantity of atoms among the given options.

Quick Tip

Use Avogadro's number (6.022×10^{23}) to quickly determine the number of particles in a given amount of substance. 1 mole always contains Avogadro's number of atoms or molecules.

70. Match List I with List II:

- (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 the reaction $H_2O \rightarrow O_2$, 4 electrons are required per oxygen atom. Therefore, 2 moles of H_2O need 4F to produce 1 mole of O_2 .
2. In the reaction $MnO_4^- \rightarrow Mn^{2+}$, 5 electrons are needed per mole, which corresponds to 5F.
3. For $CaCl_2$, 2 electrons are required per Ca atom, so 1.5 moles of Ca need 3F.
4. In the reaction $FeO \rightarrow Fe_2O_3$, 2 moles of FeO require 2F.

Quick Tip

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

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 exhibit a -2 oxidation state due to their high electronegativity.

Step 2: Polonium (Po), being a metal, primarily shows positive oxidation states ($+2$, $+4$) and does not typically exhibit -2 .

Quick Tip

In Group 16, non-metals typically exhibit a -2 oxidation state, whereas metallic elements 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: The magnetic moment is determined using the formula:

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

where n represents the number of unpaired electrons.

Step 2: For Cr^{2+} (d^4) and Fe^{2+} (d^6), both have $n = 4$ unpaired electrons.

The spin-only magnetic moment for both ions is:

$$\mu = \sqrt{4(4+2)} = 4.90 \text{ BM.}$$

Quick Tip

To determine the magnetic moment of ions, use the formula $\mu = \sqrt{n(n+2)}$, where n is the number of unpaired electrons based on 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: A tertiary carbon is a carbon atom bonded to three other carbon atoms. The presence of two tertiary carbons means two such carbon atoms exist in the structure.

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

Step 3: The other options do not meet this structural requirement.

Quick Tip

To identify tertiary carbons, check for carbon atoms bonded to three other carbons and confirm their positions in 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 . A lower K_H value indicates higher solubility in water.

Step 2: Given K_H values:

$$A = 145$$

$$B = 2 \times 10^{-5}$$

$$C = 35$$

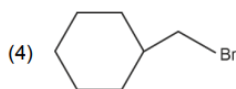
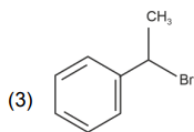
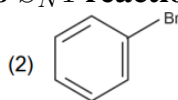
Step 3: Based on the inverse relationship, the solubility order is:

$$B \text{ (lowest } K_H) > C > A.$$

Quick Tip

Solubility follows the relation $\text{Solubility} \propto \frac{1}{K_H}$. A smaller K_H value means greater solubility in water.

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



Correct Answer: (3)

Solution:

Step 1: The rate of an S_N1 reaction depends on the stability of the carbocation formed. A more stable carbocation results in a faster reaction.

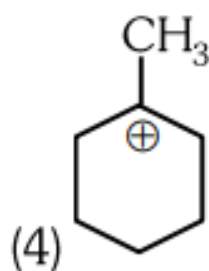
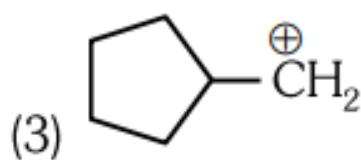
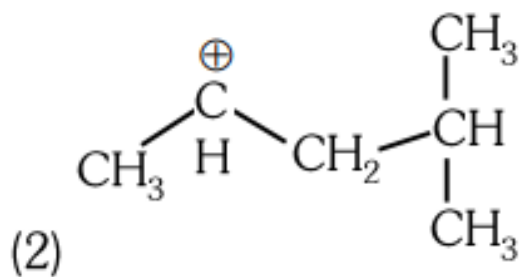
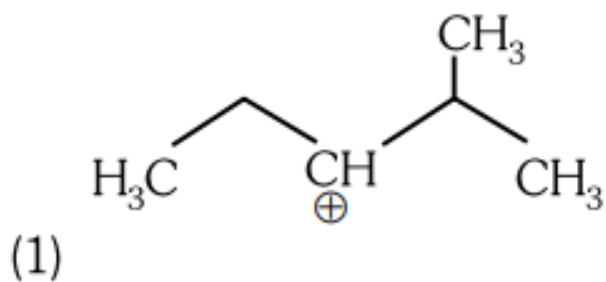
Step 2: 2-Methylbenzyl bromide forms a resonance-stabilized benzyl carbocation, further enhanced by the +I effect of the methyl group.

Step 3: The other compounds generate less stable carbocations, making their S_N1 reactions slower.

Quick Tip

In S_N1 reactions, the stability of the carbocation intermediate is key. Resonance and hyperconjugation significantly enhance carbocation stability, increasing reaction speed.

76. The most stable carbocation among the following is:



Correct Answer: (3)

Solution: Step 1: The stability of a carbocation is enhanced by resonance and hyperconjugation.

Step 2: Option (3) results in the formation of a cyclopropylmethyl carbocation, which is stabilized through resonance (a non-classical carbocation).

Step 3: The other options do not provide the same level of stabilization.

Quick Tip

Carbocation stability hierarchy: 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: In $[Co(NH_3)_6]^{3+}$, NH_3 is a strong field ligand, leading to a low-spin configuration. All electrons pair up, making the complex diamagnetic.

Step 2: In $[CoF_6]^{3-}$, F^- is a weak field ligand, resulting in a high-spin configuration with unpaired electrons, making it paramagnetic.

Step 3: Both complexes have an octahedral geometry, but their magnetic properties differ due to the nature of their ligands.

Quick Tip

To determine magnetic behavior, refer to the spectrochemical series. Strong field ligands cause electron pairing (low spin, diamagnetic), while weak field ligands allow unpaired electrons (high spin, paramagnetic).

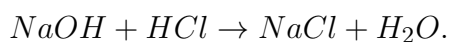
78. 1 gram of sodium hydroxide was treated with 25 mL of 0.75 M HCl solution. The mass of sodium hydroxide left unreacted is equal to:

- (1) 250 mg
- (2) Zero mg
- (3) 200 mg
- (4) 750 mg

Correct Answer: (1) 250 mg

Solution:

Step 1: The given reaction is:



Step 2: Moles of HCl:

$$0.75 \text{ M} \times 0.025 \text{ L} = 0.01875 \text{ mol}.$$

Step 3: Moles of NaOH:

$$\frac{1}{40} = 0.025 \text{ mol}.$$

Step 4: HCl reacts with 0.01875 mol of NaOH, leaving:

$$0.025 - 0.01875 = 0.00625 \text{ mol of NaOH}.$$

Step 5: Mass of unreacted NaOH:

$$0.00625 \times 40 = 250 \text{ mg}.$$

Quick Tip

In stoichiometry problems, always determine the limiting reagent to calculate the amount left unreacted.

79. Given below are two statements: Statement I: The boiling point of hydrides of Group 16 elements follows the order $\text{H}_2\text{O} > \text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{S}$.

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 is primarily influenced by molecular mass and the ability to form hydrogen bonds.

Step 2: H_2O exhibits strong hydrogen bonding, which results in the highest boiling point.

Step 3: Heavier hydrides like H_2Te , H_2Se , and H_2S follow a boiling point trend primarily governed by their molecular mass.

Quick Tip

Hydrogen bonding greatly raises boiling points in hydrides such as H_2O , while the boiling points of heavier hydrides are mainly determined by molecular mass.

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 generally increases across a period due to a rising nuclear charge, which holds electrons more tightly.

Step 2: Exception: Boron has a lower ionization enthalpy than Beryllium because Be has a fully filled $2s^2$ configuration, making it more stable.

Step 3: The correct ionization enthalpy order is:

$$Li < B < Be < C < N.$$

Quick Tip

When analyzing ionization enthalpy trends, consider electronic configuration stability—fully filled and half-filled orbitals contribute to higher stability.

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) rate constant at two different temperatures

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

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

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

Step 2: Taking the natural logarithm at two distinct temperatures gives:

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

which allows for the calculation of E_a when k_1 and k_2 are known.

Quick Tip

To find activation energy, use the rate constants at two different temperatures along 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	List II
(Quantum Number)	(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: The principal quantum number (n) determines the size of the orbital.

Step 2: The azimuthal quantum number (l) defines the shape of the orbital.

Step 3: The magnetic quantum number (m) specifies the orientation of the orbital in space.

Step 4: The spin quantum number (m_s) indicates the direction of the electron's spin.

Quick Tip

Understand the role of quantum numbers: n (size), l (shape), m (orientation), and m_s (spin direction).

84. Match List I with List II:

List I
(Compound)

- A. NH_3
- B. BrF_5
- C. XeF_4
- D. SF_6

List II
(Shape/geometry)

- I. Trigonal Pyramidal
- II. Square Planar
- III. Octahedral
- 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 has a trigonal pyramidal shape due to lone pair repulsion.

Step 2: BrF_5 has a square pyramidal geometry with one lone pair.

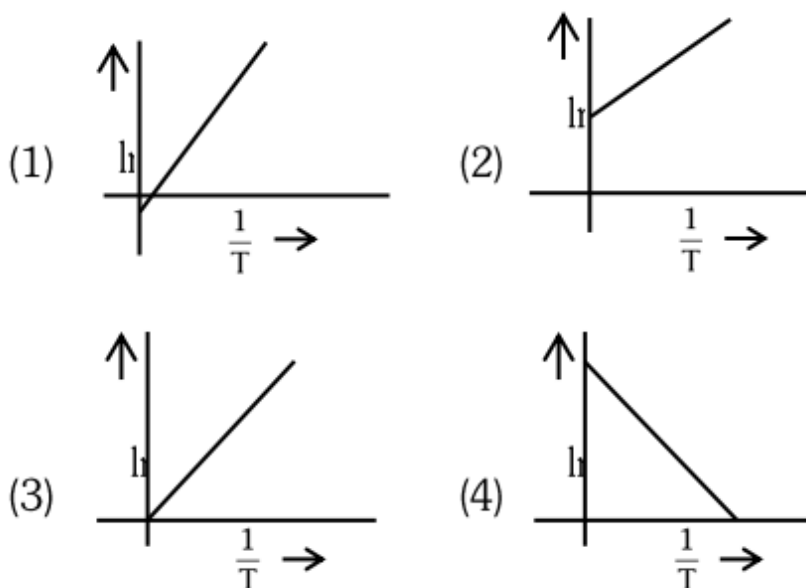
Step 3: XeF_4 is square planar because of the presence of two lone pairs.

Step 4: SF_6 has an octahedral shape as it has no lone pairs.

Quick Tip

VSEPR theory helps determine molecular shapes by considering the number of lone pairs and bond pairs around the central atom.

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 given by:

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

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

Step 3: The graph shows a linear decrease as $\frac{1}{T}$ increases.

Quick Tip

The Arrhenius plot is always a straight line with a negative slope, representing the temperature dependence of reaction rates.

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

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

- (1) -413.14 calories
- (2) 413.14 calories
- (3) 100 calories
- (4) 0 calorie

Correct Answer: (1)

Solution: Step 1: For an isothermal expansion, the work done is calculated using the formula:

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

Step 2: Substituting the given values into the equation:

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

Step 3: Simplifying the expression:

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

Quick Tip

For isothermal processes, use the formula $-nRT \ln \frac{V_2}{V_1}$ or $-nRT \ln \frac{P_2}{P_1}$, and remember to use the natural logarithm.

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

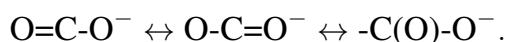
Correct Answer: (3)

Solution:

Step 1: BF_3 is planar and symmetric, resulting in a zero dipole moment.

Step 2: The dipole moment of NH_3 is greater than that of NF_3 because the bond dipoles and lone pair effects oppose each other in NF_3 .

Step 3: The carbonate ion (CO_3^{2-}) has three equivalent resonance structures:

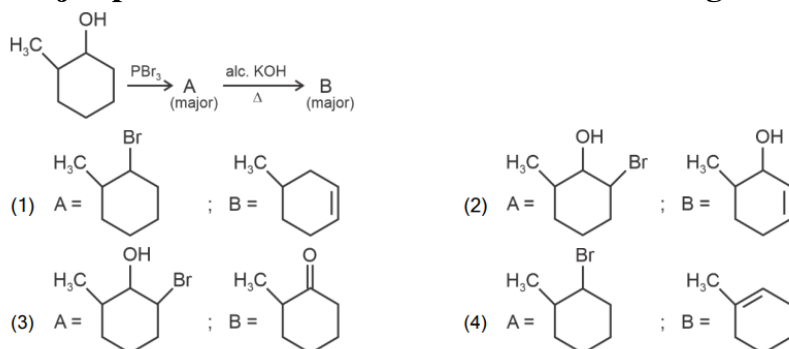


Step 4: Ozone (O_3) has two resonance structures.

Quick Tip

Resonance structures depict equivalent valid forms of a molecule. Count only those that follow valency rules and contribute to delocalization.

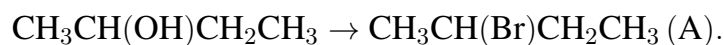
88. Major products A and B formed in the following reaction sequence are:



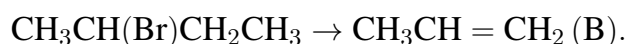
Correct Answer: (4)

Solution:

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



Step 2: In the second step, alcoholic KOH induces elimination of HBr, leading to alkene formation:



Quick Tip

In elimination reactions, alcoholic KOH facilitates dehydrohalogenation, leading to alkene formation.

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 completely paired $4f$ -orbitals.

Step 4: The other options include ions with unpaired electrons, making them paramagnetic.

Quick Tip

To determine if an ion is diamagnetic or paramagnetic, examine the electron configurations of lanthanoid ions for paired or unpaired electrons.

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: Determine the 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: Find the simplest whole number ratio by dividing each mole value by the smallest number.

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

Step 3: Write the empirical formula based on the ratio.

Empirical Formula: ABC_3 .

Quick Tip

To determine the empirical formula, convert mass to moles, divide by the smallest mole value, and express the result as 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 the elements' positions in the periodic table:

$B(Cu^{2+})$: 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 the ions in order of increasing group number:

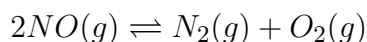
Order: $B < A < D < C < E$.

Quick Tip

Use periodic table trends and element positions to quickly determine their group numbers.

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

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



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

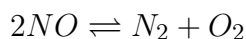
Correct Answer: (3) 0.717

Solution:

Let the degree of dissociation of NO be α .

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

At equilibrium, the dissociation of $2NO$ produces N_2 and O_2 according to the reaction:



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:

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

$$[\text{N}_2] = \alpha$$

$$[\text{O}_2] = \alpha$$

Using the equilibrium constant expression:

$$K_c = \frac{[\text{N}_2][\text{O}_2]}{[\text{NO}]^2}$$

Substituting the given values:

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

Solving the equation gives $\alpha = 0.717$.

Quick Tip

The degree of dissociation α is determined using equilibrium concentrations, the ICE table, and the 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:

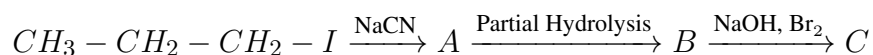
Step 1: Prevention of Hydrolysis in Fe^{2+} Solutions

Dilute H_2SO_4 is added to prevent both hydrolysis and oxidation of Fe^{2+} ions in aqueous solutions.

Quick Tip

Dilute H_2SO_4 is commonly used to stabilize Fe^{2+} ions, preventing their oxidation and hydrolysis in solution.

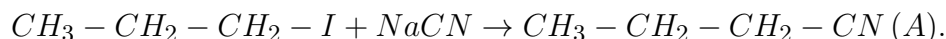
95. Identify the major product C formed in the following reaction sequence:



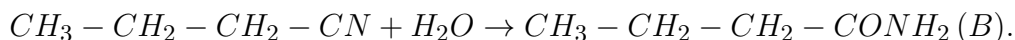
- (1) Butylamine
- (2) Butanamide
- (3) α -bromobutanoic acid
- (4) Propylamine

Correct Answer: (4)

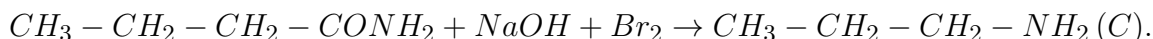
Solution: Step 1: Reaction with NaCN:



Step 2: Partial hydrolysis of the nitrile:



Step 3: Hofmann degradation:



Thus, the final product is propylamine.

Quick Tip

In Hofmann degradation, amides are converted to primary amines, with one fewer carbon atom than the original 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 g
- (2) 31.5 g
- (3) 0.0315 g
- (4) 3.15 g

Correct Answer: (1)

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

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

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

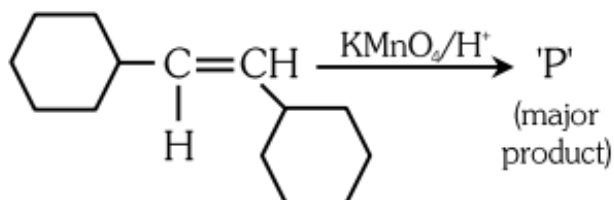
Step 2: Substituting values:

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

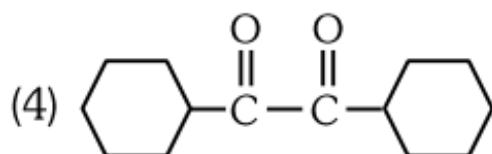
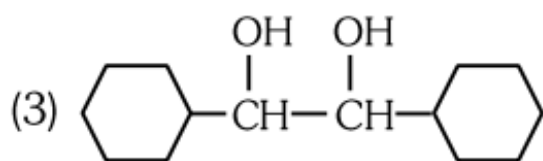
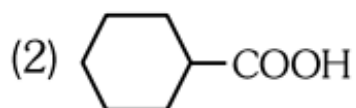
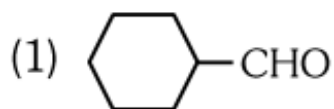
Quick Tip

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

97. For the given reaction:



'P' is



Correct Answer: (1)

Solution:

Step 1: The oxidation of alkenes with KMnO_4 under acidic conditions leads to the cleavage of the double bond, forming either carboxylic acids or ketones, depending on the substituents.

Step 2: In this reaction, the double bond in cyclohexene undergoes cleavage, resulting in the formation of cyclohexane carboxylic acid as the final product.

Quick Tip

For alkene oxidation with $KMnO_4/H^+$:

Terminal alkenes produce carboxylic acids.

Internal alkenes yield ketones or carboxylic acids, depending on the substituents.

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 consists of identical ligands, such as $[Co(NH_3)_6]^{3+}$, where only NH_3 is present.

Step 2: A heteroleptic complex contains different ligands, such as $[Co(NH_3)_4Cl_2]^+$, which includes both NH_3 and Cl^- .

Step 3: Both statements are correct.

Quick Tip

Homoleptic complexes have identical ligands, while heteroleptic complexes contain a mix. Check the ligands to determine the type.

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 $R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$)

- (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:



(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 yields H_3PO_3 (phosphorous acid) as a by-product along with RCl .

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

Quick Tip

For reactions involving PCl_3 , expect H_3PO_3 as a by-product. For reactions with PCl_5 , $POCl_3$ is formed.

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 regulate growth and development. When applied in high concentrations, they cause abnormal growth in dicot plants, ultimately leading to their death. However, monocot plants, such as grasses, are less affected due to differences in structure and metabolism. This selective action allows gardeners to use auxin-based herbicides to eliminate dicot weeds without harming monocot grasses, keeping the lawn intact.

Quick Tip

Auxins selectively target dicot plants, causing their death while leaving monocots like grasses unharmed, making them effective for weed control in lawns.

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 belongs to a class of lipids that are crucial components of biological membranes. Phospholipids like lecithin possess both

hydrophilic and hydrophobic characteristics, making them vital for the structure of membranes. Lecithin is commonly found in cell membranes and various biological tissues.

Quick Tip

Lecithin is classified as a phospholipid because it contains both a phosphate group and a lipid molecule. This structure is essential for its function in cellular membrane formation.

103. Match List I with List II:

- (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 known as alleles (III).

Step 2: B refers to "a cross between the F1 progeny and a homozygous recessive parent," which is called a test cross (IV).

Step 3: C refers to "a cross between the F1 progeny and either parent," which is known as a back cross (I).

Step 4: D refers to "the number of chromosome sets in a plant," which is termed ploidy (II).

Quick Tip

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

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 *Vallisneria* flowers are not brightly colored and do not produce nectar; they are typically small and inconspicuous.

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

Step 3: C is correct; water-pollinated species often have specialized pollen grains designed to resist wetting, such as being hydrophobic.

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

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

Quick Tip

Water-pollinated plants often feature specialized pollen grains that either float on the water's surface or are protected from moisture, aiding in 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 maintaining and publishing the list of endangered species. This compilation, known as the IUCN Red List, classifies species based on their extinction risk and serves as a crucial resource for global conservation efforts.

Quick Tip

The IUCN Red List is a vital tool in conservation biology, raising awareness about endangered species and guiding conservation strategies.

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 containing a gene of interest is introduced into a foreign organism, it may integrate into the recipient's genome. This integration ensures that the new genetic material is inherited by subsequent generations. Alternatively, the DNA might replicate independently, but for long-term inheritance, its integration into the host's genetic material is crucial.

Quick Tip

For stable inheritance in gene transfer, integration into the genome is essential, which forms the basis of genetic engineering.

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

- A. Light
 - B. Chlorophyll
 - C. CO₂
 - 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 called the Calvin cycle, utilizes CO₂, ATP, and NADPH to synthesize glucose. These molecules drive the conversion of carbon dioxide into organic compounds. Light and chlorophyll are essential for the light-dependent reactions, but they are not directly required for the dark reaction.

Quick Tip

The dark reaction does not depend on light directly but relies on the ATP and NADPH produced during the light-dependent reactions.

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 appropriate term for the conservation method described is Biodiversity conservation, where endangered species are taken from their natural habitats and provided with specialized care. This is typically done in controlled environments such as zoos or botanical gardens to ensure their protection, facilitate research, and support breeding programs.

Quick Tip

Biodiversity conservation includes both in-situ (protecting species in their natural habitat) and ex-situ (conservation in controlled environments) methods.

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* encodes one such toxin.

Step 2: Statement II is false because although the Bt toxin is initially an inactive protoxin, it is activated by the alkaline pH of the insect gut, not acidic pH.

Quick Tip

The activation of Bt toxins occurs in the alkaline environment of the insect's gut, which enables the toxin 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 main regions:

Promoter – Initiates the transcription process.

Structural gene – Encodes the protein.

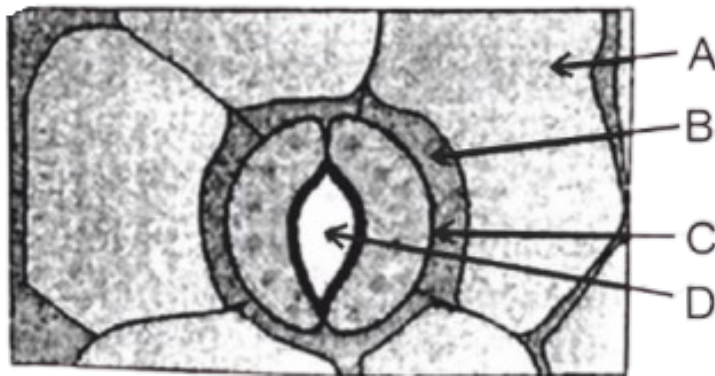
Terminator – Marks the end of transcription.

These components play a crucial role in gene expression in both prokaryotic and eukaryotic cells.

Quick Tip

A transcription unit is defined by the promoter, structural gene, and terminator, all of which regulate the transcription process.

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 epidermal cells in plant leaves and stems that regulate the opening and closing of stomata. These stomatal pores facilitate gas exchange (oxygen and carbon dioxide) and control water vapor loss.

The structure of guard cells plays a crucial role in this function. They possess thin outer walls and thickened inner walls, which are essential for stomatal movement.

Thin outer walls are more flexible, allowing the guard cells to expand outward when they absorb water and become turgid.

Thickened inner walls are rigid and restrict expansion, causing the guard cells to curve outward when turgid, opening the stomatal pore.

When water is lost, the inner walls' rigidity causes the cells to shrink, closing the stomata and reducing water loss.

This mechanism ensures a balance between water conservation and gas exchange, which is essential for photosynthesis and respiration.

Quick Tip

The differential wall thickness of guard cells (thin outer, thick inner) enables precise control over stomatal opening and closing, balancing gas exchange and water regulation.

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)

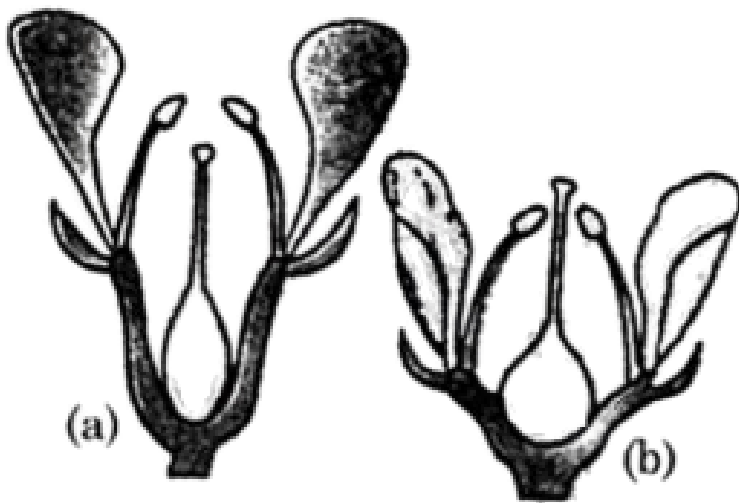
Solution:

Hind II is a restriction enzyme that cuts DNA at a specific recognition sequence, which is 6 base pairs (bp) long. Its recognition site is the palindromic sequence AAGCTT. This enzyme cleaves DNA precisely at this sequence, making it a valuable tool for DNA manipulation, including cloning, sequencing, and genetic analysis.

Quick Tip

Restriction enzymes like Hind II recognize specific palindromic sequences, typically 4-8 base pairs long, and are widely used in molecular biology research.

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 centrally positioned, while the stamens, petals, and sepals are arranged around it on the rim of the thalamus (receptacle). All floral parts are at the same level and appear to be attached to a common structure called the hypanthium.

This arrangement differs from hypogynous and epigynous flowers, where the gynoecium is positioned differently relative to the other floral parts. In perigynous flowers, the ovary remains superior, meaning it is situated above the point of attachment of the other floral structures.

Quick Tip

In perigynous flowers, the floral parts originate from the same level on the rim of the thalamus, surrounding the central gynoecium, with a superior ovary.

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 radially symmetrical flowers, can be divided into two equal halves along multiple planes. Datura is an example of an actinomorphic flower, as it displays radial symmetry in its structure.

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

Quick Tip

Actinomorphic flowers have radial symmetry, allowing them to be divided equally in multiple planes, while zygomorphic flowers exhibit symmetry 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 are primarily classified based on spore formation, fruiting body structure, and mycelial morphology.

The mode of nutrition is not a key criterion for classification because fungi are generally heterotrophic and absorb nutrients. Instead, their reproductive structures and growth patterns serve as the primary basis for classification.

Quick Tip

Fungal classification is primarily based on reproductive structures like spore formation and fruiting bodies, rather than their 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 masks the expression of the recessive allele in a heterozygous organism.

A is correct because one allele is dominant, while the other is recessive.

C is correct since Mendel's experiments confirmed that alleles exist in pairs in diploid organisms.

D is correct because Mendel referred to the hereditary units as "factors," now recognized as genes.

E is correct since, in a monohybrid cross, only the dominant trait appears in the F_1 generation.

Quick Tip

Mendel's Law of Dominance explains that in a heterozygous organism, the dominant allele is expressed, while the recessive allele remains hidden.

118. Match List I with List II:

List I	List II
A. <i>Rhizopus</i>	Mushroom
B. <i>Ustilago</i>	Smut fungus
C. <i>Puccinia</i>	Bread mould
D. <i>Agaricus</i>	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 type of smut fungus (II).

C. *Puccinia* is classified as a rust fungus (IV).

D. *Agaricus* refers to a type of mushroom (I).

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

Quick Tip

Fungal classification is often based on the mode of reproduction and the structure of the fruiting bodies. Smut and rust fungi are parasitic, whereas 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 acts as a competitive inhibitor of the enzyme succinic dehydrogenase by competing with the substrate succinate for the active site of the enzyme.

In competitive inhibition, the inhibitor has a similar structure to the substrate and binds to the enzyme's active site, preventing the substrate from attaching and thus blocking the enzymatic reaction.

Quick Tip

In competitive inhibition, an inhibitor competes with the substrate for the enzyme's active site, preventing normal enzyme activity.

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 in which mature, specialized cells lose their specific functions and revert to a more meristematic state, allowing them to divide and generate new tissues.

In this case, parenchyma cells in the vascular bundle region undergo dedifferentiation to form the interfascicular cambium, which plays a crucial role in secondary growth in plants.

Quick Tip

Dedifferentiation enables mature cells to return to a less specialized state, allowing them to contribute to 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 the principle of incomplete dominance, where neither allele is completely dominant over the other. The red allele (R) and the pink allele (R') both influence the flower color.

When a pink-flowered plant (R'R') is crossed with a red-flowered plant (RR), the F progeny inherit one red allele (R) from the red parent and one pink allele (R') from the pink parent.

This results in a mix of red-flowered (RR) and pink-flowered (R'R) plants in the progeny.

Red-flowered plants occur when both red alleles (RR) are inherited, while pink flowers result from inheriting one red allele (R) and one pink allele (R').

Quick Tip

In incomplete dominance, the heterozygous condition results in a blended phenotype. In Snapdragons, red and white alleles mix, leading to pink flowers in the F 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 find 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. <i>Clostridium butylicum</i>	I. Ethanol
B. <i>Saccharomyces cerevisiae</i>	II. Streptokinase
C. <i>Trichoderma polysporum</i>	III. Butyric acid
D. <i>Streptococcus</i> 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 CO₂ fixed in the Calvin cycle?

(1) 2 molecules of ATP and 2 molecules of NADPH

(2) 3 molecules of ATP and 3 molecules of NADPH

(3) 3 molecules of ATP and 2 molecules of NADPH

(4) 2 molecules of ATP and 3 molecules of NADPH

Correct Answer: (3)

Solution:

In the Calvin cycle, each molecule of CO₂ fixed requires 3 ATP and 2 NADPH to convert

3-phosphoglycerate (3-PGA) into G3P (Glyceraldehyde-3-phosphate).

- ATP supplies the necessary energy for phosphorylation. - NADPH acts as a reducing agent, providing electrons for the reduction steps.

Quick Tip

In the Calvin cycle, for every CO₂ molecule fixed, 3 ATP and 2 NADPH are required to drive the reactions leading to sugar formation.

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 is the capability of a single plant cell to develop into an entire new plant. This property is fundamental in plant tissue culture and micropropagation, where cells are stimulated to regenerate into a full plant.

Micropropagation is the process of cultivating plants from small tissues or cells, while somatic hybridization involves fusing somatic cells to produce hybrid plants.

Quick Tip

Totipotency allows plant cells to regenerate into a whole organism, making it a crucial process 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 stable and undisturbed for millions of years, providing ample time for species to evolve and diversify.

The consistent availability of solar energy in these regions ensures high rates of photosynthesis, which supports rich and diverse ecosystems.

Additionally, the predictable climate and stable environmental conditions in the tropics allow species to specialize in specific niches, further enhancing biodiversity. Unlike temperate zones, the tropics experience less seasonal variation, creating a stable environment for long-term species survival.

Thus, the combination of these factors (A, C, D, and E) contributes to higher species richness in tropical regions.

Quick Tip

Tropical ecosystems have remained stable for millions of years, allowing for greater species diversification and higher biodiversity.

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. The nucleolus is responsible for the active synthesis of ribosomal RNA (III).

B. The centriole has a structure resembling a cartwheel (II).

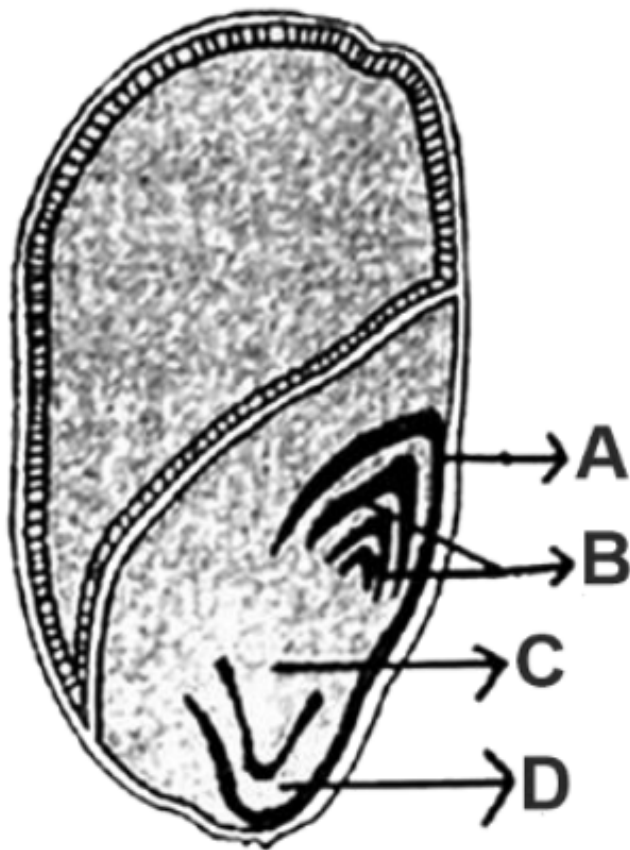
C. Leucoplasts are involved in the storage of nutrients (IV).

D. The Golgi apparatus is where glycolipids are synthesized (I).

Quick Tip

The nucleolus is where ribosomal RNA is produced, while the Golgi apparatus plays a role 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:

In metaphase of mitosis, chromosomes align along the metaphase plate at the center of the cell.

Spindle fibers, composed of microtubules, attach to the kinetochores located at the centromere of each chromosome. This attachment ensures the accurate separation of chromatids during anaphase.

Quick Tip

Kinetochores are specialized protein complexes where spindle fibers attach, facilitating the proper segregation of chromosomes during cell division.

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 start to condense and can be seen under a light microscope.

In the diplotene stage, a later phase of prophase I, the synaptonemal complex (a protein structure that facilitates the alignment of homologous chromosomes) breaks down, marking the onset of this phase.

Quick Tip

In leptotene, chromosomes become visible, while in diplotene, the synaptonemal complex breaks down.

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 is responsible for metabolic activities, while collenchyma provides structural support, particularly in young and growing plant parts.

Statement II is correct because gymnosperms (such as conifers) lack xylem vessels, which are a defining feature of angiosperms (flowering plants). Instead, gymnosperms transport water through tracheids, which serve as their primary conducting elements.

Quick Tip

Parenchyma and collenchyma are both living tissues, while gymnosperms transport water using tracheids instead of 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 a component of the lactose operon system, which also includes:

Beta-galactosidase, responsible for breaking down lactose inside the cell.

Transacetylase, involved in lactose metabolism.

In contrast, acetylase and polymerase participate in different metabolic pathways and are not directly involved in lactose transport.

Quick Tip

Permease plays a key role in the lac operon, enabling the uptake of lactose into bacterial cells for metabolism.

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:

Solution:

Bulliform cells are specialized epidermal cells found in monocot plants. They help conserve water by causing the leaf to curl inward during water stress, which reduces water loss through transpiration.

Quick Tip

Bulliform cells aid in water conservation by triggering leaf curling when the plant is under stress.

135. The cofactor of the enzyme carboxypeptidase is:

- (1) Niacin
- (2) Flavin
- (3) Haem
- (4) Zinc

Correct Answer: (4)

Solution:

Zinc serves as a cofactor for the enzyme carboxypeptidase, which catalyzes the hydrolysis of peptide bonds at the carboxyl terminal of proteins.

Zinc ions aid enzyme function by interacting with the substrate, enhancing the catalytic process.

Quick Tip

Zinc is a crucial cofactor for various enzymes, including carboxypeptidase, which plays a role in protein degradation.

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, also known as brown algae, primarily reproduce asexually through biflagellate zoospores.

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

They store carbohydrates as mannitol and laminarin, and their main pigments include chlorophyll a, c, carotenoids, and xanthophylls.

The cell walls are composed of cellulose and are often covered with a gelatinous algin coating.

Quick Tip

Brown algae store carbohydrates as mannitol and laminarin, and their cell walls are coated 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 outdoor 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 estimated the global species diversity to be around 7 million species.

Alexander von Humboldt is recognized for his work on the species-area relationship.

Paul Ehrlich proposed the Rivet Popper Hypothesis, which explains the role of species in ecosystem stability.

David Tilman conducted long-term ecosystem experiments to study the relationship between biodiversity and ecosystem function.

Quick Tip

The Rivet Popper Hypothesis states that each species plays a critical role in maintaining ecosystem stability, similar to rivets holding an airplane together.

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, resulting in photorespiration and a decrease in CO₂ fixation.

In C₄ plants, mesophyll cells exhibit low photorespiration, but bundle sheath cells still experience some degree of photorespiration, which contradicts the second statement.

Quick Tip

C₄ plants reduce photorespiration through the spatial separation of carbon fixation and the 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 possess their own circular, double-stranded DNA, resembling the DNA found in prokaryotic cells.

This chloroplast DNA encodes certain proteins essential for photosynthesis and other cellular functions.

Quick Tip

Chloroplast DNA is circular, double-stranded, and primarily maternally inherited in most plant species.

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⁻² yr⁻¹

Correct Answer: (2)

Solution:

The Gross Primary Productivity (GPP) at higher trophic levels (such as the third trophic level) is significantly lower than at the first trophic level due to energy loss between trophic transfers.

Following the 10% energy transfer rule, the GPP at the third trophic level would be approximately 10x kcal m⁻² yr⁻¹.

Quick Tip

Energy decreases at each trophic level due to inefficient energy transfer, with only 10% of energy passed on to the next level.

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 is the process of fusing protoplasts (cells that lack a cell wall) from two distinct plant varieties.

This method is employed to produce hybrid plants with specific desired traits.

Quick Tip

Protoplast fusion is an essential technique in plant genetic engineering for producing 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 FADH₂.

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 FADH₂ 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

- A. Frederick Griffith
- B. Francois Jacob & Jacques Monod
- C. Har Gobind Khorana
- D. Meselson & Stahl

List II

- I. Genetic code
- II. Semi-conservative mode of DNA replication
- III. Transformation
- 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, the process by which bacteria incorporate foreign DNA.

Jacob and Monod developed the *Lac* operon model, explaining gene regulation in

prokaryotes.

Har Gobind Khorana contributed to deciphering the genetic code and its role in protein synthesis.

Meselson and Stahl provided experimental proof for the semi-conservative model of DNA replication using isotopic labeling.

Quick Tip

Griffith's experiment with *Streptococcus pneumoniae* demonstrated bacterial transformation, a key discovery in molecular biology.

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 illustrates a wind-pollinated plant characterized by a compact inflorescence and well-exposed stamens.

- 1. **Compact Inflorescence:** A dense cluster of flowers increases the likelihood of pollen dispersal by wind, maximizing exposure to air currents.
- 2. **Well-exposed Stamens:** The male reproductive structures are positioned for efficient pollen release into the wind.
- 3. **Autogamy and Exposure:** While autogamy refers to self-pollination, the exposed stamens in wind-pollinated plants enhance cross-pollination, reducing self-fertilization and increasing

genetic diversity.

Quick Tip

Wind-pollinated plants have exposed stamens, lightweight pollen, and compact inflorescences to enhance efficient cross-pollination.

146. Match List I with List II:

List-I

- A. GLUT-4
- B. Insulin
- C. Trypsin
- D. Collagen

List-II

- I. Hormone
- II. Enzyme
- III. Intercellular ground substance
- 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 that helps facilitate the uptake of glucose into muscle and adipose tissue cells.

Insulin is a hormone produced by the pancreas that regulates blood glucose levels.

Trypsin is an enzyme responsible for protein digestion in the small intestine.

Collagen is a structural protein found in the intercellular matrix, providing support to tissues.

Quick Tip

GLUT-4 plays a key role in insulin-mediated glucose uptake, which is essential for 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 occurs through substrate-level phosphorylation, rather than oxidation.

This step leads to the formation of ATP or GTP, depending on the organism, distinguishing it from other reactions in the cycle that involve oxidation.

Quick Tip

Substrate-level phosphorylation produces ATP directly, without relying on the 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) Absciscic acid
- (4) Auxin

Correct Answer: (1) Gibberellin

Solution:

Gibberellins are plant hormones that stimulate stem elongation and promote overall plant growth.

When applied to sugarcane, gibberellins enhance stem length, leading to a higher yield.

Other plant growth regulators include:

Cytokinins, which promote cell division.

Auxins, which influence root growth.

Abscisic acid, which is primarily involved in stress responses.

Quick Tip

Gibberellins are extensively used in agriculture to enhance stem growth and improve crop yield.

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 exhibits twisted aestivation, where petals overlap in a spiral pattern.

Pea has a perigynous flower arrangement, with the ovary centrally positioned and surrounded by other floral parts.

Cotton shows marginal placentation, where ovules are attached along the edges of the ovary.

Mango is classified as a drupe fruit, characterized by a hard endocarp encasing the seed.

Quick Tip

Twisted aestivation is a characteristic feature of roses, while marginal placentation is commonly found 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, $5' \rightarrow 3'$.
- (2) The DNA-dependent DNA polymerase catalyzes polymerization in both $5' \rightarrow 3'$ and $3' \rightarrow 5'$ directions.
- (3) The DNA-dependent DNA polymerase catalyzes polymerization in the $5' \rightarrow 3'$ direction.
- (4) The DNA-dependent DNA polymerase catalyzes polymerization in one direction, $3' \rightarrow 5'$.

Correct Answer: (3) The DNA-dependent DNA polymerase catalyzes polymerization in the $5' \rightarrow 3'$ direction.

Solution:

In E. coli, DNA replication is carried out by DNA-dependent DNA polymerase, which synthesizes new DNA in the $5' \rightarrow 3'$ direction.

The template strand is read in the opposite $3' \rightarrow 5'$ direction. RNA polymerase is responsible for transcription, but it does not play a role in DNA synthesis.

Quick Tip

DNA polymerase synthesizes the DNA strand in the $5' \rightarrow 3'$ direction, while reading the template strand in the $3' \rightarrow 5'$ 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:

Pons (A) connects different regions of the brain (III).

Hypothalamus (B) contains neurosecretory cells (IV) responsible for hormone regulation.

Medulla (C) regulates respiration and gastric secretions (II).

Cerebellum (D) helps maintain posture and balance (I) while providing additional space for neurons.

Quick Tip

The brainstem, which includes the Pons and Medulla, controls essential functions such as 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 is composed of three main parts: Isthmus, Infundibulum, and Ampulla.

The Uterine fundus is a part of the uterus, not the Fallopian tube.

Quick Tip

The Uterine fundus refers to the upper portion of the uterus, whereas the Fallopian tube consists of the Isthmus, Infundibulum, and Ampulla.

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:

Ti plasmid stands for Tumor-Inducing Plasmid.

It enables *Agrobacterium tumefaciens* to cause crown gall disease in plants.

Quick Tip

Ti plasmids are widely used in genetic engineering to transfer 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 represents the maximum volume of air that can be exhaled after taking a deep breath.

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) hydrolyzes the ester bond in lipids (II).

Nuclease (B) breaks the phosphodiester bond in nucleic acids (IV).

Protease (C) cleaves peptide bonds in proteins (I).

Amylase (D) acts on the glycosidic bond in carbohydrates (III).

Quick Tip

Each enzyme specifically targets a particular type of bond based on the molecule it helps break down.

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 order of human evolution from earliest to most recent is:

Homo habilis (A), Homo erectus (D), Homo neanderthalensis (C), and finally Homo sapiens (B).

Quick Tip

Homo habilis, known as the "handy man," is one of the earliest members of the genus Homo, recognized 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 autoimmune disorders in which the immune system mistakenly attacks the body's own tissues.

Gout and muscular dystrophy, however, are not considered autoimmune disorders.

Quick Tip

Autoimmune diseases arise when the immune system wrongly identifies the body's own tissues as foreign or 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:

The common cold is caused by rhinoviruses (III).

Haemozoin is a byproduct of Plasmodium (I), the parasite responsible for malaria.

The Widal test is used for diagnosing typhoid (II).

Allergies are often triggered by dust mites (IV).

Quick Tip

The Widal test identifies antibodies against *Salmonella typhi*, helping diagnose typhoid fever.

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:

The axoneme is a component of cilia and flagella (II).

The cartwheel pattern is characteristic of the centriole (I).

The crista is found in the mitochondria (IV).

The satellite is associated with chromosomes (III).

Quick Tip

The axoneme is a structural element of cilia and flagella, essential 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 species of Ctenophora (II).

The radula is found in Mollusca (I).

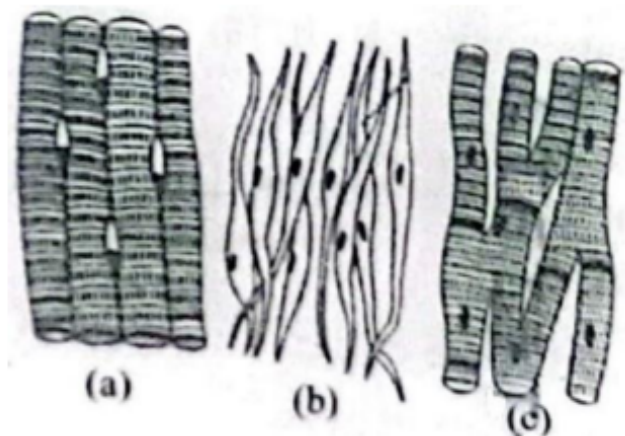
The stomochord is present in Hemichordata (IV).

The air bladder is a feature of Osteichthyes (III).

Quick Tip

The radula is a feeding structure 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) represents skeletal muscles, such as the biceps and triceps, which are attached to bones and control voluntary movements.

Figure (b) illustrates smooth muscles, which are non-striated, involuntary, and found in internal organs like the stomach wall.

Figure (c) depicts cardiac muscles, which are striated, involuntary, and exclusively 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 is characterized by the completion of terminalization of chiasmata (II).

Pachytene is identified by the presence of recombination nodules, where crossing over occurs (IV).

Zygotene involves the formation of the synaptonemal complex, facilitating chromosome

pairing (I).

Leptotene is marked by chromosomes appearing as thin thread-like structures (III).

Quick Tip

Diakinesis is the final stage of prophase I, where crossing over is complete, and chromosomes are prepared for metaphase.

164. Match List I with List II:

	List I		List II
A.	Down's syndrome	I.	11 th chromosome
B.	α -Thalassemia	II.	'X' chromosome
C.	β -Thalassemia	III.	21 st chromosome
D.	Klinefelter's syndrome	IV.	16 th chromosome

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

Down's syndrome is caused by trisomy of chromosome 21 (III).

α -Thalassemia is linked to chromosome 16 (IV).

β -Thalassemia is associated with chromosome 11 (I).

Klinefelter's syndrome results from the 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 mainly designed for large-scale cultivation of microorganisms or cells, rather than small-scale cultures.

They are equipped with agitators, oxygen delivery systems, and foam control mechanisms to ensure optimal growth conditions.

Quick Tip

Bio-reactors are crucial in industrial biotechnology for the mass production of products such as vaccines, enzymes, and antibiotics.

166. Match List I with List II:

List I

List II

- | | |
|-----------------|-----------------|
| A. Pterophyllum | I. Hagfish |
| B. Myxine | II. Sawfish |
| C. Pristis | III. Angelfish |
| 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).

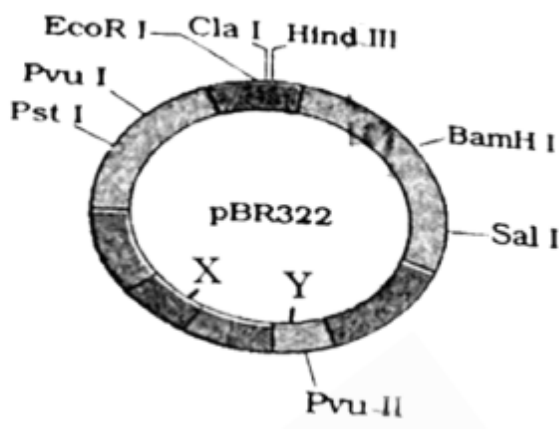
Exocoetus is known as the Flying fish (IV).

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 because 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 because 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 possess a body cavity fully 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 groups listed, 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 incorrect. The descending limb of the loop of Henle is permeable to water but impermeable to electrolytes.

Statement II is incorrect. The proximal convoluted tubule is lined with simple cuboidal epithelium featuring a brush border, not columnar epithelium.

Quick Tip

The descending limb of the loop of Henle absorbs water, while the ascending limb is responsible for electrolyte absorption.

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 order of stages in cell division is as follows:

- E. Gap 1 phase (the first phase where the cell grows).
- C. Synthesis phase (DNA replication takes place).
- A. Gap 2 phase (preparation for cell division).
- D. Karyokinesis (nuclear division).
- B. Cytokinesis (cytoplasmic division).

Quick Tip

Karyokinesis refers to the division of the nucleus, while cytokinesis is 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 located on the 10th abdominal segment. These structures function as sensory organs, enabling the cockroach to detect air currents and environmental changes.

Quick Tip

Anal cerci serve as sensory structures, allowing cockroaches to sense movements and vibrations 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. Being lipophilic, they can easily cross cell membranes and interact with intracellular receptors.

Glucagon, on the other hand, is a peptide hormone, not a steroid. It is synthesized from amino acids and functions by binding to cell surface receptors to trigger a response.

Quick Tip

Steroid hormones originate from cholesterol, while peptide hormones like glucagon are composed of amino acids and act via cell surface receptors.

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:

its 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.

so correct sequence is E-C-A-D-B

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, ensuring it is complementary to the DNA template strand.

For the given DNA template strand:

3'TACATGGCAAATATCCATTCA5'

The corresponding RNA strand is:

5'AUGUACCGUUUAUAGGUAAGU3'

Quick Tip

During RNA synthesis, thymine (T) in DNA is replaced by 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 obtained from the Erythroxylum plant. (III)

Heroin is synthesized from morphine, which is derived from the opium poppy (Papaver somniferum). (IV)

Morphine is commonly used as an effective sedative during surgery. (I)

Marijuana is derived from *Cannabis sativa*. (II)

Quick Tip

Heroin and morphine are opiate derivatives, while cocaine and marijuana come from different plant species.

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 type of bacterium.

B. Leishmaniasis is caused by **Leishmania**, a protozoan parasite.

C. Ringworm is a fungal infection caused by various species of fungi.

D. Filariasis is caused by **Wuchereria bancrofti**, a nematode (roundworm).

Quick Tip

Typhoid is bacterial, Leishmaniasis is caused by a protozoan, 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: A deficiency leads to emphysema (III).

B. Cry IAb: Used to treat ADA deficiency (IV).

C. Cry IAc: A toxin effective against the cotton bollworm (I).

D. Enzyme replacement therapy: A toxin effective against the corn borer (II).

Quick Tip

Enzyme replacement therapy is used to manage 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 crucial for infant growth, as it supplies essential nutrients and immune protection.

Colostrum, the first milk, is packed with antibodies that help protect the baby from infections.

Quick Tip

Colostrum is high in immunoglobulins, particularly IgA, which shields 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 occurring when the 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: Present as goblet cells in the alimentary canal (III).

B. Compound epithelium: Found on the moist surface of the buccal cavity (IV).

C. Multicellular glandular epithelium: Located in glands such as the salivary glands (I).

D. Endocrine glandular epithelium: Found in glands like the pancreas, which secrete hormones (II).

Quick Tip

Unicellular goblet cells produce 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.

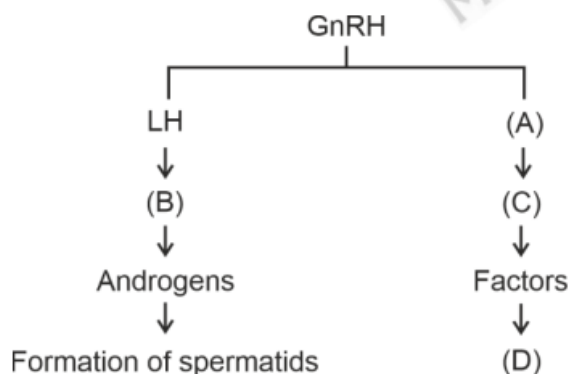
Juxtamedullary nephrons are fewer in number compared to cortical nephrons.

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. The P wave represents atrial depolarization (I).

B. The QRS complex represents ventricular depolarization (II).

C. The T wave represents ventricular repolarization (III).

D. The T-P gap indicates the electrically silent phase of the heart (IV).

Quick Tip

The P wave, QRS complex, and T wave reflect the electrical activity in the heart as observed 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 is correct because Bone marrow is the primary lymphoid organ where blood cells, including lymphocytes, are produced.

Statement II is correct because 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 incorrect because Gause's principle applies to species competing for the **same resources**, not different resources.

Statement II is correct because the inferior species is likely to be eliminated during competition if resources are limited.

Thus, Statement I is incorrect, and Statement II is correct, 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 & hyperglycemia.
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:

Exophthalmic goiter (A): Caused by excess thyroid hormone, leading to protruding eyeballs (III).

Acromegaly (B): Results from excess growth hormone secretion, leading to abnormal bone

growth (IV).

Cushing's syndrome (C): Caused by excess cortisol secretion, characterized by moon face and hyperglycemia (I).

Cretinism (D): Due to thyroid hormone deficiency, causing stunted growth and developmental issues (II).

Thus, the correct match is:

$$A - III, B - IV, C - I, D - II.$$

Quick Tip

Endocrine disorders such as acromegaly and Cushing's syndrome result from hormonal imbalances, while cretinism is caused by thyroid hormone deficiency during early development.

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 $I_B I_B$ (homozygous) or $I_B i$ (heterozygous).

The mother's blood group is A+, which means her genotype can be $I_A I_A$ or $I_A i$.

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: $I_B i$ (father) and $I_A i$ (mother).

Thus, the correct answer is Option (4): $I_B i$, $I_A i$, and ii .

Quick Tip

The O blood group (genotype ii) requires both parents to carry the recessive i allele.

195. Match List I with List II:

List I	List II
A. RNA polymerase III	I. snRNPs
B. Termination of transcription	II. Promoter
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, making the correct match (IV).

Termination of transcription in prokaryotes is facilitated by the Rho factor, corresponding to (III).

Splicing of exons is carried out by snRNPs (small nuclear ribonucleoproteins), matching with (I).

The TATA box is a promoter sequence recognized during transcription initiation, making the correct match (II).

Thus, the correct match is:

$$A - IV, B - III, C - I, D - II.$$

Quick Tip

The TATA box is a crucial promoter sequence that helps in initiating transcription by RNA polymerase II.

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."

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.

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.

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 true because Both mitochondria and chloroplasts are double-membrane bound organelles.

Statement II is false because 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.

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 false: Non-chordates generally do not have a pharynx perforated by gill slits, which is a feature of chordates.

Statement B is true: Non-chordates lack a notochord.

Statement C is false: Non-chordates typically have a ventral nervous system, not dorsal.

Statement D is true: If a heart is present in non-chordates, it is typically dorsal.

Statement E is true: A post-anal tail is generally absent in non-chordates.

So, 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.