

## NEET UG 2024 Q4 Question Paper with Solutions

<b>Time Allowed</b> :200 minutes	<b>Maximum Marks</b> :720	<b>Total questions</b> :200
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### General Instructions

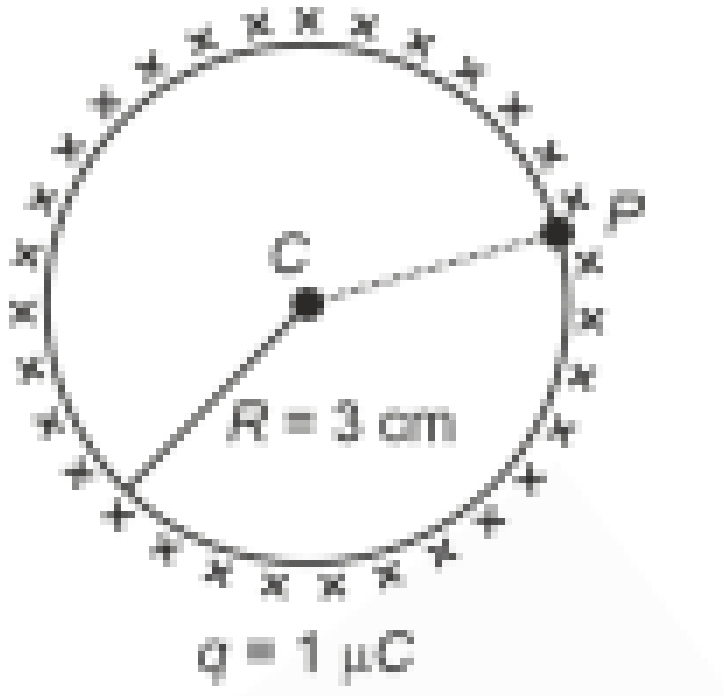
**Read the following instructions very carefully and strictly follow them:**

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 thin spherical shell is charged by some source. The potential difference between the two points  $C$  and  $P$  (in V) shown in the figure is: (Take  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$  SI units)



- (1)  $3 \times 10^5$
- (2)  $1 \times 10^5$
- (3)  $0.5 \times 10^5$
- (4) Zero

**Correct Answer:** (4) Zero

**Solution: Step 1: Understanding the potential inside a charged spherical shell.** In electrostatics, it is known that the electric potential inside a conducting spherical shell remains constant and equals the potential at the surface.

**Step 2: Applying the principle.** Since both points  $C$  and  $P$  are positioned inside the shell, the potential at these points must be the same:

$$V_C = V_P$$

Therefore, the potential difference is:

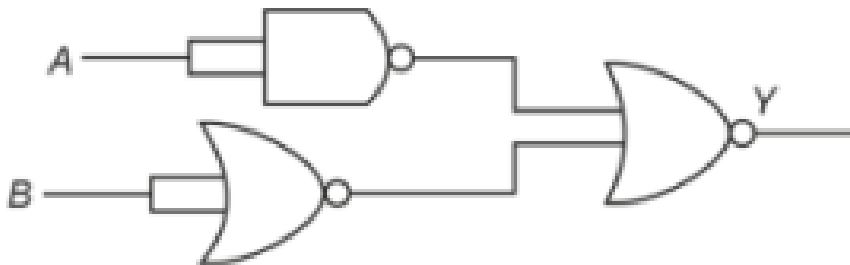
$$V_C - V_P = 0$$

**Conclusion:** The potential difference between the points is zero, so the correct answer is option (4).

#### Quick Tip

The potential inside a charged spherical shell remains constant, making the potential difference between any two internal points zero.

2. The output  $Y$  of the given logic gate is similar to the output of a/an:



- (1) NAND gate
- (2) NOR gate
- (3) OR gate
- (4) AND gate

**Correct Answer:** (4) AND gate

**Solution: Step 1: Analyzing the circuit.** The given logic gate arrangement is a combination of NAND and OR gates that ultimately mimic the behavior of an AND gate.

**Step 2: Verification of logic.** Upon analyzing the functioning of the circuit, we find that the final output behaves exactly like an AND gate.

**Conclusion:** Thus, the correct answer is (4), which is an AND gate.

#### Quick Tip

Breaking down complex logic circuits step by step can simplify the analysis and help identify the equivalent logic gate.

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

- (1) Interference pattern will disappear
- (2) There will be a central dark fringe surrounded by a few colored fringes
- (3) There will be a central bright white fringe surrounded by a few colored fringes
- (4) All bright fringes will be of equal width

**Correct Answer:** (3) There will be a central bright white fringe surrounded by a few colored fringes

**Solution: Step 1: Effect of white light on interference patterns.** With a monochromatic light source, the interference fringes are uniform in color. However, white light consists of various wavelengths, leading to a mix of different colored fringes.

**Step 2: Resulting pattern.** At the center, all the wavelengths combine constructively, producing a white fringe. As we move away from the center, different wavelengths will form colored fringes due to different interference patterns.

**Conclusion:** Thus, the correct answer is (3), a central bright white fringe surrounded by colored fringes.

**Quick Tip**

In interference with white light, the central fringe is white, while surrounding fringes show colors due to different wavelengths.

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**4. In a vernier caliper,  $(N + 1)$  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:**

- (1)  $\frac{1}{10N}$
- (2)  $\frac{1}{100(N+1)}$
- (3)  $100N$
- (4)  $10(N + 1)$

**Correct Answer:** (2)  $\frac{1}{100(N+1)}$

**Solution: Step 1: Formula for Vernier constant.** The vernier constant (VC) is the

difference between one MSD (main scale division) and one VSD (vernier scale division). We know that  $(N + 1)$  VSDs equal  $N$  MSDs, and we can express this as:

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

**Step 2: Calculating the VC.** The VC is:

$$VC = 0.1 - \frac{N}{N + 1} \times 0.1 = \frac{0.1}{N + 1}$$

Converting to cm:

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

**Conclusion:** Thus, the correct answer is (2).

#### Quick Tip

For calculating the vernier constant, use the formula  $VC = 1 \text{ MSD} - 1 \text{ VSD}$  and perform unit conversions carefully.

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

- (1) 4 mm
- (2) 0.4 mm
- (3) 40 mm
- (4) 8 mm

**Correct Answer:** (1) 4 mm

**Solution: Step 1: Apply the formula for elongation.** The elongation is calculated by:

$$\Delta L = \frac{FL}{AY}$$

Using the given values, the elongation is:

$$\Delta L = \frac{8 \times 10^8 \times 1}{2 \times 10^{11}} = 4 \times 10^{-3} \text{ m} = 4 \text{ mm}$$

**Conclusion:** The maximum elongation is 4 mm.

#### Quick Tip

For elongation problems, remember to use the correct formula and ensure all units are consistent.

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**6. The moment of inertia of a thin rod about an axis passing through its mid point and perpendicular to the rod is  $2400 \text{ g cm}^2$ . The length of the 400 g rod is nearly:**

- (1) 8.5 cm
- (2) 17.5 cm
- (3) 20.7 cm
- (4) 72.0 cm

**Correct Answer:** (1) 8.5 cm

**Solution: Step 1: Formula for moment of inertia of a thin rod.** The formula for the moment of inertia of a thin rod with mass  $M$  and length  $L$  about an axis perpendicular to the rod and passing through its center is:

$$I = \frac{ml^2}{12}$$

**Step 2: Substituting the values.** Using the given mass  $m = 400 \text{ g}$  and moment of inertia  $I = 2400 \text{ g} \cdot \text{cm}^2$ :

$$2400 = \frac{400l^2}{12}$$

Simplifying this equation:

$$72 = l^2$$

Solving for  $l$ :

$$l = \sqrt{72} = 8.48 \text{ cm} \approx 8.5 \text{ cm}$$

**Conclusion:** Thus, the length of the rod is approximately 8.5 cm.

#### Quick Tip

To calculate the moment of inertia of a thin rod, use the formula  $I = \frac{ml^2}{12}$ , and ensure correct unit conversions.

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**7. A tightly wound 100-turn coil of radius 10 cm carries a current of 7 A. The magnetic field at the center of the coil is:**

(Take permeability of free space as  $4\pi * 10^{-7}$  SI units)

- (1) 44 mT
- (2) 4.4 T

(3) 4.4 mT

(4) 44 T

**Correct Answer:** (3) 4.4 mT

**Solution: Step 1: Formula for the magnetic field of a coil.** The magnetic field at the center of a coil with  $N$  turns, radius  $R$ , and current  $I$  is given by:

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

**Step 2: Substituting the values.** Given that  $\mu_0 = 4\pi \times 10^{-7}$ ,  $N = 100$ ,  $I = 7$  A, and  $R = 0.1$  m:

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

**Conclusion:** Thus, the magnetic field at the center of the coil is 4.4 mT.

#### Quick Tip

The magnetic field at the center of a coil depends on the number of turns, current, and the radius of the coil.

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**8. At any instant of time  $t$ , the displacement of any particle is given by  $2t-1$  (SI unit) under the influence of force of 5 N. The value of instantaneous power is (in SI unit):**

(1) 10

(2) 5

(3) 7

(4) 6

**Correct Answer:** (1) 10

**Solution: Step 1: Calculate the velocity.** The velocity of the particle is the derivative of displacement with respect to time:

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

**Step 2: Differentiate the given displacement equation.**

$$\frac{d}{dt}(2t - 1) = 2$$

So, the velocity is  $v = 2$  m/s.

**Step 3: Calculate the instantaneous power.** Power is given by the formula:

$$P = F \cdot v$$

Substituting the given force  $F = 5 \text{ N}$  and velocity  $v = 2 \text{ m/s}$ :

$$P = 5 \times 2 = 10 \text{ W}$$

**Conclusion:** Thus, the instantaneous power is 10 W.

#### Quick Tip

Power is calculated as the product of force and velocity:  $P = F \cdot v$ .

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**9. Two bodies A and B of same mass undergo completely inelastic one dimensional collision. The body A moves with velocity  $v_1$  while body B is at rest before collision.**

**The velocity of the system after collision is  $v_2$ . The ratio  $v_1 : v_2$  is**

(1) 1 : 2

(2) 2 : 1

(3) 4 : 1

(4) 1 : 4

**Correct Answer:** (2) 2 : 1

**Solution: By Conservation of Linear Momentum:**

$$\Rightarrow mv_1 = (m + m)v_2$$

Simplifying the equation:

$$\Rightarrow mv_1 = 2mv_2$$

Dividing both sides by  $m$ :

$$\Rightarrow v_1 = 2v_2$$

Therefore, the ratio of  $v_1$  to  $v_2$  is:

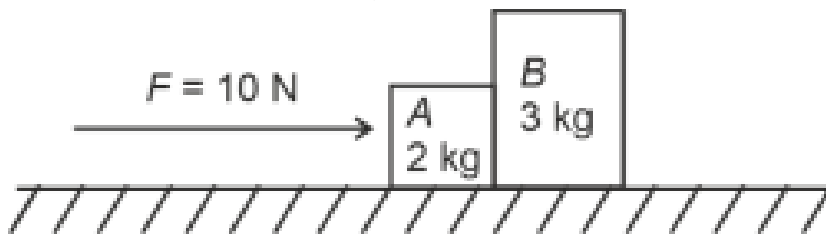
$$\Rightarrow \frac{v_1}{v_2} = 2 : 1$$

**Conclusion:** The correct answer is (2), 2:1.

**Quick Tip**

In completely inelastic collisions, momentum is conserved, but kinetic energy is not.

**10. A horizontal force 10 N is applied to a block A as shown in figure. 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 :**



- (1) 0
- (2) 4 N
- (3) 6 N
- (4) 10 N

**Correct Answer:** (3) 6 N

**Solution:** By Newton's II law.

$$F_{\text{net}} = ma$$

The system consists of two blocks, and we are given the following equations:

$$\text{For block A: } F - N = 2a \quad \text{or} \quad 10 - N = 2a \quad \dots \text{(i)}$$

$$\text{For block B: } N = 3a \quad \dots \text{(ii)}$$

To solve for acceleration  $a$  and the normal force  $N$ , substitute the value of  $N$  from equation (ii) into equation (i):

$$10 - 3a = 2a$$

Simplifying:

$$10 = 5a$$

Solving for  $a$ :

$$a = \frac{10}{5} = 2 \text{ m/s}^2$$

Now, substitute  $a = 2 \text{ m/s}^2$  into equation (ii) to find  $N$ :

$$N = 3a = 3 \times 2 = 6 \text{ N}$$

**Conclusion:** The force exerted by block A on block B is 6 N.

#### Quick Tip

Use  $F = ma$  to calculate acceleration and force in problems involving motion.

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**11. The mass of a planet is  $\frac{1}{10}$  that of the earth and its radius is  $\frac{1}{2}$  that of the earth. The acceleration due to gravity on the planet is:**

- (1)  $19.6 \text{ m/s}^2$
- (2)  $9.8 \text{ m/s}^2$
- (3)  $4.9 \text{ m/s}^2$
- (4)  $3.92 \text{ m/s}^2$

**Correct Answer:** (4)  $3.92 \text{ m/s}^2$

**Solution: Step 1: Formula for acceleration due to gravity.** The acceleration due to gravity is given by:

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

where  $M$  is the mass and  $R$  is the radius.

**Step 2: Compute for the planet.** Since  $M_p = \frac{1}{10}M_e$  and  $R_p = \frac{1}{2}R_e$ :

$$g_p = \frac{G \times \frac{1}{10}M_e}{\left(\frac{1}{2}R_e\right)^2}$$
$$g_p = \frac{(1/10)M_e}{(1/4)R_e^2} g_e$$

$$g_p = \frac{1}{10} \times 4g_e = \frac{4}{10}g_e = 0.4 \times 9.8 = 3.92 \text{ m/s}^2$$

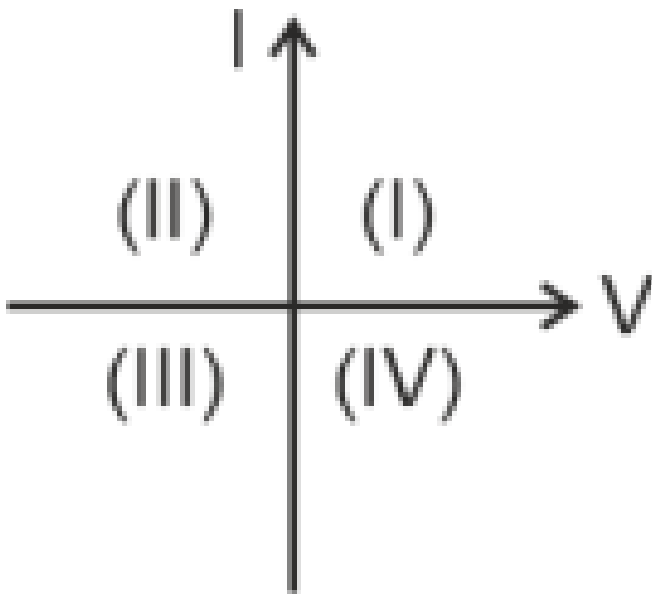
**Conclusion:** Thus, the correct answer is (4), 3.92 m/s<sup>2</sup>.

#### Quick Tip

The acceleration due to gravity is directly proportional to mass and inversely proportional to the square of the radius.

**12. Consider the following statements A and B and choose the correct option:**

- **A:** For a solar-cell, the I-V characteristics lies in the IV quadrant of the given graph.
- **B:** In a reverse biased pn junction diode, the current measured in  $\mu A$ , is due to majority charge carriers.



- (1) A is correct but B is incorrect.
- (2) A is incorrect but B is correct.
- (3) Both A and B are correct.
- (4) Both A and B are incorrect.

**Correct Answer:** (1) A is correct but B is incorrect.

**Solution: Step 1: Understanding diode behavior.** Diodes allow current to flow in one direction, making statement B incorrect.

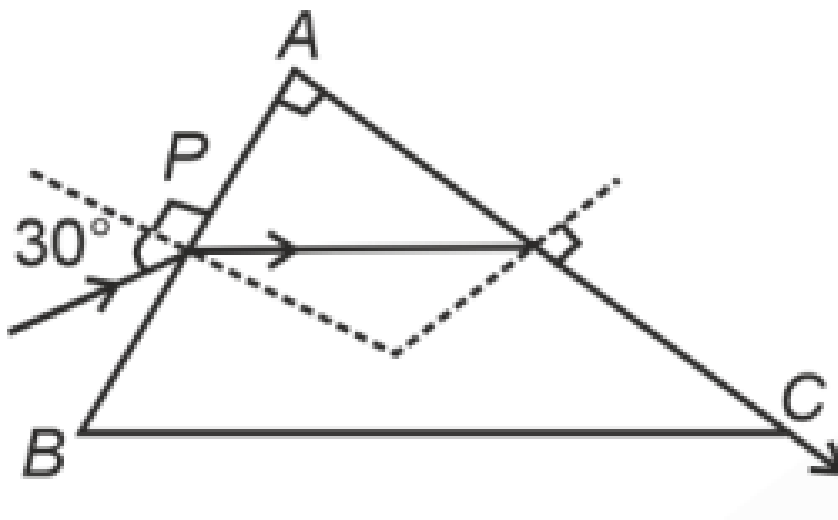
**Step 2: I-V characteristic of diodes.** The I-V curve of a diode is nonlinear due to threshold voltage, confirming statement A is correct.

**Conclusion:** Thus, the correct answer is (1).

**Quick Tip**

Diodes allow unidirectional current flow, and their I-V curve is nonlinear.

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



- (1)  $\frac{\sqrt{5}}{4}$
- (2)  $\frac{\sqrt{5}}{2}$
- (3)  $\frac{\sqrt{3}}{4}$
- (4)  $\frac{\sqrt{3}}{2}$

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

**Solution:** In a prism,  $r_1 + c = A$

$$r_1 = 90^\circ - c \quad \dots (1)$$

From Snell's law:

$$\sin c = \frac{1}{\mu} \quad \Rightarrow \quad \cos c = \sqrt{\frac{\mu^2 - 1}{\mu^2}}$$

Now, applying Snell's law on the incidence surface:

$$\sin 30^\circ = \mu \sin(r_1)$$

Substituting the values:

$$1 \times \frac{1}{2} = \mu \times \sin(90^\circ - c)$$

Since  $\sin(90^\circ - c) = \cos c$ :

$$\frac{1}{2} = \mu \times \cos c = \mu \times \sqrt{\frac{\mu^2 - 1}{\mu^2}}$$

Simplifying further:

$$\frac{1}{2} = \mu \times \sqrt{\frac{\mu^2 - 1}{\mu^2}}$$

On squaring both sides:

$$\frac{1}{4} = \mu^2 - 1$$

Solving for  $\mu^2$ :

$$\mu^2 = \frac{5}{4}$$

Finally, taking the square root:

$$\mu = \sqrt{\frac{5}{4}} = \frac{\sqrt{5}}{2}$$

**Conclusion:** Thus, the correct answer is (2).

#### Quick Tip

For prisms, use Snell's Law at interfaces and total internal reflection if necessary.

#### 14. Given below are two statements:

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

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

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

- (1) Both Statement I and Statement II are correct
- (2) Both Statement I and Statement II are incorrect
- (3) Statement I is correct but Statement II is incorrect
- (4) Statement I is incorrect but Statement II is correct

**Correct Answer:** (3) Statement I is correct but Statement II is incorrect

**Solution:**

### Step 1: Analyzing Statement I

Atoms consist of protons, neutrons, and electrons. Protons carry a positive charge, electrons carry a negative charge, and neutrons are neutral. The number of protons in an atom is equal to the number of electrons, ensuring electrical neutrality.

Mathematically, for a neutral atom:

$$\begin{aligned}\text{Total charge} &= (\text{Number of protons} \times \text{Charge of proton}) + (\text{Number of electrons} \times \text{Charge of electron}) \\ &= (Z \times +e) + (Z \times -e) = 0\end{aligned}$$

where  $Z$  is the atomic number. Since this equation holds true for all neutral atoms, Statement I is correct.

### Step 2: Analyzing Statement II

While atoms of each element emit a characteristic spectrum, they are not necessarily stable. Many atoms exist in excited states or as isotopes with unstable nuclei (e.g., radioactive elements). Stability depends on nuclear configuration and electron arrangements.

For example: - Hydrogen emits a characteristic spectrum, but isotopes like tritium ( ${}^3\text{H}$ ) are radioactive. - Heavy elements like uranium undergo radioactive decay, making them unstable.

Thus, while characteristic spectra are unique to each element, stability is not guaranteed.

Statement II is incorrect.

**Conclusion:** Since Statement I is correct and Statement II is incorrect, the correct answer is (3).

### Quick Tip

Neutral atoms have an equal number of protons and electrons, ensuring no net charge. However, atomic stability depends on nuclear and electronic configurations.

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

- (1) 19.8 mN
- (2) 198 N
- (3) 1.98 mN
- (4) 99 N

**Correct Answer:** (1) 19.8 mN

**Solution:**

**Given:**

- Surface Tension,  $T = 0.07 \text{ N/m}$
- Radius of the Disc,  $R = 4.5 \text{ cm} = 0.045 \text{ m}$

The excess force due to surface tension is given by the formula:

$$F = T \times 2\pi R$$

Substituting the values:

$$F = 0.07 \times 2 \times 3.14 \times 0.045$$

Simplifying the calculation:

$$F = 0.07 \times 6.28 \times 0.045$$

$$F = 197.82 \times 10^{-4}$$

Thus, the force is:

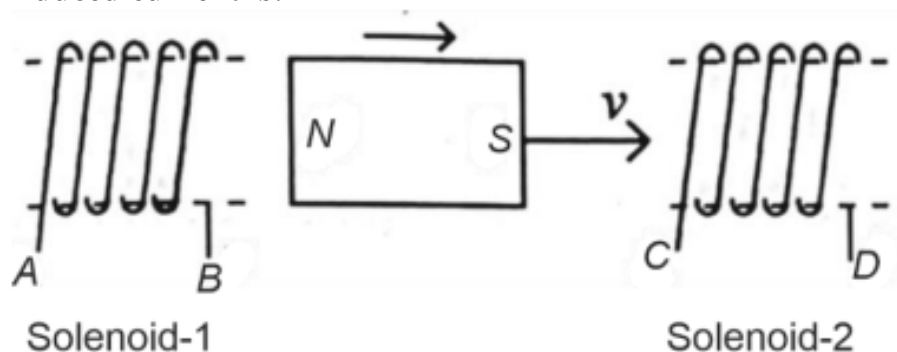
$$F = 19.8 \text{ mN}$$

**The correct option is 1.**

### Quick Tip

Surface tension force is proportional to the circumference in detachment problems.

16. In the given diagram, a strong bar magnet is moved through a loop. The direction of induced current is:



- (1) AB and DC
- (2) BA and CD
- (3) AB and CD
- (4) BA and DC

**Correct Answer:** (1) AB and DC

**Solution: Step 1: Apply Lenz's Law.**

Lenz's Law states that the direction of induced current in a loop opposes the change in magnetic flux.

**Step 2: Determine current direction.**

When the magnet moves through the loop, the current induced must produce a field opposing this motion. Based on the orientation of the magnet, the induced current flows in the AB and DC directions.

**Conclusion:** Thus, the correct answer is (1), AB and DC.

### Quick Tip

Lenz's Law states that the induced current creates a magnetic field that opposes the motion of the magnet.

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

- (1) Constant velocity
- (2) Constant acceleration
- (3) Constant velocity but varying acceleration
- (4) Varying velocity and varying acceleration

**Correct Answer:** (4) Varying velocity and varying acceleration

**Solution: Step 1:** Understanding motion in a circle.

A particle in uniform circular motion has constant speed but a changing direction.

**Step 2:** Velocity and acceleration.

Since velocity is a vector, it changes direction at every instant, leading to varying velocity.

The acceleration is also changing because its direction always points towards the center.

**Conclusion:** Thus, the correct answer is (4), varying velocity and varying acceleration.

**Quick Tip**

In uniform circular motion, speed remains constant, but velocity and acceleration vectors continuously change direction.

**18. Match List I with List II.**

<b>List I</b> (Spectral Lines of Hydrogen for transitions from)	<b>List II</b> (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

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

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

**Solution: Step 1:** Understanding hydrogen spectral series.

Each spectral series corresponds to electron transitions in a hydrogen atom.

**Step 2:** Match the series to their wavelength range.

Lyman series (*A*) lies in the Ultraviolet (*III*).

Balmer series (*B*) lies in the Visible (*II*).

Paschen series (*C*) lies in the Infrared (*IV*).

Brackett series (*D*) lies in the Infrared (*I*).

**Conclusion:** Thus, the correct answer is (2).

#### Quick Tip

Spectral series are categorized based on the energy level transitions in the hydrogen atom.

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

- (1) Strain and angle
- (2) Stress and angle
- (3) Strain and arc
- (4) Angular speed and stress

**Correct Answer:** (1) Strain and angle

**Solution: Concepts:** here we are using some concepts i.e Dimensions, Solid angle, Strain, Stress, Angular speed

**Explanation:**

The dimension of a solid angle is a dimensionless quantity. Similarly, strain and angle are also dimensionless quantities. Strain is defined as the ratio of change in length to the original length, and angle is defined as the ratio of arc length to radius. Both of these ratios are dimensionless.

**Step by Step Solution:**

**Step 1:** Identify the dimension of solid angle. Solid angle is a dimensionless quantity.

**Step 2:** Identify the dimensions of the given quantities: strain, angle, stress, arc, and angular speed.

**Step 3:** Compare the dimensions of each quantity with that of the solid angle.

**Final Answer:**

(a) strain and angle

**Quick Tip**

Dimensionless quantities often describe ratios, such as strain and angle.

**20. An unpolarized light beam strikes a glass surface at Brewster's angle. Then**

- (1) The reflected light will be partially polarized.
- (2) The refracted light will be completely polarized.
- (3) Both the reflected and refracted light will be partially polarized.
- (4) The reflected light will be completely polarized.

**Correct Answer:** (4) The reflected light will be completely polarized.

**Solution: Step 1: Brewster's Law.**

At Brewster's angle, the reflected and refracted light are perpendicular.

**Step 2: Nature of reflected light.** According to Brewster's Law:

$$\tan \theta_B = \frac{n_2}{n_1}$$

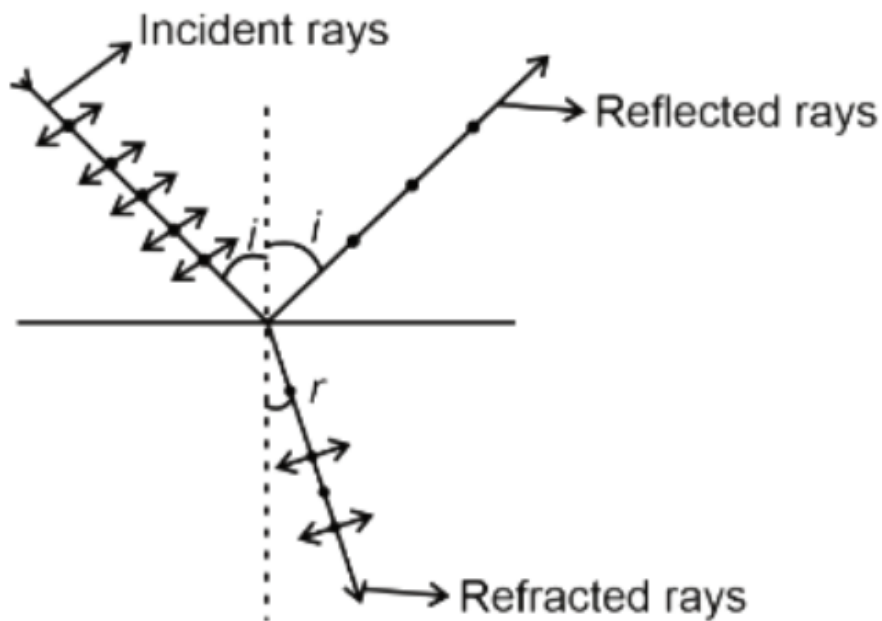
At this angle, the reflected light is completely polarized, and the refracted light is partially polarized.

**Explanation:**

According to **Brewster's law**, when light is incident at the Brewster angle  $\theta_B$ , the reflected light is completely polarised, and the refracted light is partially polarised. Brewster's angle  $\theta_B$  is given by:

$$\tan \theta_B = \frac{n_2}{n_1}$$

where  $n_1$  and  $n_2$  are the refractive indices of the two media.



**Diagram Explanation:**

In the given diagram:

- The incident rays are approaching the surface at the angle  $i$ .
- The reflected rays are entirely polarised when the angle of incidence is equal to the Brewster angle  $\theta_B$ .
- The refracted rays are partially polarised.

**Conclusion:**

At the Brewster angle:

- The reflected light is completely polarised.
- The refracted light is partially polarised.

**Final Answer:** (4) The reflected light will be completely polarised but the refracted light will be partially polarised.

**Quick Tip**

At Brewster's angle, the reflected light is completely polarized, while the refracted light is partially polarized.

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

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

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

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

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

- (1) Both A and R are true and R is the correct explanation of A.
- (2) Both A and R are true and R is NOT the correct explanation of A.
- (3) A is true but R is false.
- (4) A is false but R is true.

**Correct Answer:** (3) A is true but R is false.

**Solution: Step 1: Understanding the Assertion (A).** The electric potential at an axial point of a dipole is indeed calculated using the formula:

$$V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$$

Thus, Assertion A is correct.

**Step 2: Evaluating the Reason (R).** The potential of a dipole at an axial point is given by the equation:

$$V_{\text{axial}} = \pm \frac{kp}{r^2}$$

Substituting the given values:

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

Thus, Assertion A is correct.

However, Reason R is not correct, as the expression for potential provided does not accurately describe the situation.

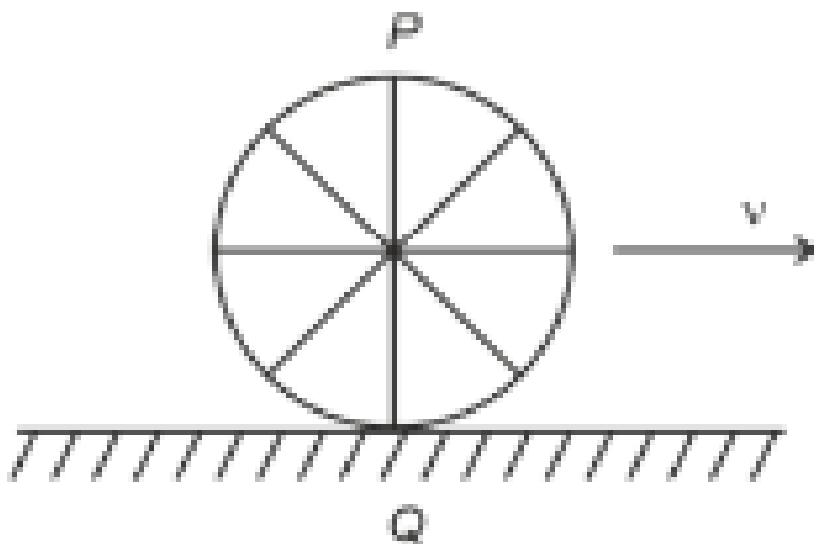
**Conclusion:** Since Assertion A is correct but Reason R is false, the correct answer is option (3).

#### Quick Tip

The potential inside a dipole is calculated differently based on the position relative to the dipole's axis.

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22. 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 any point on a rolling wheel is a combination of the wheel's center velocity and the tangential velocity of the point due to rotation. - For the topmost point  $P$ , the tangential velocity due to rotation is in the same direction as the wheel's linear velocity. Thus, its total speed is  $v + v = 2v$ . - For the bottommost point  $Q$ , the tangential velocity is in the opposite direction to the linear velocity, resulting in a net speed of  $v - v = 0$ . Thus, point  $P$  moves faster than point  $Q$ .

**Quick Tip**

For rolling motion without slipping: - The topmost point has a speed of  $2v$ . - The bottommost point has zero speed.

---

23. If  $x = 5 \sin(\pi t + \frac{\pi}{3})$  represents the motion of a particle, find the amplitude and time

**period of the motion.**

- (1) 5 cm, 2 s
- (2) 5 m, 2 s
- (3) 5 cm, 1 s
- (4) 5 m, 1 s

**Correct Answer:** (1) 5 cm, 2 s

**Solution: Step 1: Identify the amplitude.** The general equation for simple harmonic motion (SHM) is:

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

Comparing the given equation  $x = 5 \sin(\pi t + \frac{\pi}{3})$  with the standard SHM equation, we can see that the amplitude  $A = 5$  cm.

**Step 2: Calculate the time period.** The angular frequency  $\omega$  is given as  $\pi$ . The time period  $T$  is related to the angular frequency by:

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

Substituting  $\omega = \pi$ :

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

**Conclusion:** Thus, the amplitude is 5 cm and the time period is 2 s, corresponding to option (1).

**Quick Tip**

In SHM, the amplitude is the coefficient of the sine function, and the time period is given by  $T = \frac{2\pi}{\omega}$ .

---

**24. A logic circuit provides the output  $Y$  as per the truth table given below. Identify the circuit.**

Input $A$	Input $B$	Output $Y$
0	0	0
0	1	1
1	0	1
1	1	0

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

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

(C)  $\bar{B}$

(D)  $B$

**Correct Answer:** (3)  $\bar{B}$

**Solution:** From the truth table:

When  $A = 0$  and  $B = 0$ ,  $Y = 0$ .

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

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

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

Thus,  $Y = 1$  when  $B = 0$ , regardless of  $A$ . Therefore,  $Y = \bar{B}$ .

**Conclusion:** Thus, the Boolean expression for  $Y$  is  $\bar{B}$ , which corresponds to option (3).

#### Quick Tip

To determine the logic expression, check the conditions when the output is 1 or 0 from the truth table.

**25. 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 and B only

(B) A, B, C and D only

(C) A, C and D only

(D) A, B, D and E only

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

**Solution: Step 1: Evaluate each statement.**

*A* : The energy of a photon is indeed  $E = h\nu$ , which is correct.

*B* : The velocity of a photon is always  $c$ , which is correct.

*C* : The momentum of a photon is given by  $p = \frac{h\nu}{c}$ , which is correct.

*D* : In photon-electron collisions, both energy and momentum are conserved, which is correct.

**Step 2: Analyze the options.**

Statements *A*, *B*, *C*, and *D* are correct, corresponding to option (B).

#### Quick Tip

Photons have no mass but carry energy and momentum, obeying conservation laws in interactions.

---

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

(1)  $T$

(2)  $4T$

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

(4)  $\sqrt{2}T$

**Correct Answer:** (2)  $4T$

**Solution:**

The tension in the string is proportional to the square of the velocity. This can be expressed

as:

$$T \propto v^2$$

This indicates that the tension  $T$  increases with the square of the velocity. Let the initial velocity be  $v$ , and the new velocity is  $2v$ .

Substituting the new velocity  $2v$  into the expression for tension, we get:

$$T' = k(2v)^2 = k \cdot 4v^2$$

Comparing the new tension  $T'$  with the original tension  $T$ :

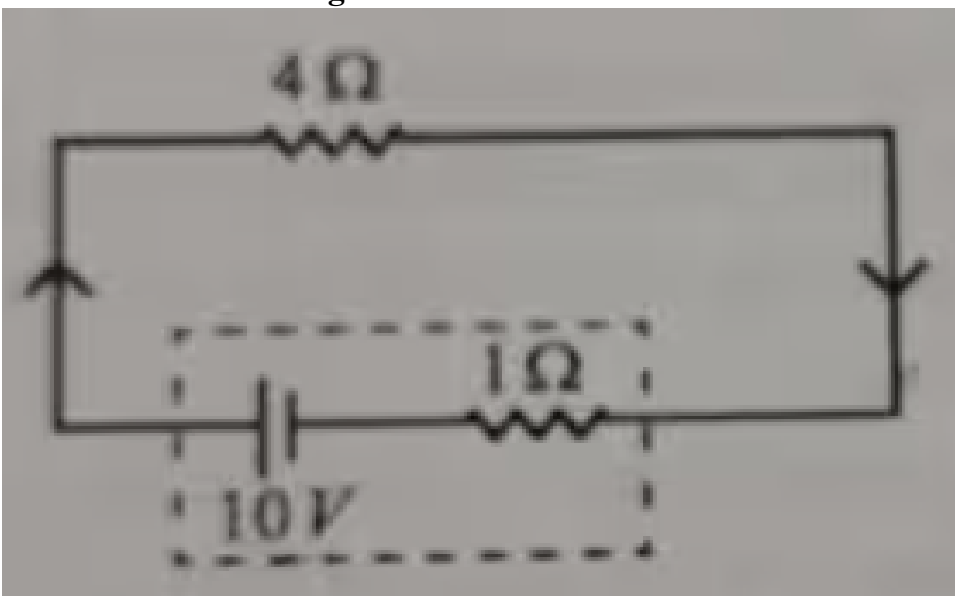
$$T' = 4T$$

Thus, when the speed is doubled, the tension becomes four times the original tension. The new tension is  $T' = 4T$ .

#### Quick Tip

The tension in the string of a circular motion system is proportional to the square of the speed of the object:  $T \propto v^2$ .

**27. 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:**



- (1) 4 V
- (2) 6 V
- (3) 8 V
- (4) 10 V

**Correct Answer:** (3) 8 V

**Solution:**

The circuit consists of a 10 V battery, a 4  $\Omega$  resistor, and a 1  $\Omega$  resistor in series.

First, we calculate the total current  $I$  using the formula for series circuits:

$$I = \frac{E}{R + r}$$

where: -  $E = 10 \text{ V}$  is the electromotive force (EMF), -  $R = 4 \Omega$  is the resistance of the 4  $\Omega$  resistor, and -  $r = 1 \Omega$  is the resistance of the 1  $\Omega$  resistor.

Substituting the values:

$$I = \frac{10}{4 + 1} = \frac{10}{5} = 2 \text{ A}$$

Thus, the current  $I$  in the circuit is 2 A.

Next, we calculate the potential drop across the 1  $\Omega$  resistor, denoted as  $V_T$ . The potential drop is given by:

$$V_T = E - I \cdot r$$

Substituting the known values:

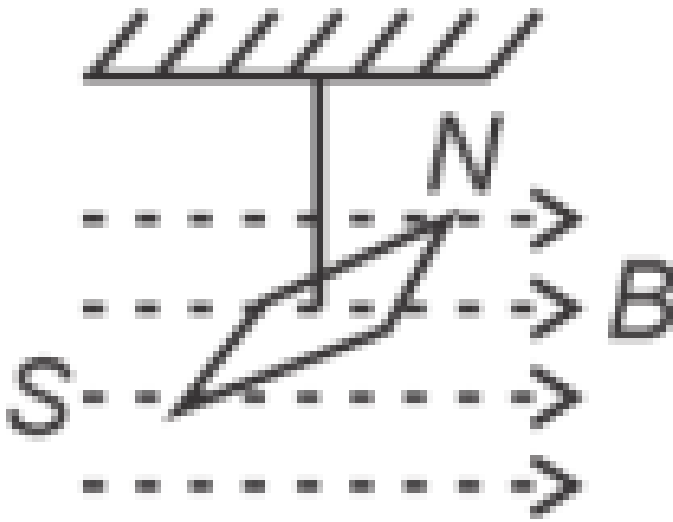
$$V_T = 10 - 2 \cdot 1 = 10 - 2 = 8 \text{ V}$$

Thus, the potential drop across the 1  $\Omega$  resistor is 8 V.

**Quick Tip**

The terminal voltage of a battery is reduced due to the voltage drop across its internal resistance:  $V = \text{emf} - Ir$ .

28. In a uniform magnetic field of 0.049 T, a magnetic dipole is placed with a dipole moment of  $5 \text{ A} \cdot \text{m}^2$ . Calculate the torque acting on it if the angle between the dipole moment and magnetic field is  $30^\circ$ .



- (1)  $5\pi^2$
- (2)  $128\pi^2$
- (3)  $50\pi^2$
- (4)  $1280\pi^2$

**Correct Answer:** (4)  $1280\pi^2$

**Solution:**

We are given the following values:

$$B = 0.049 \text{ T}, \quad f = \frac{20}{5} = 4 \text{ Hz}$$

$$I = 9.8 \times 10^{-6} \text{ kg m}^2$$

$$M = x \times 10^{-5} \text{ A m}^2$$

The formula for frequency  $f$  is given by:

$$f = \frac{1}{2\pi} \sqrt{\frac{MB}{I}}$$

Substituting the known values:

$$M = \frac{f^2 I (4\pi^2)}{B} = \frac{16 \times 4\pi^2 \times 98 \times 10^{-7}}{49 \times 10^{-3}}$$

Simplifying the expression:

$$x \times 10^{-5} = 128\pi^2 \times 10^{-4}$$

Therefore:

$$x = 1280\pi^2$$

#### Quick Tip

The torque on a magnetic dipole depends on the dipole moment, magnetic field strength, and the angle between them:  $\tau = MB \sin \theta$ .

---

**29. 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:**

- (1)  $26 \Omega$
- (2)  $52 \Omega$
- (3)  $55 \Omega$
- (4)  $60 \Omega$

**Correct Answer:** (2)  $52 \Omega$

#### Solution:

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

**Step 1:** The first 5 parts are connected in series. The total resistance for resistors connected in series is the sum of their individual resistances. Therefore:

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

**Step 2:** The next 5 parts are connected in parallel. The total resistance for resistors connected in parallel is given by:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1}.$$

Since all resistors have the same value, this simplifies to:

$$\frac{1}{R_p} = 5 \cdot \frac{1}{10} = \frac{5}{10} = \frac{1}{2}.$$

Hence, the resistance for the parallel combination is:

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

**Step 3:** The total resistance is the sum of the series resistance and parallel resistance.

Therefore:

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

Thus, the total resistance of the wire is  $52 \Omega$ .

#### Quick Tip

When identical resistors are connected in parallel, the effective resistance is given by  $\frac{R}{n}$ , where  $n$  is the number of resistors.

### 30. Match List-I with List-II:

List-I (Material)	List-II (Susceptibility $\chi$ )
A. Diamagnetic	$\chi = 0$
B. Ferromagnetic	$\chi \ll 1$
C. Paramagnetic	$0 < \chi \ll 1$
D. Non-magnetic	$0 < \chi < \epsilon$

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

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

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

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

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

**Solution: Step 1: Understand the properties of materials.** - Diamagnetic materials are weakly repelled by a magnetic field ( $I$ ). - Paramagnetic materials are weakly attracted by a

magnetic field (II). - Ferromagnetic materials are strongly attracted by a magnetic field

(III). - Superconductors exhibit perfect diamagnetism (IV).

**Step 2: Match the lists.** Based on these properties, the correct match is:

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

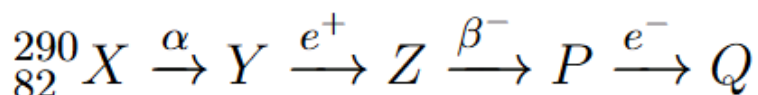
**Conclusion:** The correct matching is option (1).

#### Quick Tip

Diamagnetic, paramagnetic, ferromagnetic, and superconducting materials exhibit distinct magnetic properties. Memorize these for quick recall.

---

**31. In the nuclear emission stated above, the mass number and atomic number of the resulting nucleus will be:**



(1) 280, 81

(2) 286, 80

(3) 288, 82

(4) 286, 81

**Correct Answer:** (4) 286, 81

**Solution: Step 1: Analyze the effect of alpha emission.**

In an alpha ( $\alpha$ ) emission:

- The mass number ( $A$ ) decreases by 4.
- The atomic number ( $Z$ ) decreases by 2.

**Step 2: Apply the changes.**

Given initial nucleus properties:

- Initial mass number ( $A$ ) = 290
- Initial atomic number ( $Z$ ) = 83

After alpha emission:

$$A' = A - 4 = 290 - 4 = 286$$

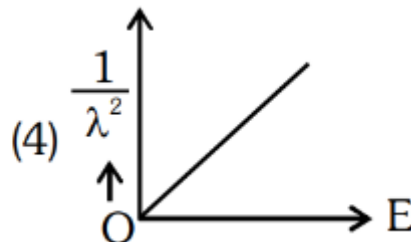
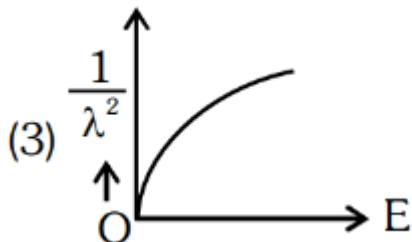
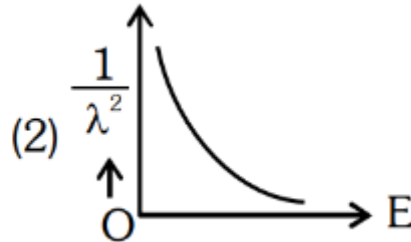
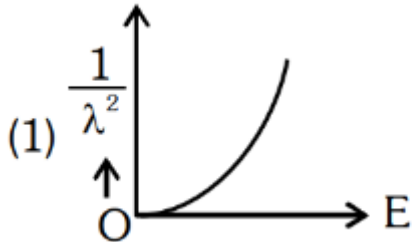
$$Z' = Z - 2 = 83 - 2 = 81$$

**Conclusion:** The resulting nucleus has a mass number 286 and an atomic number 81, corresponding to option (4).

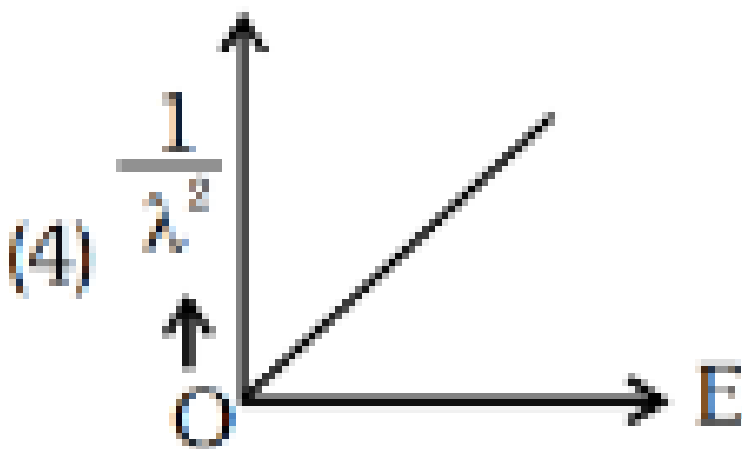
**Quick Tip**

In alpha decay, the mass number decreases by 4, and the atomic number decreases by 2.

32. The graph which shows the variation of  $\frac{1}{\lambda^2}$  with stopping potential  $V$  for a photoelectric experiment is:



**Correct Answer:** (4)



**Solution: Step 1: Recall the photoelectric equation.** The photoelectric equation is:

$$eV = h\nu - \phi$$

- where:
- $e$  is the electron charge,
  - $V$  is the stopping potential,
  - $h$  is Planck's constant,
  - $\nu$  is the frequency of incident light,
  - $\phi$  is the work function.

**Step 2: Relate frequency to wavelength.** Using  $\nu = \frac{c}{\lambda}$ , we have:

$$eV = h\frac{c}{\lambda} - \phi$$

Rewriting:

$$V = \frac{hc}{e} \frac{1}{\lambda} - \frac{\phi}{e}$$

**Step 3: Analyze the graph.** Plotting  $\frac{1}{\lambda}$  against  $V$  gives a straight line with:

- A positive slope  $\frac{hc}{e}$ ,
- A negative intercept  $-\frac{\phi}{e}$  on the  $V$ -axis.

**Conclusion:** The graph is linear with a positive intercept, corresponding to option (4).

#### Quick Tip

The photoelectric equation predicts a linear relationship between stopping potential and  $\frac{1}{\lambda}$ .

---

**33. 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) :**

- (1) 1 : 2
- (2) 2 : 1
- (3) 1 : 1
- (4) 1 : 4

**Correct Answer:** (1) 50 V

**Solution: Recall the transformer equation.** For an ideal transformer, the relationship

between the primary voltage ( $V_p$ ) and the secondary voltage ( $V_s$ ) is given by:

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

where:

$N_p$  and  $N_s$  are the number of turns in the primary and secondary coils, respectively.

**For an ideal transformer:**

The voltage ratio is related to the turns ratio by the following equation:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = 2 : 1$$

where:  $V_s$  is the secondary voltage,

$V_p$  is the primary voltage,

$N_s$  is the number of turns in the secondary coil,

$N_p$  is the number of turns in the primary coil.

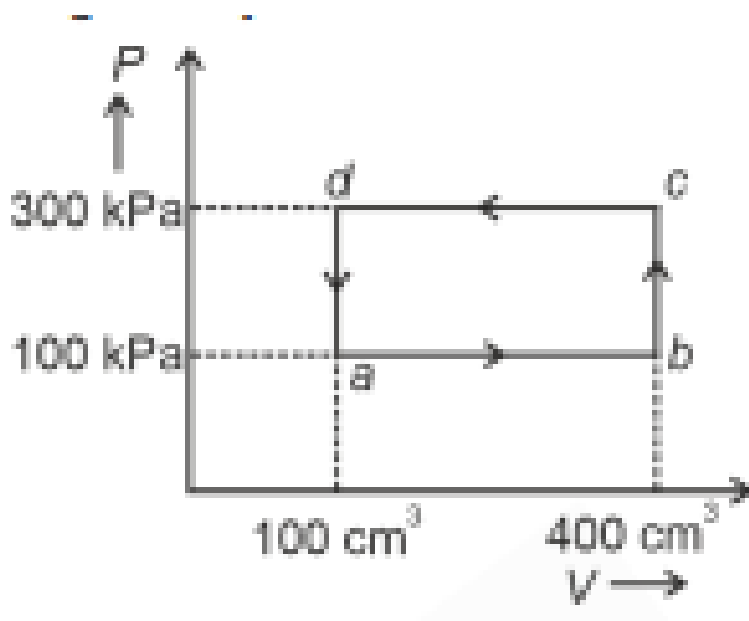
**Conclusion:** For this ideal transformer, the ratio of the secondary voltage to the primary voltage is equal to the ratio of the number of turns in the secondary coil to the number of turns in the primary coil, which is 2 : 1.

**Quick Tip**

In an ideal transformer, the voltage ratio equals the turns ratio:  $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ .

---

**34. A thermodynamic system is taken through the cycle  $abcd$ , where  $ab$  is isochoric,  $bc$  is isobaric,  $cd$  is isothermal, and  $da$  is adiabatic. What is the work done during the complete cycle?**



- (1) Zero
- (2) 30 J
- (3) -90 J
- (4) -60 J

**Correct Answer:** (1) Zero

**Solution: Step 1: Analyze the thermodynamic cycle.**

The work done in a thermodynamic process is the area enclosed by the cycle on a  $P - V$  diagram. For a closed cycle:

$$W_{\text{net}} = Q_{\text{net}}$$

where  $Q_{\text{net}}$  is the net heat exchanged.

**Step 2: Apply the first law of thermodynamics.**

The first law of thermodynamics states:

$$\Delta U = Q - W$$

For a complete cycle, the internal energy ( $U$ ) returns to its initial value, so  $\Delta U = 0$ . This implies:

$$Q_{\text{net}} = W_{\text{net}}$$

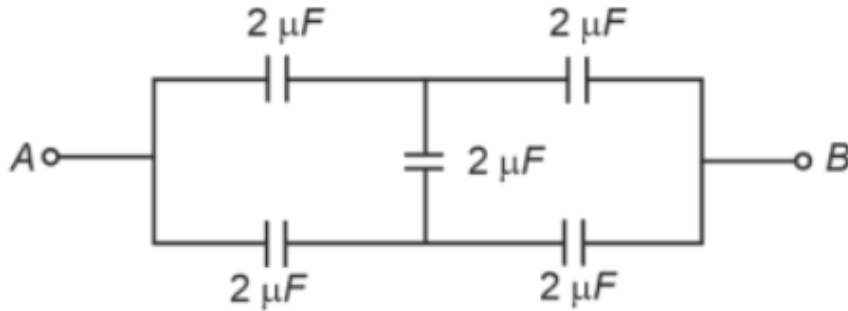
Since the net heat exchanged in the cycle is zero, the net work done is also zero.

**Conclusion:** The net work done during the complete cycle is 0, corresponding to option (1).

### Quick Tip

For a complete thermodynamic cycle, the internal energy change is zero, making the net work done equal to the net heat exchanged.

35. In the following circuit, the equivalent capacitance between points  $A$  and  $B$  is:



- (1)  $2 \mu\text{F}$
- (2)  $1 \mu\text{F}$
- (3)  $0.5 \mu\text{F}$
- (4)  $4 \mu\text{F}$

**Correct Answer:** (1)  $2 \mu\text{F}$

**Solution: Step 1: Simplify the circuit.**

Two  $2 \mu\text{F}$  capacitors are connected in series. The equivalent capacitance ( $C_{\text{series}}$ ) is:

$$\frac{1}{C_{\text{series}}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{2} + \frac{1}{2} = 1 \mu\text{F}$$

**Step 2: Calculate the total capacitance.** The  $C_{\text{series}}$  of  $1 \mu\text{F}$  is connected in parallel with another  $1 \mu\text{F}$ . The total capacitance is:

$$C_{\text{total}} = C_{\text{series}} + C_3 = 1 + 1 = 2 \mu\text{F}$$

**Conclusion:** The equivalent capacitance between  $A$  and  $B$  is  $2 \mu\text{F}$ , corresponding to option (1).

### Quick Tip

For capacitors in series, use  $\frac{1}{C_{\text{eq}}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$ . For capacitors in parallel, add them directly.

---

**36. If the plates of a parallel plate capacitor connected to a battery are moved close to each other, the**

- 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, B and E only
- (2) A, C and E only
- (3) B, D and E only
- (4) A, B and C only

**Correct Answer:** (2) A, C and E only

**Solution: Step 1: Effect of reducing the plate separation.** The capacitance ( $C$ ) of a parallel plate capacitor is given by:

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

- where: -  $\epsilon$  is the permittivity of the dielectric,  
-  $A$  is the area of the plates,  
-  $d$  is the distance between the plates.

When  $d$  decreases,  $C$  increases proportionally.

**Step 2: Analyze the energy and charge.**

- The energy stored in the capacitor is:

$$U = \frac{1}{2} \frac{Q^2}{C}$$

If  $C$  increases,  $U$  decreases for a constant charge  $Q$ .

- The potential difference across the plates is:

$$V = \frac{Q}{C}$$

If  $C$  increases,  $V$  decreases for a constant  $Q$ .

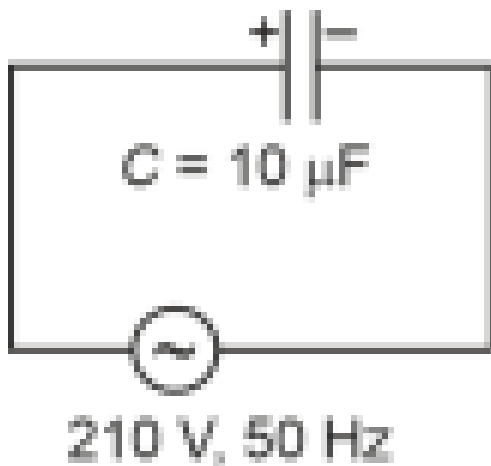
**Step 3: Identify correct statements.** Based on these principles, the correct statements are  $A$ ,  $C$ , and  $E$ .

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

**Quick Tip**

The capacitance of a parallel plate capacitor is inversely proportional to the plate separation ( $d$ ).

**37. A  $10\ \mu\text{F}$  capacitor is connected to a 210 V, 50 Hz AC supply. What is the peak current in the circuit?**



- (1) 0.58 A
- (2) 0.93 A
- (3) 1.20 A
- (4) 0.35 A

**Correct Answer:** (2) 0.93 A

**Solution: Step 1: Formula for capacitive reactance.** The capacitive reactance ( $X_C$ ) is given by:

$$X_C = \frac{1}{2\pi fC}$$

where: -  $f = 50\ \text{Hz}$  (frequency),

-  $C = 10\ \mu\text{F} = 10 \times 10^{-6}\ \text{F}$ .

Substituting the values:

$$X_C = \frac{1}{2\pi \times 50 \times 10 \times 10^{-6}} = \frac{1}{3.14 \times 0.0005} \approx 636\ \Omega$$

**Step 2: Calculate the peak current.** The peak current ( $I_{\text{peak}}$ ) is given by:

$$I_{\text{peak}} = \frac{V_{\text{peak}}}{X_C}$$

The peak voltage is:

$$V_{\text{peak}} = \sqrt{2}V_{\text{rms}} = \sqrt{2} \times 210 \approx 297 \text{ V}$$

Thus:

$$I_{\text{peak}} = \frac{297}{636} \approx 0.93 \text{ A}$$

**Conclusion:** The peak current is 0.93 A, corresponding to option (2).

### Quick Tip

The peak current in an AC circuit depends on the capacitive reactance:  $I_{\text{peak}} = \frac{V_{\text{peak}}}{X_C}$ .

**38. A force defined by  $F = \alpha t^2 + \beta t$  acts on a particle. What is the dimension of the ratio**

$\frac{\alpha t}{\beta}$ ?

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

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

(3)  $\alpha\beta t$

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

**Correct Answer:** (2)  $\frac{\alpha t}{\beta}$

**Solution: Step 1: Dimensional analysis of force.** The force is given as  $F = \alpha t^2 + \beta t$ . The dimensions of force are:

$$[F] = [MLT^{-2}]$$

**Step 2: Analyze  $\alpha$  and  $\beta$ .** From the term  $\alpha t^2$ :

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

From the term  $\beta t$ :

$$[\beta] = \frac{[F]}{[t]} = \frac{[MLT^{-2}]}{[T]} = [MLT^{-3}]$$

**Step 3: Dimension of  $\frac{\alpha t}{\beta}$ .** The ratio is:

$$\frac{\alpha t}{\beta} = \frac{[\alpha][t]}{[\beta]} = \frac{[MLT^{-4}][T]}{[MLT^{-3}]} = [1]$$

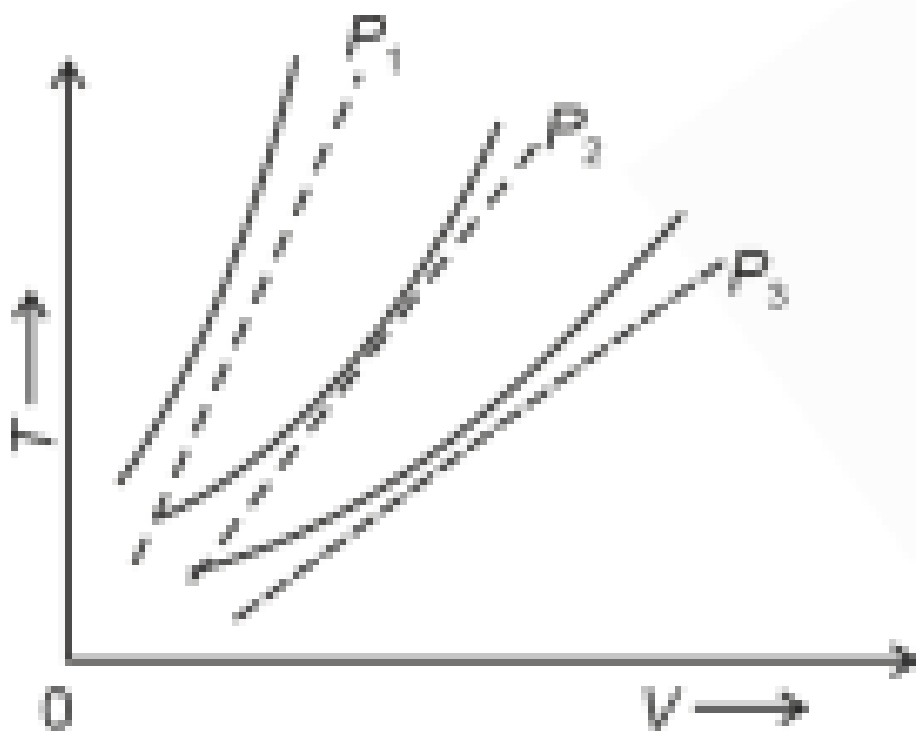
Thus,  $\frac{\alpha t}{\beta}$  is dimensionless.

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

#### Quick Tip

Dimensional analysis helps verify the consistency of physical quantities and determine unknown dimensions.

**39. The following graph represents the  $T - V$  curves of a thermodynamic process for three different pressures  $P_1, P_2, P_3$ . Arrange the pressures in increasing order.**



(1)  $P_3 > P_2 > P_1$

(2)  $P_1 > P_3 > P_2$

(3)  $P_2 > P_1 > P_3$

(4)  $P_1 > P_2 > P_3$

**Correct Answer:** (4)  $P_1 > P_2 > P_3$

**Solution: Step 1: Analyze the isothermal behavior.** For an ideal gas, the equation of state is:

$$PV = nRT$$

At constant temperature ( $T$ ), the relationship becomes:

$$P \propto \frac{1}{V}$$

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

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

#### Quick Tip

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

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

- (1)  $M$
- (2)  $\frac{M}{2}$
- (3)  $2M$
- (4)  $\frac{M}{\sqrt{3}}$

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

**Solution: Step 1: Formula for magnetic moment.**

The magnetic moment ( $M$ ) of a bar magnet is given by:

$$M = mL$$

where: -  $m$  is the pole strength,

-  $L$  is the length of the magnet.

**Step 2: Effect of halving the length.** If the length ( $L$ ) is reduced to  $\frac{L}{2}$ , the new magnetic moment ( $M'$ ) becomes:

$$M' = m \times \frac{L}{2} = \frac{mL}{2} = \frac{M}{2}$$

**Conclusion:** The new magnetic moment is  $\frac{M}{2}$ , corresponding to option (2).

### Quick Tip

The magnetic moment of a bar magnet is directly proportional to its length.

**41. A parallel plate capacitor is charged by connecting it to a battery through a resistor.**

**If  $I$  is the current in the circuit, then in the gap between the plates:**

- (1) There is no current
- (2) Displacement current of magnitude equal to  $I$  flows in the same direction as  $I$
- (3) Displacement current of magnitude equal to  $I$  flows in a direction opposite to that of  $I$
- (4) Displacement current of magnitude greater than  $I$  flows but can be in any direction

**Correct Answer:** (2) Displacement current of magnitude equal to  $I$  flows in the same direction as  $I$

**Solution:** Displacement current occurs in the gap between the plates of a capacitor, driven by the changing electric field due to the charging of the plates. The magnitude of displacement current is equal to the conduction current  $I$  in the circuit and flows in the same direction.

**Conclusion:** Hence, the correct answer is (2).

### Quick Tip

Displacement current is equal to the conduction current and flows in the same direction in a charging capacitor.

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

- (1)  $5 \times 10^3 \text{ N}$
- (2)  $50 \times 10^3 \text{ N}$
- (3)  $100 \times 10^3 \text{ N}$
- (4)  $2 \times 10^3 \text{ N}$

**Correct Answer:** (2)  $50 \times 10^3 \text{ N}$

**Solution:** The compressive force due to thermal expansion is found using the formula:

$$F = \frac{\Delta L \cdot Y \cdot A}{L}$$

where  $\Delta L = \alpha L \Delta T$ . Substituting the values:

$$\Delta L = 1 \cdot 10^{-5} \cdot 100 = 10^{-3} \text{ m}$$

Substitute into the force equation:

$$F = \frac{10^{-3} \cdot 0.5 \times 10^{11} \cdot 10^{-3}}{1} = 50 \times 10^3 \text{ N}$$

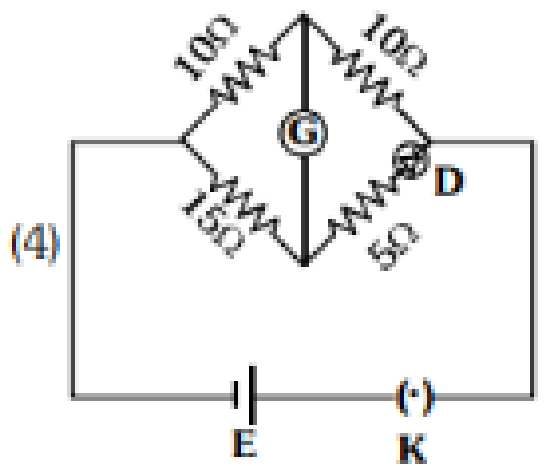
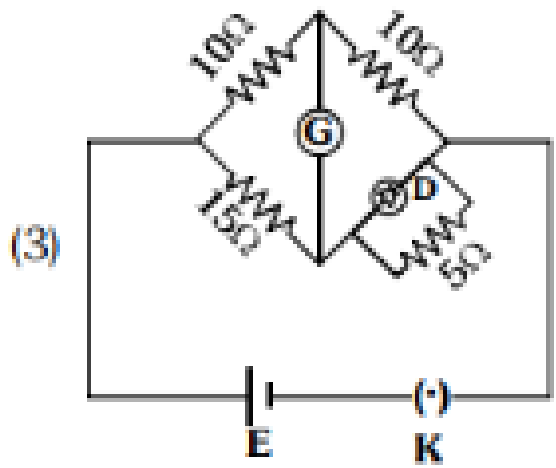
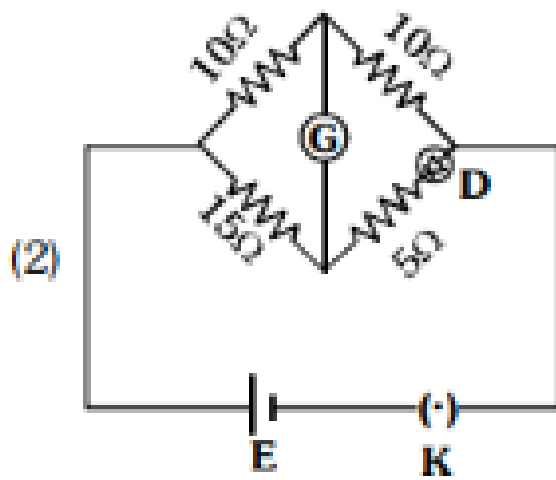
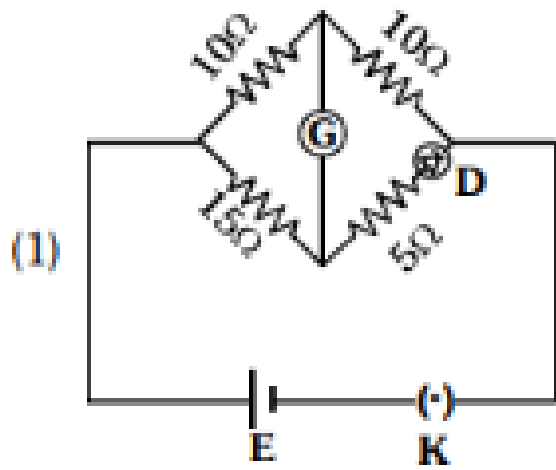
**Conclusion:** Thus, the force is  $50 \times 10^3 \text{ N}$ , corresponding to option (2).

#### Quick Tip

Use the formula  $F = \frac{\Delta L \cdot Y \cdot A}{L}$  to calculate compressive force due to thermal expansion.

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**43. Choose the correct circuit which can achieve the bridge balance.**



**Correct Answer:** (1) The first circuit

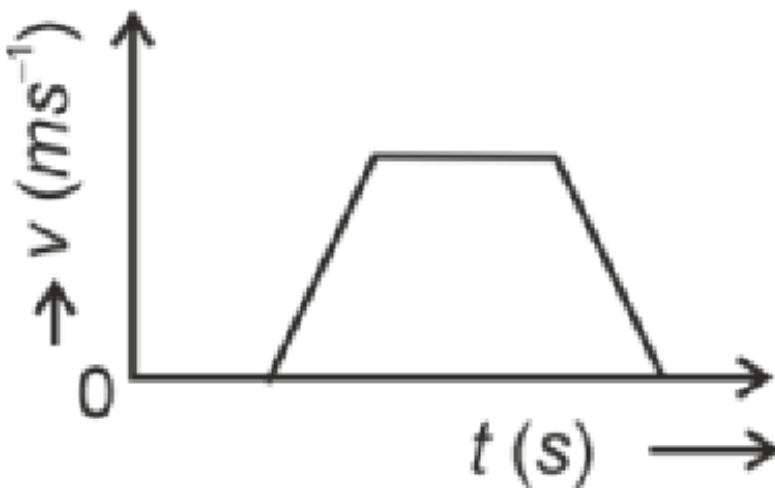
**Solution:** A Wheatstone bridge balances when the resistances in both legs of the circuit are in equal ratio. The first circuit satisfies the Wheatstone bridge condition, where the resistances are arranged to achieve balance.

**Conclusion:** The correct answer is (1), where the first circuit achieves bridge balance.

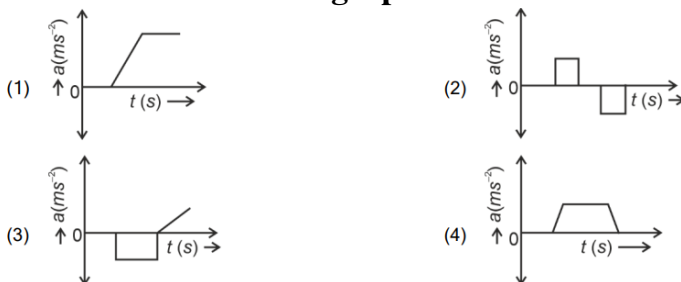
**Quick Tip**

A Wheatstone bridge is balanced when the ratios of resistances in opposite legs are equal.

**44. The velocity  $v$  – time  $t$  plot of the motion of a body is shown below:**



**The acceleration  $a$  – time  $t$  graph that best suits this motion is:**



**Correct Answer:** (3) The third graph

**Solution:** The velocity-time graph shows an increase in velocity, followed by a constant velocity, and then a decrease in velocity. Acceleration is the rate of change of velocity: - Acceleration is positive during the increasing velocity, - Zero during constant velocity, -

Negative during decreasing velocity.

**Conclusion:** Thus, the third graph represents the correct acceleration-time graph.

#### Quick Tip

Acceleration is the rate of change of velocity. Positive when velocity increases, zero when constant, and negative when decreasing.

---

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

- (1) 34
- (2) 28
- (3) 17
- (4) 32

**Correct Answer:** (2) 28

**Solution:** The magnifying power of a telescope is given by:

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

Substitute  $f_o = 140$  cm and  $f_e = 5.0$  cm:

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

**Conclusion:** Thus, the magnifying power of the telescope is 28, corresponding to option (2).

#### Quick Tip

The magnifying power of a telescope is the ratio of the focal length of the objective to that of the eyepiece.

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

- (1)  $\frac{5GmM}{6R}$
- (2)  $\frac{2GmM}{3R}$

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

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

**Correct Answer:** (1)  $\frac{5GmM}{6R}$

**Solution: Step 1: Formula for the energy required to launch the satellite.** The total energy required to launch a satellite into orbit is the sum of the gravitational potential energy and the kinetic energy of the satellite. The total mechanical energy  $E$  of a satellite in a circular orbit is given by:

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

where  $r$  is the distance from the center of the Earth, which is  $3R$  in this case (because the altitude is  $2R$ ).

**Step 2: Substituting values.** The distance  $r = 3R$ , so the minimum energy required to launch the satellite is:

$$E = -\frac{GmM}{2 \cdot 3R} = -\frac{GmM}{6R}$$

**Step 3: Energy required to launch the satellite.** The energy required to launch the satellite from the surface of Earth to this orbit is the difference between the final energy and the initial energy (which is zero at the surface). Thus, the energy required is:

$$\text{Energy required} = \frac{5GmM}{6R}$$

**Conclusion:** The minimum energy required to launch the satellite is  $\frac{5GmM}{6R}$ , corresponding to option (1).

#### Quick Tip

The energy required to launch a satellite depends on the gravitational potential and kinetic energies at the orbit.

---

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

(1)  $\sqrt{3}$

(2)  $\sqrt{2}$

(3)  $2\sqrt{3}$

(4) 4

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

**Solution:** The time period  $T$  of a simple pendulum is given by:

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

If the length is halved, the new time period  $T'$  is:

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

Thus, the ratio of the new time period to the original is  $\frac{1}{\sqrt{2}}$ , and  $x = \sqrt{2}$ .

**Conclusion:** Thus,  $x = \sqrt{2}$ , corresponding to option (2).

#### Quick Tip

The time period of a pendulum depends on its length, not the mass of the bob.

---

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

- (A) Hold the sheet there if it is magnetic.
- (B) Hold the sheet there if it is non-magnetic.
- (C) Move the sheet away from the pole with uniform velocity if it is conducting.
- (D) Move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar.

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

- (1) B and D only
- (2) A and C only
- (3) A, C and D only
- (4) C only

**Correct Answer:** (2) A and C only

**Solution:** A magnetic sheet requires a force to hold it in place. This happens because of the interaction between the magnetic field and the magnetic material. The material experiences a force that tends to pull it in the direction of the magnetic field lines. The force is generally

related to the magnetic field intensity  $B$  and the properties of the material, including its magnetic permeability.

For a magnetic material, the force required to hold it in place is often calculated using the following general equation:

$$F = \frac{\mu_0 A (B_2^2 - B_1^2)}{2}$$

where: -  $\mu_0$  is the permeability of free space,

-  $A$  is the area of the magnetic sheet,

-  $B_2$  and  $B_1$  are the magnetic field strengths before and after the material is placed.

This force holds the magnetic sheet in its position to maintain the magnetic equilibrium and prevent movement due to magnetic forces.

### **Eddy Currents and Motion:**

On the other hand, when a conducting sheet is exposed to a changing magnetic field, it develops eddy currents within the material. According to Faraday's Law of Induction, a time-varying magnetic field induces a circulating current in the conductor. These eddy currents generate their own magnetic field that opposes the change in the applied magnetic field (Lenz's Law).

The induced eddy currents produce a force that can cause motion in the conducting sheet.

The magnitude of the force is related to the rate of change of the magnetic field, the electrical conductivity of the sheet, and its dimensions. The induced currents are given by:

$$\mathcal{E} = -\frac{d\Phi}{dt}$$

where: -  $\mathcal{E}$  is the induced electromotive force (emf), -  $\Phi$  is the magnetic flux through the loop.

For the induced currents to produce motion, the conducting sheet must have an area that interacts with the changing magnetic field. The resulting force can cause movement of the sheet in the direction opposite to the applied magnetic field change, as per Lenz's law.

Hence (2) A and C only are correct

### Quick Tip

Magnetic forces act on magnetic materials and conductors in changing fields, inducing forces that can cause motion.

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

- (1) 1 : 1
- (2) 2 : 9
- (3) 1 : 2
- (4) 2 : 3

**Correct Answer:** (2) 2 : 9

**Solution:** The power consumed by a resistor is given by the formula:

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

where: -  $P$  is the power consumed, -  $V$  is the voltage across the resistor, -  $R$  is the resistance.

The ratio of powers consumed by two resistors  $A$  and  $B$  is given by:

$$\frac{P_A}{P_B} = \frac{R_B}{R_A}$$

Now, we are given that the resistance  $R_A = 2R_B$ . Substituting this into the equation:

$$\frac{P_A}{P_B} = \frac{R_B}{2R_B} = \frac{1}{2}$$

Therefore, the ratio of powers consumed by the resistors  $A$  and  $B$  is 1 : 2.

### For Series Combination:

In a series combination, the total resistance is the sum of individual resistances. The power consumed in a series combination is given by:

$$P_S = \frac{V^2}{3R_B}$$

### For Parallel Combination:

In a parallel combination, the total resistance is given by the reciprocal of the sum of the reciprocals of individual resistances. The power consumed in a parallel combination is given by:

$$P_P = \frac{3V^2}{2R_B}$$

The ratio of power consumed in series combination to parallel combination is:

$$\frac{P_S}{P_P} = \frac{2}{9}$$

#### Quick Tip

The power ratio in series and parallel combinations depends on the total resistance in the circuit.

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

- (1) They are transverse in nature
- (2) The energy density in electric field is equal to energy density in magnetic field
- (3) They travel with a speed equal to  $\frac{1}{\sqrt{\mu_0\epsilon_0}}$
- (4) They originate from charges moving with uniform speed

**Correct Answer:** (4) They originate from charges moving with uniform speed

**Solution:** Electromagnetic waves are transverse, travel at the speed  $\frac{1}{\sqrt{\mu_0\epsilon_0}}$ , and have equal energy densities in the electric and magnetic fields. They are generated by accelerating charges, not by charges moving at uniform speed.

**Conclusion:** Thus, the incorrect property is (4).

#### Quick Tip

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

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

- (1) O

- (2) Se
- (3) Te
- (4) Po

**Correct Answer:** (4) Po

**Solution: Step 1: Oxidation states of Group 16 elements.**

The common oxidation states of Group 16 elements are -2, +2, +4, and +6. These elements tend to show the -2 oxidation state most often, but this is not true for all elements in the group.

**Step 2: Analyzing each element.**

Oxygen (O) readily forms compounds in the -2 oxidation state.

Selenium (Se) and Tellurium (Te) also commonly show the -2 oxidation state.

Polonium (Po), however, does not typically show the -2 oxidation state because it is a heavier element and prefers to form compounds in higher oxidation states, such as +2 and +4.

**Conclusion:** The element that does not show the -2 oxidation state is (4), Polonium.

#### Quick Tip

Polonium (Po) does not exhibit the -2 oxidation state, unlike the lighter Group 16 elements like oxygen and selenium.

#### 52. Match List I with List II.

List I (Molecule)	List II (Number and types of bonds)
A. Ethane	I. One $\sigma$ -bond and two $\pi$ -bonds
B. Ethene	II. Two $\pi$ -bonds
C. Carbon molecule, $C_2$	III. One $\sigma$ -bond
D. Ethyne	IV. One $\sigma$ -bond and one $\pi$ -bond

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

D-III

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

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

**Solution:****Step 1: Analyzing the bond types.**

Ethane ( $C_2H_6$ ) has a single bond between the carbon atoms, so it has one  $\sigma$ -bond (A-III).

Ethene ( $C_2H_4$ ) has a  $\sigma$ -bond and a  $\pi$ -bond between the carbon atoms (B-IV).

Carbon molecule  $C_2$  (dimer of carbon) has a triple bond, consisting of one  $\sigma$ -bond and two  $\pi$ -bonds (C-II).

Ethyne ( $C_2H_2$ ) has one  $\sigma$ -bond and one  $\pi$ -bond between the carbon atoms (D-I).

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

**Quick Tip**

Ethane, ethene, ethyne, and carbon molecules all have different bonding types between carbon atoms, determined by the number of bonds.

**53. Fehling's solution 'A' is:**

- (1) aqueous copper sulphate
- (2) alkaline copper sulphate
- (3) alkaline solution of sodium potassium tartrate (Rochelle's salt)
- (4) aqueous sodium citrate

**Correct Answer:** (1) aqueous copper sulphate

**Solution:****Step 1: Composition of Fehling's solution.**

Fehling's solution is used to test for the presence of reducing sugars. It consists of two solutions, Fehling's A and Fehling's B.

Fehling's A is an aqueous solution of copper sulphate ( $CuSO_4$ ).

Fehling's B is an alkaline solution of sodium potassium tartrate (Rochelle's salt).

**Step 2: Identifying Fehling's solution 'A'.**

Fehling's solution 'A' is specifically the aqueous copper sulphate solution.

**Conclusion:** The correct answer is (1), aqueous copper sulphate.

### Quick Tip

Fehling's solution consists of two solutions, Fehling's A (copper sulphate) and Fehling's B (sodium potassium tartrate).

#### 54. Match List I with List II.

List I (Conversion)	List II (Faraday Required)
A. 1 mol of $\text{H}_2\text{O}$ to $\text{O}_2$	3F
B. 1 mol of $\text{MnO}_4^-$ to $\text{Mn}^{2+}$	2F
C. 1.5 mol of Ca from molten $\text{CaCl}_2$	1F
D. 1 mol of $\text{FeO}$ to $\text{Fe}_2\text{O}_3$	5F

Choose the correct answer from the options given below:

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

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

**Solution: Step 1: Analyzing the conversions.**

For 1 mol of  $\text{H}_2\text{O}$  to  $\text{O}_2$ , the reaction involves the oxidation of water, requiring 2 Faradays per mole of  $\text{O}_2$ . Thus, 1 mol requires  $2F$  (A-II).

For 1 mol of  $\text{MnO}_4^-$  to  $\text{Mn}^{2+}$ , the reduction involves the transfer of 5 electrons, thus requiring  $5F$  (B-IV).

For 1.5 mol of Ca from molten  $\text{CaCl}_2$ , the electrolysis of  $\text{CaCl}_2$  requires 2 electrons per mole of Ca. For 1.5 moles, it requires  $3F$  (C-I).

For 1 mol of  $\text{FeO}$  to  $\text{Fe}_2\text{O}_3$ , the reaction involves the oxidation of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ , requiring 1 Faraday (D-III).

**Conclusion:** The correct matching is (1).

### Quick Tip

The number of Faradays required in an electrochemical reaction depends on the number of electrons transferred during the reaction.

**55. Identify the correct reagents that would bring about the following transformation.**



- (1) (i)  $\text{H}_2\text{O}/\text{H}^+$ , (ii)  $\text{CrO}_3$   
(2) (i)  $\text{BH}_3$ , (ii)  $\text{H}_2\text{O}_2/\text{OH}^-$ , (iii) PCC  
(3) (i)  $\text{BH}_3$ , (ii)  $\text{H}_2\text{O}_2/\text{OH}^-$ , (iii) alk.  $\text{KMnO}_4$ , (iv)  $\text{H}_3\text{O}^+$   
(4) (i)  $\text{H}_2\text{O}/\text{H}^+$ , (ii) PCC

**Correct Answer:** (2) (i)  $\text{BH}_3$ , (ii)  $\text{H}_2\text{O}_2/\text{OH}^-$ , (iii) PCC

**Solution: Step 1: Understanding the transformation.**

The given transformation involves the oxidation of an alkene (ethylene) to an aldehyde (acetaldehyde). The reagents must be selected to selectively oxidize the double bond of the alkene to form the aldehyde group.

**Step 2: Identifying the reagents.**

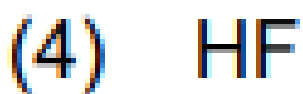
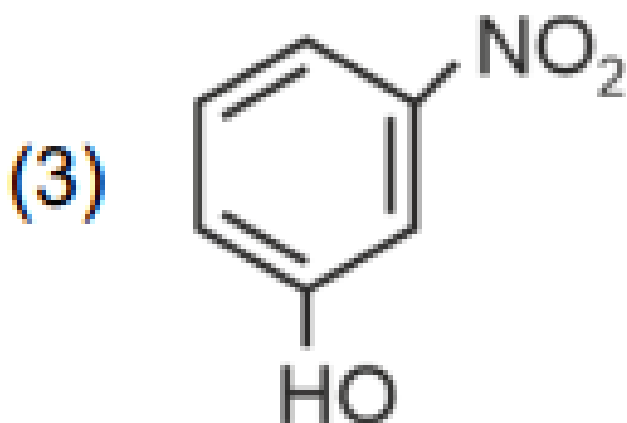
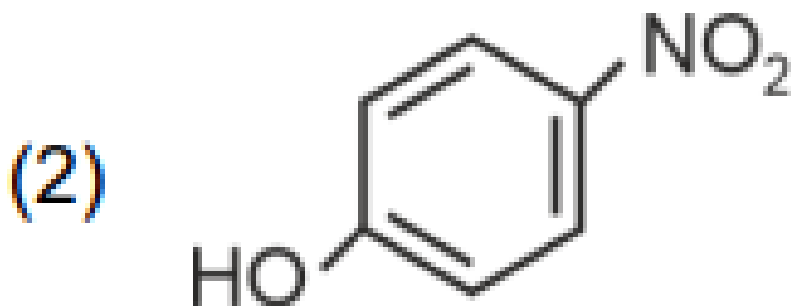
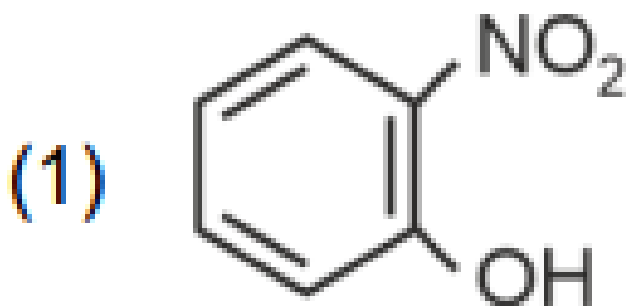
- (i)  $\text{BH}_3$  (Borane) is used to reduce the alkene to an alcohol.  
(ii)  $\text{H}_2\text{O}_2/\text{OH}^-$  (Hydrogen peroxide in the presence of a base) will then oxidize the alcohol to the aldehyde.

**Conclusion:** The correct reagents are (2).

### Quick Tip

Borane ( $\text{BH}_3$ ) reduces alkenes to alcohols, and hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) oxidizes alcohols to aldehydes.

**56. Intramolecular hydrogen bonding is present in:**



**Correct Answer:** (1)

**Solution: Step 1: Understanding intramolecular hydrogen bonding.** Intramolecular hydrogen bonding occurs when a hydrogen atom, attached to a highly electronegative atom (like oxygen or nitrogen), forms a bond with another electronegative atom within the same molecule.

**Step 2: Analyzing the given molecules.** - The molecule in option (1) shows a structure where the hydroxyl group and the nitro group are close enough to form an intramolecular

hydrogen bond. - The molecules in options (2) and (3) do not have the suitable arrangement to form intramolecular hydrogen bonds. - HF, in option (4), forms intermolecular hydrogen bonds, not intramolecular.

**Conclusion:** The correct answer is (1), where intramolecular hydrogen bonding is present.

#### Quick Tip

Intramolecular hydrogen bonding occurs within a molecule, whereas intermolecular hydrogen bonding occurs between different molecules.

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**57. Activation energy of any chemical reaction can be calculated if one knows the value of:**

- (1) rate constant at standard temperature
- (2) probability of collision
- (3) orientation of reactant molecules during collision
- (4) rate constant at two different temperatures

**Correct Answer:** (4) rate constant at two different temperatures

**Solution: Step 1: Understanding activation energy.** Activation energy ( $E_a$ ) is the energy required to convert reactants into products in a chemical reaction. The Arrhenius equation, which relates the rate constant to the activation energy, is:

$$k = Ae^{-\frac{E_a}{RT}}$$

where  $k$  is the rate constant,  $A$  is the pre-exponential factor,  $E_a$  is the activation energy,  $R$  is the gas constant, and  $T$  is the temperature.

**Step 2: Calculating activation energy.** The activation energy can be determined by knowing the rate constants at two different temperatures and using the Arrhenius equation to solve for  $E_a$ .

**Conclusion:** The correct answer is (4), as activation energy can be calculated using rate constants at two different temperatures.

### Quick Tip

The activation energy can be determined using the rate constant at two different temperatures with the help of the Arrhenius equation.

58. Match List I with List II:

List I (Complex)	List II (Type of isomerism)
A. $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$	Solvate isomerism
B. $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Br}$	Linkage isomerism
C. $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$	Ionization isomerism
D. $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$	Coordination isomerism

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

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

**Solution:** Complex A exhibits ionization isomerism because  $\text{NO}_2^-$  can ionize.

Complex B shows solvate isomerism due to  $\text{SO}_4^{2-}$  exchange with water molecules.

Complex C shows coordination isomerism between the two metal centers.

Complex D shows linkage isomerism because  $\text{Cl}^-$  can bind in multiple ways.

### Quick Tip

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

59. 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:

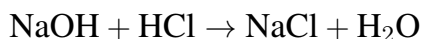
- (1) 750 mg
- (2) 250 mg

(3) Zero mg

(4) 200 mg

**Correct Answer:** (2) 250 mg

**Solution: Step 1: Writing the balanced chemical equation.** The reaction between sodium hydroxide (NaOH) and hydrochloric acid (HCl) is:



From this equation, 1 mole of NaOH reacts with 1 mole of HCl.

**Step 2: Moles of HCl used.** The molarity of HCl solution is 0.75 M, and the volume is 25 mL = 0.025 L. The moles of HCl used are:

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

**Step 3: Moles of NaOH reacted.** Since the reaction is 1:1, the moles of NaOH reacted will also be 0.01875 mol.

**Step 4: Mass of NaOH reacted.** The molar mass of NaOH is 40 g/mol. Therefore, the mass of NaOH reacted is:

$$\text{Mass of NaOH} = 0.01875 \times 40 = 0.75 \text{ g} = 750 \text{ mg}$$

**Step 5: Mass of NaOH left unreacted.** Initially, there was 1 g (1000 mg) of NaOH. The mass left unreacted is:

$$\text{Mass of NaOH left} = 1000 - 750 = 250 \text{ mg}$$

**Conclusion:** The mass of sodium hydroxide left unreacted is 250 mg, corresponding to option (2).

#### Quick Tip

The reaction between NaOH and HCl is a 1:1 reaction, meaning the moles of NaOH reacted will equal the moles of HCl used.

---

**60. Arrange the following elements in increasing order of electronegativity: N, O, F, C, Si**

(1)  $Si < C < N < O < F$

(2)  $Si < C < O < N < F$

(3)  $O < F < N < C < Si$

(4)  $F < O < N < C < Si$

**Correct Answer:** (1)  $Si < C < N < O < F$

**Solution: Step 1: Electronegativity trend.**

Electronegativity increases across a period and decreases down a group. Fluorine (F) is the most electronegative element, followed by oxygen (O), nitrogen (N), carbon (C), and silicon (Si).

**Step 2: Correct order.**

The correct order of increasing electronegativity is:



**Conclusion:** The correct order of electronegativity is (1),  $Si < C < N < O < F$ .

#### Quick Tip

Electronegativity increases from left to right across a period and decreases from top to bottom in a group.

#### 61. 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-III, C-II, D-I

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

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

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

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

**Solution: Step 1: Understanding each process.**

- Isothermal process: This process occurs at constant temperature, which corresponds to

option  $A - II$ . - Isochoric process: This process happens at constant volume, matching  
option  $B - III$ . - Isobaric process: This is a process that occurs at constant pressure, so it's  
 $C - IV$ . - Adiabatic process: In this process, there is no heat exchange with the  
surroundings, hence  $D - I$ .

**Step 2: Matching the processes with the conditions.** The correct matching is:

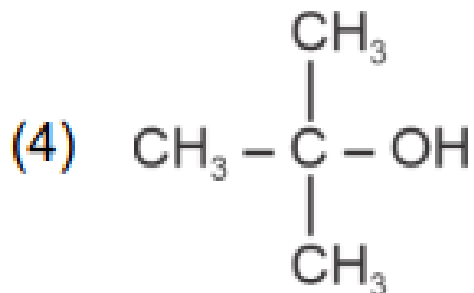
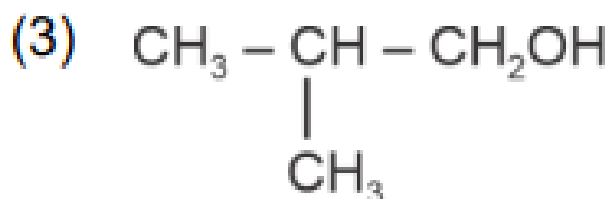
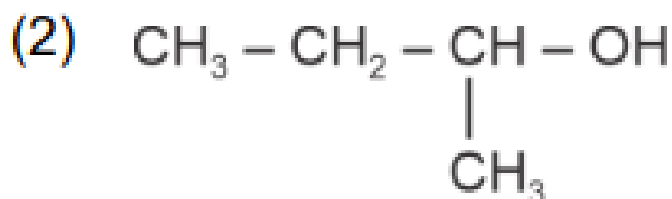
$A - II, B - III, C - IV, D - I$

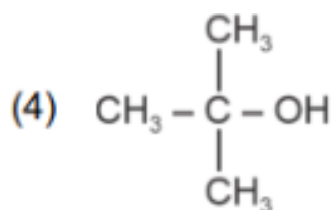
**Conclusion:** Thus, the correct answer is (4).

#### Quick Tip

Isothermal, isochoric, isobaric, and adiabatic processes are characterized by specific conditions of temperature, volume, pressure, and heat exchange.

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





**Correct Answer:**

**Solution: Step 1: Understanding Lucas reagent.**

Lucas reagent is a mixture of concentrated HCl and  $\text{ZnCl}_2$ , and it is commonly used to test alcohols for their reactivity. The reaction rate with Lucas reagent depends on the type of alcohol: - Tertiary alcohols react instantly, - Secondary alcohols take time to react, - Primary alcohols react very slowly or not at all.

**Step 2: Identifying the reactive alcohol.** Among the options, the tertiary alcohol reacts instantaneously with Lucas reagent because it forms a stable carbocation that facilitates the  $\text{S}_{\text{N}}1$  reaction mechanism.

**Conclusion:** The alcohol that reacts instantaneously with Lucas reagent is a tertiary alcohol, corresponding to option (4).

#### Quick Tip

Tertiary alcohols react quickly with Lucas reagent due to the formation of a stable tertiary carbocation.

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

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

**Correct Answer:** (1)  $-x$

**Solution: Case 1: Helium ion ( $\text{He}^+$ )** For  $\text{He}^+$ ,  $Z = 2$  and  $n = 1$ . The energy of the electron in the ground state is given as  $-x$ , and we can express this using the energy formula for a hydrogen-like atom:

$$E_1 = -R_H \left( \frac{Z^2}{n^2} \right)$$

Substituting  $Z = 2$  and  $n = 1$ :

$$E_1 = -4R_H = -x \quad \text{so} \quad R_H = \frac{x}{4}$$

**Case 2: Beryllium ion ( $Be^{3+}$ )** For  $Be^{3+}$ ,  $Z = 4$  and  $n = 2$ . The energy  $E_2$  is given by:

$$E_2 = -R_H \left( \frac{Z^2}{n^2} \right)$$

Substituting  $Z = 4$  and  $n = 2$ :

$$E_2 = -\frac{x}{4} \left( \frac{16}{4} \right) = -x$$

**Conclusion:** The energy for the  $n = 2$  state in the  $Be^{3+}$  ion is also  $-x$ , corresponding to option (1).

**Quick Tip**

The energy levels of hydrogen-like atoms are given by the formula  $E_n = -R_H \left( \frac{Z^2}{n^2} \right)$ .

**64. The compound that will undergo  $SN1$  reaction with the fastest rate is:**

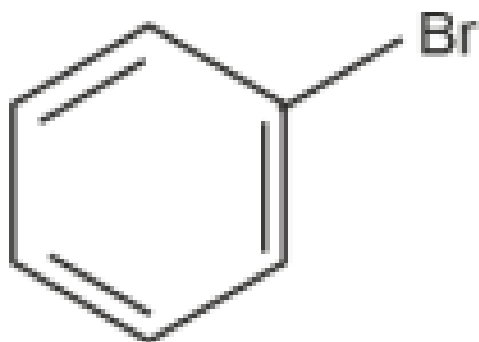
(1)



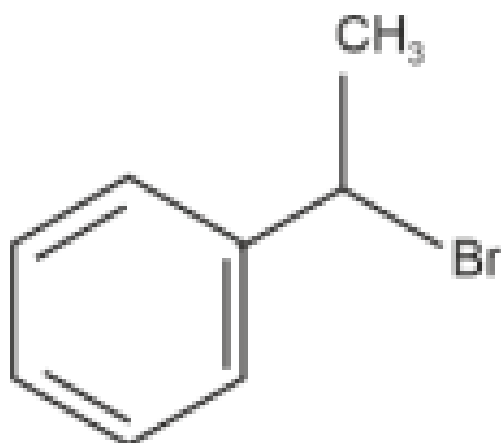
(2)



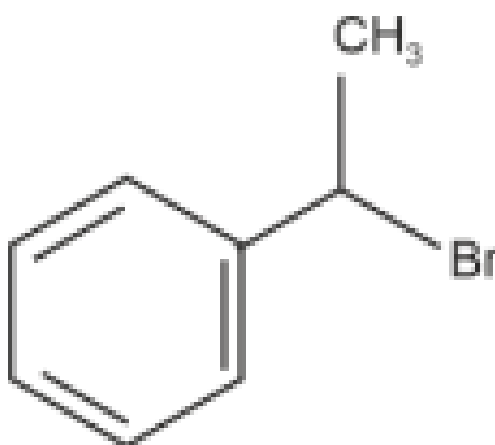
(3)



(4)



(4)



**Correct Answer:**

**Solution: Step 1: Understanding the SN1 mechanism.** The SN1 reaction involves the formation of a carbocation intermediate. The more stable the carbocation, the faster the reaction. Tertiary carbocations are more stable than secondary or primary ones, thus making tertiary alkyl halides react faster in SN1 reactions.

**Step 2: Analyzing the compounds.** - Option (4) shows a tertiary alkyl halide. Tertiary carbocations are highly stable due to inductive effects and hyperconjugation, so this

compound will react fastest in an SN1 reaction. - The other compounds either have primary or secondary carbocations, which are less stable and thus react slower.

**Conclusion:** The compound in option (4), a tertiary alkyl halide, will undergo the fastest SN1 reaction.

#### Quick Tip

Tertiary carbocations are more stable than secondary or primary ones, making tertiary alkyl halides react faster in SN1 reactions.

---

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

- (1)  $B > A > C$
- (2)  $B > C > A$
- (3)  $A > C > B$
- (4)  $A > B > C$

**Correct Answer:** (2)  $B > C > A$

**Solution: Step 1: Understanding Henry's law.** According to Henry's law, the solubility of a gas in a liquid is inversely proportional to its Henry's law constant. A smaller  $K_H$  means the gas is more soluble in the liquid.

**Step 2: Analyzing the gases.** - Gas B has the smallest  $K_H$  value, meaning it is the most soluble in water. - Gas C has a moderate  $K_H$  value, and gas A has the largest  $K_H$  value, making it the least soluble.

**Conclusion:** The solubility order is  $B > C > A$ , corresponding to option (2).

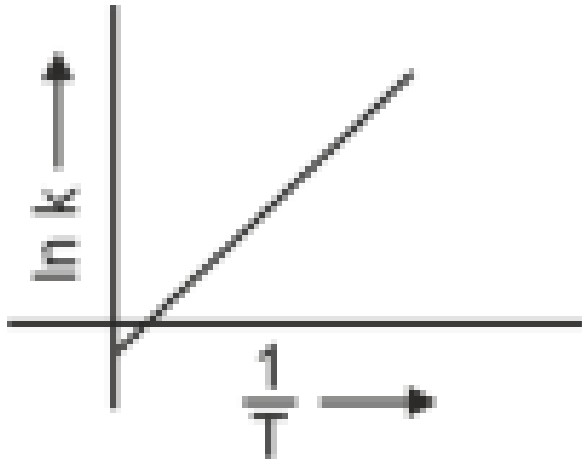
#### Quick Tip

The smaller the Henry's law constant, the higher the solubility of the gas in water.

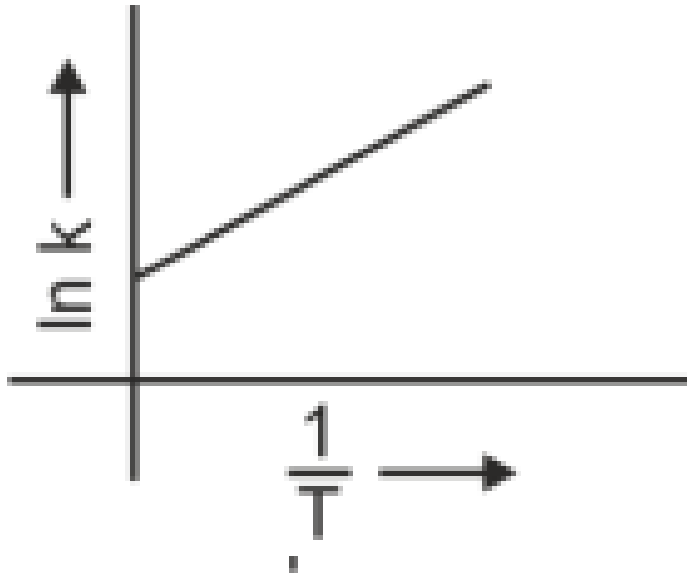
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**66. Which plot of  $\ln k$  vs  $\frac{1}{T}$  is consistent with the Arrhenius equation?**

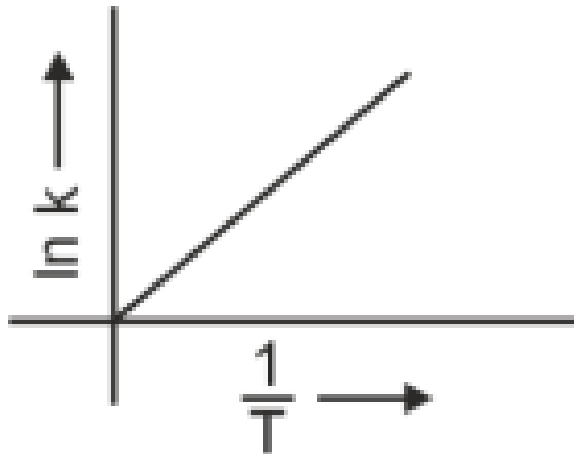
(1)

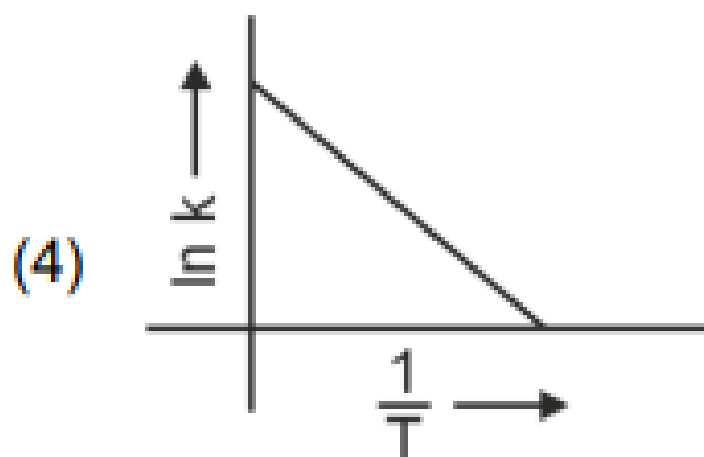
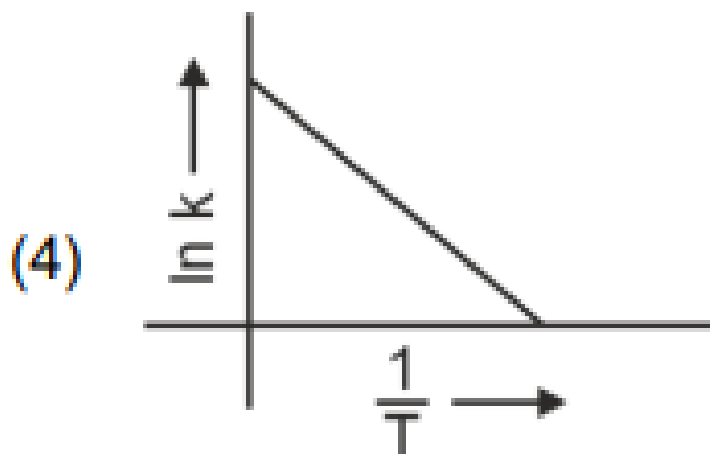


(2)



(3)





**Correct Answer:**

**Solution: Step 1: Arrhenius equation.** The Arrhenius equation is:

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

This equation has the form of a straight line, where  $\ln k$  is plotted against  $\frac{1}{T}$ .

**Step 2: Interpreting the plot.** The plot that yields a straight line with a negative slope corresponds to the Arrhenius equation. This is option (4).

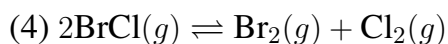
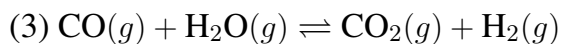
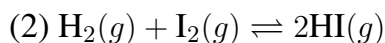
**Conclusion:** The plot in option (4) matches the form of the Arrhenius equation.

#### Quick Tip

In the Arrhenius equation, a plot of  $\ln k$  vs  $\frac{1}{T}$  gives a straight line with a slope of  $-\frac{E_a}{R}$ .

**67. In which of the following equilibria,  $K_p$  and  $K_c$  are NOT equal?**





**Correct Answer:** (1)

**Solution: Step 1: Understanding  $K_p$  and  $K_c$ .** The relationship between  $K_p$  and  $K_c$  is given by:

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

where  $\Delta n$  is the change in the number of moles of gases.

**Step 2: Identifying the correct equilibrium.** For the reaction  $\text{PCl}_5(g) \rightleftharpoons \text{PCl}_3(g) + \text{Cl}_2(g)$ , there is no change in the number of moles of gas ( $\Delta n = 0$ ), so  $K_p = K_c$  holds. However, for the other reactions,  $\Delta n \neq 0$ , and thus  $K_p \neq K_c$ .

**Conclusion:** In the equilibrium  $\text{PCl}_5(g) \rightleftharpoons \text{PCl}_3(g) + \text{Cl}_2(g)$ ,  $K_p$  and  $K_c$  are not equal, so the correct answer is (1).

#### Quick Tip

When the number of moles of gases changes in a reaction,  $K_p$  and  $K_c$  are not equal.

---

**68. Given below are two statements: Statement I:** The boiling point of three isomeric pentanes follows the order



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

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

- (1) Both Statement I and Statement II are correct
- (2) Both Statement I and Statement II are incorrect
- (3) Statement I is correct but Statement II is incorrect
- (4) Statement I is incorrect but Statement II is correct

**Correct Answer:** (1)

**Solution: Step 1: Understanding the boiling points of isomers.** n-pentane has a higher boiling point than isopentane, which in turn is higher than neopentane due to the difference in molecular shape. Straight-chain molecules like n-pentane have more surface contact, leading to stronger intermolecular forces.

**Step 2: Understanding branching effect.** Branching reduces the surface area of the molecule, resulting in weaker London dispersion forces and thus a lower boiling point, as described in Statement II.

**Conclusion:** Both statements are correct, so the answer is (1).

#### Quick Tip

Increased branching decreases the boiling point due to reduced surface area for intermolecular forces.

---

**69. 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.  $\text{NH}_2\text{OH}$
- E.  $\text{NaHSO}_3$

Choose the correct options from the given below:

- (1) B and C
- (2) A and D
- (3) B and D
- (4) E and D

**Correct Answer:** (3) B and D

**Solution: Step 1: Identifying glucose reactions.**

Glucose reacts with Tollen's reagent to form silver mirror (A).

Glucose reacts with Schiff's reagent to form a red color (B).

Glucose reacts with  $\text{NaHSO}_3$  to form a product (E).

Glucose does not react with  $\text{NH}_2\text{OH}$  (D).

**Conclusion:** The correct answer is (3), where glucose does not react with B (Schiff's reagent) and D (NH<sub>2</sub>OH).

#### Quick Tip

Glucose is a reducing sugar and reacts with various reagents like Tollen's and Schiff's reagents, but not with NH<sub>2</sub>OH.

### 70. 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 and C  
(2) A, B and D  
(3) A, C and D  
(4) C and D

**Correct Answer:** (3) A, C and D

**Solution: Step 1: Entropy and spontaneity.** Entropy is a measure of disorder or randomness. For most processes, entropy increases when the system becomes more disordered, such as during phase changes or when the number of gas molecules increases.

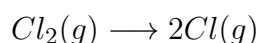
**General Principle:** When a liquid evaporates to vapor, entropy increases.

#### Example 1:



The number of gaseous product molecules increases, so entropy increases.

#### Example 2:



1 mole of  $\text{Cl}_2(g)$  forms 2 moles of  $\text{Cl}(g)$ . So entropy increases.

**Conclusion:** Processes (A) (C) and (D) result in an increase in entropy, so the correct answer is (3).

#### Quick Tip

Entropy increases when a system becomes more disordered or when the number of gas molecules increases.

#### 71. Match List I with List II.

List I (Reaction)	List II (Reagents/Condition)
A. $C_6H_6 \rightarrow 2C_6H_5$	I. Cl/Anhyd. $AlCl_3$
B. $C_6H_5OH \rightarrow C_6H_5COOH$	II. $CrO_3$
C. $C_6H_5CH_3 \rightarrow C_6H_5COOH$	III. $KMnO_4/KOH, \Delta$
D. $C_6H_5CH_3 \rightarrow C_6H_4(CH_3)$	IV. $O_3, Zn-H_2O$

Choose the correct answer from the options given below:

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

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

**Solution: Step 1: Identifying the reactions and conditions.**

Reaction A uses  $KMnO_4/KOH$  for oxidation.

Reaction B uses  $CrO_3$  for oxidation of aldehydes.

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

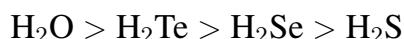
Reaction D involves ozonolysis.

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

#### Quick Tip

Electrophilic substitution reactions in aromatic compounds can be carried out using reagents like  $AlCl_3$ , while oxidations often require reagents like  $CrO_3$  or  $KMnO_4$ .

**72. Given below are two statements: Statement I:** The boiling point of hydrides of Group 16 elements follows the order



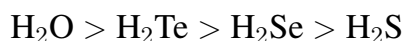
**Statement II:** On the basis of molecular mass,  $\text{H}_2\text{O}$  is expected to have lower boiling point than the other members of the group but due to the presence of extensive H-bonding in  $\text{H}_2\text{O}$ , it has higher boiling point.

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

- (1) Both Statement I and Statement II are TRUE
- (2) Both Statement I and Statement II are false
- (3) Statement I is correct but Statement II is FALSE
- (4) Statement I is incorrect but Statement II is TRUE

**Correct Answer:** (1) Both Statement I and Statement II are TRUE

**Solution: Step 1: Boiling points of Group 16 hydrides.** The boiling points of the hydrides of Group 16 elements follow the trend:



This is because water has extensive hydrogen bonding, which results in a higher boiling point compared to other hydrides.

**Step 2: Understanding the molecular mass effect.** Though  $\text{H}_2\text{O}$  has a lower molecular mass compared to the other hydrides, the extensive hydrogen bonding in water significantly raises its boiling point.

**Conclusion:** Both statements are correct, so the answer is (1).

#### Quick Tip

Hydrogen bonding in water increases its boiling point despite its relatively lower molecular mass compared to other Group 16 hydrides.

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**73. For the reaction  $2A \rightleftharpoons B + C$ ,  $K_c = 4 \times 10^{-3}$ . At a given time, the composition of reaction mixture is:**

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

Then, which of the following is correct?

- (1) Reaction is at equilibrium.
- (2) Reaction has a tendency to go in forward direction.
- (3) Reaction has a tendency to go in backward direction.
- (4) Reaction has gone to completion in forward direction.

**Correct Answer:** (3)

**Solution: Step 1: Checking the reaction quotient  $Q_c$ .** The reaction quotient  $Q_c$  is given by:

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

Substituting the values:

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

**Step 2: Comparing  $Q_c$  with  $K_c$ .** Since  $Q_c > K_c$ , the reaction will shift toward the left (backward direction).

**Conclusion:** The reaction has a tendency to go in the backward direction, corresponding to option (3).

#### Quick Tip

When  $Q_c > K_c$ , the reaction shifts toward the reactants (backward direction).

#### 74. Match List I with List II.

List I (Quantum Number)	List II (Information Provided)
$m$	Shape of orbital
$m_s$	Orientation of spin of electron
$l$	Size of orbital
$n$	Orientation of orbital

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

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

**Solution: Step 1: Identifying the quantum numbers.**

$m_l$  (magnetic quantum number) provides information about the orientation of the orbital (A-III).

$m_s$  (spin quantum number) provides information about the orientation of the spin of the electron (B-IV).

$l$  (azimuthal quantum number) provides information about the shape of the orbital (C-I).

$n$  (principal quantum number) provides information about the size of the orbital (D-II).

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

**Quick Tip**

Each quantum number provides specific information about the orbital characteristics such as shape, orientation, size, and electron spin.

---

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

- (1) n-hexane
- (2) 2-methylpentane
- (3) 2,3-dimethylbutane
- (4) 2,2-dimethylbutane

**Correct Answer:** (3) 2,3-dimethylbutane

**Solution: Step 1: Analyzing the molecular formula.**

The molecular formula is  $C_6H_{14}$ , which suggests a straight chain alkane. We are told the compound has two tertiary carbons. Tertiary carbons are carbon atoms bonded to three other carbon atoms.

**Step 2: Identifying the structure.** - 2,3-dimethylbutane fits the description because the structure includes two methyl groups attached to the second and third carbon atoms of a butane backbone, making two tertiary carbons.

**Conclusion:** The IUPAC name of the compound is 2, 3-dimethylbutane.

### Quick Tip

Tertiary carbons are carbon atoms attached to three other carbon atoms, typically found in branched structures.

**76. On heating, some solid substances change from solid to vapor state without passing through liquid state. The technique used for the purification of such solid substances based on the above principle is known as:**

- (1) Crystallization
- (2) Sublimation
- (3) Distillation
- (4) Chromatography

**Correct Answer:** (2) Sublimation

**Solution: Step 1: Understanding sublimation.** Sublimation is the process in which a substance changes directly from the solid phase to the gaseous phase without passing through the liquid phase.

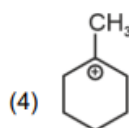
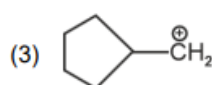
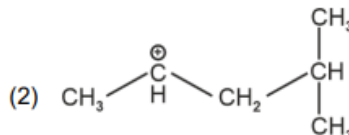
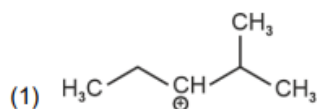
**Step 2: Identifying the purification technique.** Sublimation is used to purify substances that can directly transition from solid to vapor, such as iodine and naphthalene.

**Conclusion:** The correct technique is (2), sublimation.

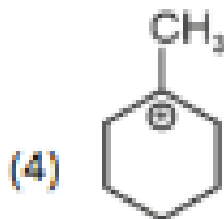
### Quick Tip

Sublimation is useful for purifying substances that can transition directly from solid to gas, bypassing the liquid state.

**77. The most stable carbocation among the following is:**

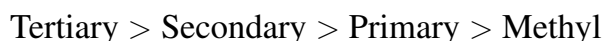


**Correct Answer:**



**Solution: Step 1: Understanding carbocation stability.**

Carbocation stability follows the order:



The more alkyl groups attached to the positively charged carbon, the more stable the carbocation due to inductive effects and hyperconjugation.

**Step 2: Analyzing the given carbocations.**

Option (1) shows a tertiary carbocation, which is the most stable type.

Option (2) is a secondary carbocation.

Option (3) and (4) are less stable than the tertiary carbocation.

**Conclusion:** The most stable carbocation is the tertiary one in option (1).

#### Quick Tip

Tertiary carbocations are more stable due to inductive effects and hyperconjugation from neighboring alkyl groups.

**78. Given below are two statements: Statement I:** Aniline does not undergo Friedel-Crafts alkylation reaction. **Statement II:** Aniline cannot be prepared through Gabriel synthesis.

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

- (1) Both statement I and Statement II are true
- (2) Both Statement I and Statement II are false
- (3) Statement I is correct but Statement II is false
- (4) Statement I is incorrect but Statement II is true

**Correct Answer:** (1) Both statement I and Statement II are true

**Solution: Step 1: Understanding Friedel-Crafts alkylation.**

Aniline does not undergo Friedel-Crafts alkylation because the amino group ( $-\text{NH}_2$ ) is an electron-donating group, which deactivates the aromatic ring towards electrophilic substitution.

**Step 2: Understanding Gabriel synthesis.**

Gabriel synthesis can be used to prepare primary amines from phthalimide, and aniline can indeed be synthesized through Gabriel synthesis.

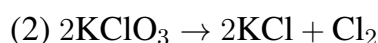
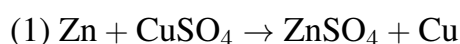
**Conclusion:** Both statements are true, so the correct answer is (1).

**Quick Tip**

Aniline is resistant to Friedel-Crafts alkylation due to the electron-donating nature of the amino group. Gabriel synthesis is a method for preparing primary amines, including aniline.

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**79. Which reaction is NOT a redox reaction?**



**Correct Answer:** (4)  $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$

**Solution: Step 1: Identifying redox reactions.** In a redox reaction, there is a transfer of electrons, with one substance being oxidized and another being reduced.

**Step 2: Analyzing the reactions.**

- Option (1) involves the reduction of  $\text{Cu}^{2+}$  to  $\text{Cu}$  and the oxidation of  $\text{Zn}$  to  $\text{Zn}^{2+}$ , so it is a redox reaction.
- Option (2) involves the reduction of  $\text{KClO}_3$  to  $\text{KCl}$  and the oxidation of  $\text{Cl}^-$  to  $\text{Cl}_2$ , so it is a redox reaction.
- Option (3) involves the reduction of  $\text{Cl}^-$  and the oxidation of  $\text{H}_2$  to form  $\text{HCl}$ , so it is a redox reaction.
- Option (4) is a double displacement reaction with no change in oxidation states, so it is not a redox reaction.

**Conclusion:** The reaction in option (4) is not a redox reaction.

### Quick Tip

In a redox reaction, there is a transfer of electrons between reactants, whereas in a double displacement reaction, there is no change in oxidation states.

### 80. Match List I with List II.

List I (Compound)	List II (Shape/geometry)
A. $\text{NH}_3$	I. Trigonal Pyramidal
B. $\text{Br}_5$	II. Square Planar
C. $\text{XeF}_4$	III. Octahedral
D. $\text{SF}_6$	IV. Square Pyramidal

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

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

**Solution: Step 1: Analyzing the compounds.**

- $\text{NH}_3$  has a trigonal pyramidal shape due to the lone pair on nitrogen (A-I).
- $\text{Br}_5$  is square pyramidal in shape (B-IV).
- $\text{XeF}_4$  has a square planar geometry due to its four bonding pairs and two lone pairs (C-II).
- $\text{SF}_6$  has an octahedral geometry with six bonding pairs of electrons (D-III).

**Conclusion:** The correct matching is (1).

### Quick Tip

The shape of molecules can be determined using VSEPR theory based on the number of bonding and lone pairs of electrons.

**81. Arrange the following elements in increasing order of first ionization enthalpy: Li, Be, B, C, N**

(1)  $Li < Be < B < C < N$

(2)  $Li < B < Be < C < N$

(3)  $Li < Be < C < B < N$

(4)  $Li < Be < N < C < B$

**Correct Answer:** (2)  $Li < B < Be < C < N$

**Solution: Step 1: Understanding ionization enthalpy.** Ionization enthalpy represents the amount of energy required to remove an electron from an atom in the gaseous phase. It typically increases as we move across a period due to increased nuclear charge, and decreases as we move down a group because the outermost electron is farther from the nucleus.

**Step 2: Analyzing the elements.** - Lithium ( $Li$ ) has the lowest ionization enthalpy in this list. - Boron ( $B$ ) has a relatively low ionization enthalpy because of its half-filled p-orbital, which is relatively stable. - Beryllium ( $Be$ ) has a higher ionization enthalpy compared to boron due to its full 2s orbital. - Carbon ( $C$ ) and nitrogen ( $N$ ) both have higher ionization enthalpies due to their higher nuclear charge, and nitrogen's half-filled p-orbital adds additional stability.

**Conclusion:** The correct order of increasing ionization enthalpy is  $Li < B < Be < C < N$ , corresponding to option (2).

#### Quick Tip

Ionization enthalpy increases across a period because the increasing nuclear charge makes it harder to remove an electron.

---

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

A.  $Ti^{3+}$

B.  $Cr^{2+}$

C.  $Mn^{2+}$

D.  $Fe^{2+}$

E.  $Sc^{3+}$

Choose the most appropriate answer from the options given below.

(1) B and D only

(2) A and E only

(3) B and C only

(4) A and D only

**Correct Answer:** (1) B and D only

**Solution: Step 1: Understanding magnetic moment.** The magnetic moment is determined by the number of unpaired electrons in an ion, and is calculated using the formula:

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

where  $n$  is the number of unpaired electrons.

**Step 2: Identifying the ions.** -  $\text{Ti}^{3+}$  has a  $d^1$  configuration, resulting in 1 unpaired electron.

-  $\text{Mn}^{2+}$  has a  $d^5$  configuration, leading to 5 unpaired electrons. -  $\text{Sc}^{3+}$  has a  $d^0$  configuration, meaning no unpaired electrons (diamagnetic). -  $\text{Cr}^{2+}$  has a  $d^4$  configuration, resulting in 4 unpaired electrons. -  $\text{Fe}^{2+}$  has a  $d^6$  configuration, leading to 4 unpaired electrons.

Among these ions,  $\text{Cr}^{2+}$  (B) and  $\text{Fe}^{2+}$  (D) have the same number of unpaired electrons (4), and thus they will exhibit the same "spin only" magnetic moment.

**Conclusion:** The correct answer is (1), as B and D have the same magnetic moment.

#### Quick Tip

The magnetic moment is directly related to the number of unpaired electrons in an ion. "Spin only" magnetic moment is determined by this number.

---

**83. The  $E^\circ$  value for the  $\text{Mn}^{3+}/\text{Mn}^{2+}$  couple is more positive than that of  $\text{Cr}^{3+}/\text{Cr}^{2+}$  or  $\text{Fe}^{3+}/\text{Fe}^{2+}$  due to change of:**

(1)  $d^5$  to  $d^4$  configuration

(2)  $d^5$  to  $d^2$  configuration

(3)  $d^4$  to  $d^5$  configuration

(4)  $d^3$  to  $d^5$  configuration

**Correct Answer:** (3)  $d^4$  to  $d^5$  configuration

**Solution: Step 1: Understanding the stability of electron configurations.** The  $\text{Mn}^{3+}$  ion has a  $d^4$  electron configuration, while  $\text{Mn}^{2+}$  has a  $d^5$  configuration, which is especially stable due to the half-filled stability of the  $d^5$  configuration. Thus, the transition from  $d^4$  to  $d^5$  results in a significant increase in stability, leading to a more positive  $E^\circ$  value for the

$\text{Mn}^{3+}/\text{Mn}^{2+}$  couple.

**Step 2: Analyzing other couples.** Other couples like  $\text{Cr}^{3+}/\text{Cr}^{2+}$  and  $\text{Fe}^{3+}/\text{Fe}^{2+}$  do not have such a stable transition.

**Conclusion:** The correct answer is (3), the transition from  $d^4$  to  $d^5$  configuration accounts for the higher positive  $E^\circ$  value for the  $\text{Mn}^{3+}/\text{Mn}^{2+}$  couple.

#### Quick Tip

The stability of electron configurations plays a crucial role in determining the reduction potential of a metal ion.

---

**84. The highest number of helium atoms is in:**

- (1) 4 mol of helium
- (2) 4 u of helium
- (3) 3 g of helium
- (4) 2.271098 L of helium at STP

**Correct Answer:** (1) 4 mol of helium

**Solution: Step 1: Understanding the number of atoms in a mole.** One mole of any substance contains  $6.022 \times 10^{23}$  atoms, which is known as Avogadro's number.

**Step 2: Analyzing the options.** - Option (1) corresponds to 4 moles of helium, which will contain the highest number of helium atoms. - The other options represent smaller quantities of helium.

**Conclusion:** The correct answer is (1), 4 mol of helium contains the highest number of helium atoms.

#### Quick Tip

One mole of any substance contains  $6.022 \times 10^{23}$  atoms, which is known as Avogadro's number.

---

**85. Given below are two statements:**

**Statement I:** Both  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{CoF}_6]^{3-}$  complexes are octahedral but differ in their

magnetic behaviour. **Statement II:**  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is diamagnetic whereas  $[\text{CoF}_6]^{3-}$  is paramagnetic.

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

- (1) Both Statement I and Statement II are correct
- (2) Both Statement I and Statement II are incorrect
- (3) Statement I is correct but Statement II is false
- (4) Statement I is false but Statement II is correct

**Correct Answer:** (1) Both Statement I and Statement II are true

**Solution: Step 1: Understanding the complexes.** Both  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{CoF}_6]^{3-}$  are octahedral complexes due to the presence of six ligands around the central metal ion, cobalt. However, they exhibit different magnetic properties due to the nature of their ligands.

**Step 2: Analyzing the magnetic behaviour.** -  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is diamagnetic, meaning that all electrons in the  $d^6$  configuration pair up, resulting in no unpaired electrons. -  $[\text{CoF}_6]^{3-}$  is paramagnetic because fluoride ligands do not cause pairing of electrons, leaving unpaired electrons in the  $d^6$  configuration.

**Conclusion:** Both statements are true, so the correct answer is (1).

#### Quick Tip

Diamagnetism occurs when all electrons are paired, while paramagnetism arises when there are unpaired electrons.

---

**86. The pair of lanthanoid ions which are diamagnetic is:**

- (1)  $\text{Ce}^{4+}$  and  $\text{Yb}^{2+}$
- (2)  $\text{Ce}^{3+}$  and  $\text{Eu}^{2+}$
- (3)  $\text{Gd}^{3+}$  and  $\text{Eu}^{3+}$
- (4)  $\text{Pm}^{3+}$  and  $\text{Sm}^{3+}$

**Correct Answer:** (1)  $\text{Ce}^{4+}$  and  $\text{Yb}^{2+}$

**Solution: Step 1: Identifying the electron configuration.** -  $\text{Ce}^{4+}$  has a completely empty 4f orbital, leading to its diamagnetism. -  $\text{Yb}^{2+}$  has a completely filled 4f orbital, which makes it diamagnetic.

**Step 2: Analyzing the other ions.** -  $\text{Ce}^{3+}$  and  $\text{Eu}^{2+}$  both have unpaired electrons, meaning they are paramagnetic. -  $\text{Gd}^{3+}$ ,  $\text{Eu}^{3+}$ ,  $\text{Pm}^{3+}$ , and  $\text{Sm}^{3+}$  also possess unpaired electrons, making them paramagnetic.

**Conclusion:** The diamagnetic pair is  $\text{Ce}^{4+}$  and  $\text{Yb}^{2+}$ , corresponding to option (1).

#### Quick Tip

Lanthanoid ions with completely filled or empty f-orbitals are diamagnetic, while those with unpaired electrons are paramagnetic.

---

**87. Given below are certain cations. Using inorganic qualitative analysis, arrange them in increasing group number from 0 to VI.**

A.  $\text{Al}^{3+}$

B.  $\text{Cu}^{2+}$

C.  $\text{Ba}^{2+}$

D.  $\text{Co}^{2+}$

E.  $\text{Mg}^{2+}$

Choose the correct answer from the options given below:

(1) B, A, D, C, E

(2) B, C, A, D, E

(3) E, C, D, B, A

(4) E, A, B, C, D

**Correct Answer:** (1) B, A, D, C, E

**Solution: Step 1: Understanding the cations.** -  $\text{Al}^{3+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Co}^{2+}$ , and  $\text{Mg}^{2+}$  belong to different groups in the periodic table. - Using qualitative analysis, we can group these cations as follows:

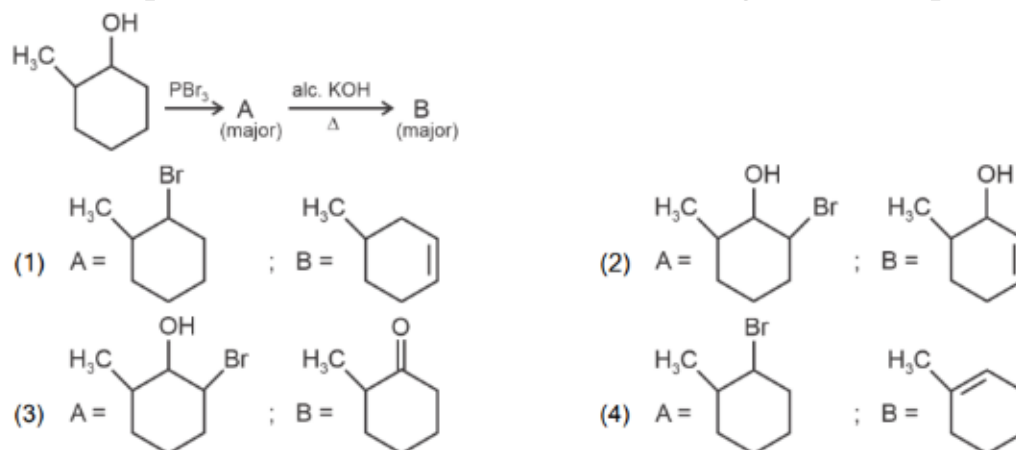
B ( $\text{Cu}^{2+}$ ), A ( $\text{Al}^{3+}$ ), D ( $\text{Co}^{2+}$ ), C ( $\text{Ba}^{2+}$ ), E ( $\text{Mg}^{2+}$ )

**Conclusion:** The correct order in increasing group number is (1), B, A, D, C, E.

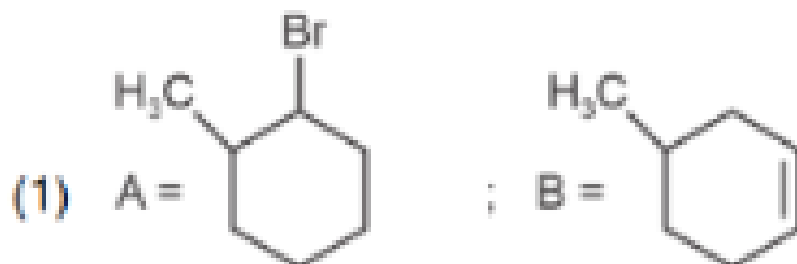
### Quick Tip

In inorganic qualitative analysis, cations are grouped based on their chemical reactivity with various reagents.

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



**Correct Answer:**



**Solution:** In this reaction sequence, the alcohol undergoes halogenation with  $\text{PBr}_3$ , resulting in the formation of a bromo compound. This is followed by a reaction with alcoholic KOH, leading to the formation of an alkene via elimination. Finally, the alkene reacts with  $\text{Br}_2$ , producing a dibromo product.

**Conclusion:** The major products formed are A: Alkene, B: Dibromo compound.

### Quick Tip

Reactions involving  $\text{PBr}_3$ , KOH, and  $\text{Br}_2$  are typical for converting alcohols into alkenes and then halogenating them.

89. The work done during reversible isothermal expansion of one mole of hydrogen gas at 25°C from pressure of 20 atmosphere to 10 atmosphere is: (Given  $R = 2.0 \text{ cal K}^{-1} \text{ mol}^{-1}$ )

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

**Correct Answer:** (2) -413.14 calories

**Solution:** For isothermal expansion, the work done is given by the formula:

$$W = -nRT \ln \left( \frac{V_f}{V_i} \right)$$

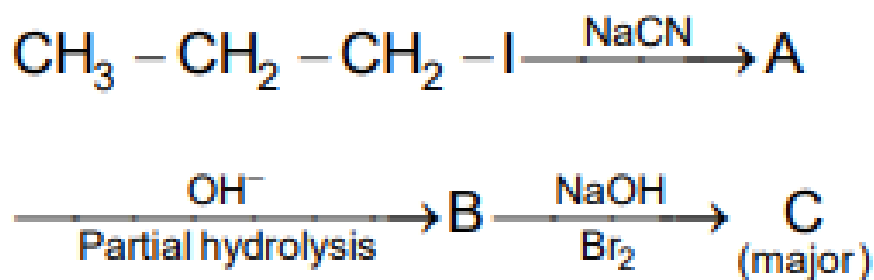
Since  $P_1V_1 = P_2V_2$ , the work done can be calculated by considering the pressure and volume change, and the negative sign indicates that the gas does work on the surroundings.

**Conclusion:** The work done during the reversible isothermal expansion is  $\boxed{-413.14}$  calories.

#### Quick Tip

In an isothermal process, the temperature remains constant, and the work done can be calculated using the gas law equations.

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



- (1) propylamine
- (2) butylamine
- (3) butanamide
- (4)  $\alpha$ -bromobutanoic acid

**Correct Answer:** (1) propylamine

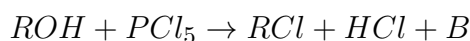
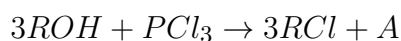
**Solution:** In the first step of the reaction sequence, the alcohol is treated with NaCN to form a nitrile. This nitrile undergoes partial hydrolysis, followed by reaction with NaOH and Br<sub>2</sub> to yield an amine.

**Conclusion:** The major product is propylamine, corresponding to option (1).

#### Quick Tip

The nucleophilic substitution with NaCN followed by hydrolysis and alkylation typically leads to the formation of amines.

**91. The products A and B obtained in the following reactions, respectively, are**



- (1) POCl<sub>3</sub> and H<sub>3</sub>PO<sub>3</sub>
- (2) POCl<sub>3</sub> and H<sub>3</sub>PO<sub>4</sub>
- (3) H<sub>3</sub>PO<sub>4</sub> and POCl<sub>3</sub>
- (4) H<sub>3</sub>PO<sub>3</sub> and POCl<sub>3</sub>

**Correct Answer:** (4) H<sub>3</sub>PO<sub>3</sub> and POCl<sub>3</sub>

**Solution:** In the first reaction, PCl<sub>3</sub> reacts with alcohol (ROH) to form alkyl chloride (RCl) and phosphorous acid (H<sub>3</sub>PO<sub>3</sub>).

In the second reaction, PCl<sub>5</sub> reacts with alcohol to form alkyl chloride (RCl), hydrochloric acid (HCl), and POCl<sub>3</sub>.

**Conclusion:** The products are H<sub>3</sub>PO<sub>3</sub> and POCl<sub>3</sub>, corresponding to option (4).

#### Quick Tip

PCl<sub>3</sub> and PCl<sub>5</sub> are both common chlorinating agents for alcohols. The products depend on the stoichiometry and the nature of the chlorinating agent.

**92. Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is (Given: Molar mass of Cu = 63 g mol<sup>-1</sup>, 1 F = 96487 C)**

- (1) 3.15 g
- (2) 0.315 g
- (3) 31.5 g
- (4) 0.0315 g

**Correct Answer:** (2) 0.315 g

**Solution:** Using the formula for electrochemical deposition:

$$\text{Mass} = \frac{M \cdot I \cdot t}{n \cdot F}$$

where: - M = Molar mass of copper = 63 g/mol - I = Current = 9.6487 A - t = Time = 100 s -  
n = Number of electrons = 2 (for Cu<sup>2+</sup>) - F = Faraday constant = 96487 C/mol

Substituting the values:

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

**Conclusion:** The mass of copper deposited is 0.315 g, corresponding to option (2).

#### Quick Tip

The electrochemical deposition of metals can be calculated using Faraday's law of electrolysis.

**93. A compound X contains 32% of A, 20% of B and the remaining percentage of C. Then, the empirical formula of X is:** (Given atomic masses of A = 64, B = 40, C = 32 u)

- (1) A<sub>2</sub>BC<sub>2</sub>
- (2) ABC<sub>3</sub>
- (3) AB<sub>2</sub>C<sub>2</sub>
- (4) ABC<sub>4</sub>

**Correct Answer:** (2) ABC<sub>3</sub>

**Solution:** To calculate the empirical formula, assume 100 g of the compound. Therefore,

Mass of A = 32 g

Mass of B = 20 g

Mass of C = 48 g (since the total is 100 g)

Now, calculate the moles of each element:

Moles of A =  $\frac{32}{64} = 0.5 \text{ mol}$

Moles of B =  $\frac{20}{40} = 0.5$  mol

Moles of C =  $\frac{48}{32} = 1.5$  mol

The simplest ratio of A:B:C is 1:1:3, so the empirical formula is  $ABC_3$ .

**Conclusion:** The empirical formula is  $ABC_3$ , corresponding to option (2).

#### Quick Tip

The empirical formula represents the simplest whole-number ratio of elements in a compound.

---

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

- (1) dilute hydrochloric acid
- (2) concentrated sulphuric acid
- (3) dilute nitric acid
- (4) dilute sulphuric acid

**Correct Answer:** (4) dilute sulphuric acid

**Solution:** During the preparation of Mohr's salt ( $Fe(NH_4)_2SO_4 \cdot 6H_2O$ ), dilute sulphuric acid is used to prevent the hydrolysis of  $Fe^{2+}$  ions.

Hydrolysis can occur in the presence of higher concentrations of acid, which would result in the precipitation of iron(III) hydroxide.

**Conclusion:** The correct acid is dilute sulphuric acid, corresponding to option (4).

#### Quick Tip

Dilute sulphuric acid prevents the oxidation of  $Fe^{2+}$  to  $Fe^{3+}$  during the preparation of Mohr's salt.

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**95. Identify the correct answer.**

- (1) Three resonance structures can be drawn for ozone.
- (2)  $BF_3$  has non-zero dipole moment.
- (3) Dipole moment of  $NF_3$  is greater than that of  $NH_3$ .

(4) Three canonical forms can be drawn for  $\text{CO}_3^{2-}$  ion.

**Correct Answer:** (4) Three canonical forms can be drawn for  $\text{CO}_3^{2-}$  ion.

**Solution:** Ozone ( $\text{O}_3$ ) has three resonance structures, but it does not fit option (1) fully.

$\text{BF}_3$  has zero dipole moment because it has a symmetric trigonal planar shape.

The dipole moment of  $\text{NF}_3$  is less than that of  $\text{NH}_3$ , contradicting option (3).

$\text{CO}_3^{2-}$  has three canonical resonance forms, which makes option (4) correct.

**Conclusion:** The correct answer is (4).

#### Quick Tip

Resonance structures help explain the delocalization of electrons in molecules, such as the carbonate ion.

**96. The rate of a reaction quadruples when temperature changes from  $27^\circ\text{C}$  to  $57^\circ\text{C}$ .**

**Calculate the energy of activation.** Given  $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $\log 4 = 0.6021$

(1) 38.04 kJ/mol

(2) 380.4 kJ/mol

(3) 3.80 kJ/mol

(4) 3804 kJ/mol

**Correct Answer:** (1) 38.04 kJ/mol

**Solution:** From the Arrhenius equation, the change in rate constant with temperature is given by:

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

Since the rate quadruples, we have:

$$\frac{k_2}{k_1} = 4 \quad \Rightarrow \quad \log 4 = 0.6021$$

Now, we use the given temperatures:  $T_1 = 27^\circ\text{C} = 300 \text{ K}$  and  $T_2 = 57^\circ\text{C} = 330 \text{ K}$ , and solve for  $E_a$ . Substituting the values:

$$0.6021 = \frac{E_a}{8.314} \left(\frac{1}{300} - \frac{1}{330}\right)$$

Solving for  $E_a$ , we get:

$$E_a = \frac{(\log(4)) \times 2.303 \times 8.314 \times 300 \times 330}{30}$$

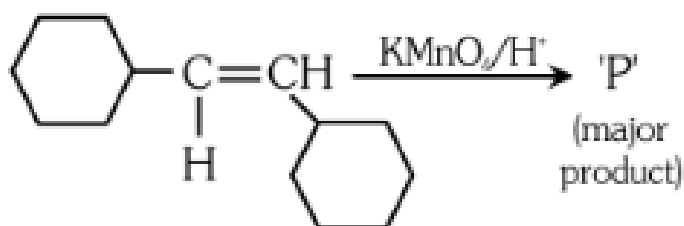
$$E_a = 38.04 \text{ kJ/mol}$$

**Conclusion:** The energy of activation is 38.04 kJ/mol, corresponding to option (1).

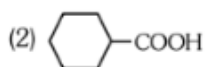
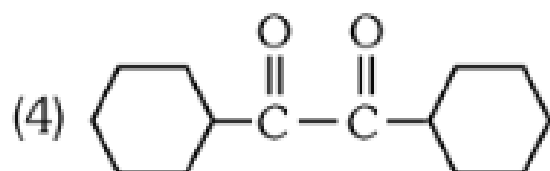
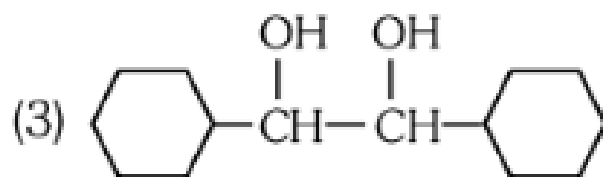
### Quick Tip

The Arrhenius equation can be used to calculate the activation energy from the change in rate constant with temperature.

97. For the given reaction:



'P' is



**Correct Answer:**

**Solution:**  $\text{KMnO}_4$  is a strong oxidizing agent. In the presence of an acidic medium, it oxidizes the alkene ( $\text{C} = \text{CH}_2$ ) to a carboxylic acid group.

**Conclusion:** The major product is  $\text{COOH}$ , corresponding to option (2).

#### Quick Tip

$\text{KMnO}_4$  in acidic medium can oxidize alkenes to carboxylic acids.

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**98. The plot of osmotic pressure ( $\Pi$ ) vs concentration ( $\text{mol L}^{-1}$ ) for a solution gives a straight line with slope  $25.73 \text{ L bar mol}^{-1}$ . The temperature at which the osmotic pressure measurement is done is (Use  $R = 0.083 \text{ L bar mol}^{-1}\text{K}^{-1}$ )**

(1)  $37^\circ\text{C}$

(2)  $310^\circ\text{C}$

(3)  $25.73^\circ\text{C}$

(4)  $12.05^\circ\text{C}$

**Correct Answer:** (1)  $37^\circ\text{C}$

**Solution: Step 1: Write the given equation for the slope**

The slope of the plot  $\Pi$  vs  $C$  is given as  $RT$ . We are given that the slope is  $25.73$  and  $R = 0.083$ .

$$RT = 25.73$$

**Step 2: Solve for the temperature  $T$**

Substitute the value of  $R$  into the equation:

$$0.083 \times T = 25.73$$

Divide both sides by  $0.083$  to solve for  $T$ :

$$T = \frac{25.73}{0.083}$$

$$T = 309.47 \text{ K}$$

Rounding to the nearest whole number, we get:

$$T \approx 310 \text{ K}$$

**Step 3: Convert the temperature to Celsius**

To convert the temperature from Kelvin to Celsius, subtract 273.15 from the Kelvin temperature.

$$T_{\text{Celsius}} = T_{\text{Kelvin}} - 273.15$$

$$T_{\text{Celsius}} = 310 - 273.15$$

$$T_{\text{Celsius}} = 36.85^{\circ}\text{C}$$

Rounding to the nearest whole number, we get:

$$T_{\text{Celsius}} \approx 37^{\circ}\text{C}$$

**Conclusion:** The temperature is approximately 310 K or 37 °C.

#### Quick Tip

Remember the relationship between the slope of the  $\Pi$  vs  $C$  plot and the temperature. Also, remember the conversion formula between Kelvin and Celsius:  $T_{\text{Celsius}} = T_{\text{Kelvin}} - 273.15$ .

#### 99. Given below are two statements:

Statement I:  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is a homoleptic complex whereas  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  is a heteroleptic complex.

Statement II: Complex  $[\text{Co}(\text{NH}_3)_6]^{3+}$  has only one kind of ligands but  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  has more than one kind of ligands.

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

- (1) Both Statement I and Statement II are true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Statement I is false but Statement II is true

**Correct Answer:** (1) Both Statement I and Statement II are true

**Solution:** Statement I is correct because  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is a homoleptic complex (only  $\text{NH}_3$  as a ligand), whereas  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  is heteroleptic (contains both  $\text{NH}_3$  and  $\text{Cl}$  as ligands). Statement II is also correct because  $[\text{Co}(\text{NH}_3)_6]^{3+}$  has only  $\text{NH}_3$  ligands, while  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  has two types of ligands.

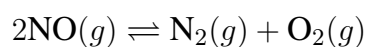
**Conclusion:** Both statements are true, corresponding to option (1).

#### Quick Tip

Homoleptic complexes have only one type of ligand, while heteroleptic complexes contain more than one type of ligand.

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

$$\text{N}_2 = 3.0 \times 10^{-3} \text{ M}, \text{O}_2 = 4.2 \times 10^{-3} \text{ M and NO} = 2.8 \times 10^{-3} \text{ M.}$$



If  $0.1 \text{ mol L}^{-1}$  of  $\text{NO}(g)$  is taken in a closed vessel, what will be degree of dissociation ( $\alpha$ ) of  $\text{NO}(g)$  at equilibrium?

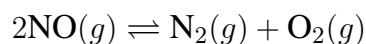
- (1) 0.00889
- (2) 0.0889
- (3) 0.8889
- (4) 0.717

**Correct Answer:** (4) 0.717

**Solution:** Using the equilibrium concentrations of the gases, the degree of dissociation is calculated based on the stoichiometry of the reaction.

### Calculation of Equilibrium Constant and Degree of Dissociation

Given the reaction:



The equilibrium constant expression is given by:

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

Substituting the concentrations, we get:

$$K_c = \frac{3 \times 10^{-3} \times 4.2 \times 10^{-3}}{(2.8 \times 10^{-3})^2 \times 2.8 \times 10^{-3}} = 1.607$$

Let the initial concentration of NO be 0.1 M, and let  $\alpha$  be the degree of dissociation. Then at equilibrium, the concentrations are:

$$[\text{NO}] = 0.1 - 0.1\alpha, \quad [\text{N}_2] = 0.05\alpha, \quad [\text{O}_2] = 0.05\alpha$$

The expression for  $K_c$  becomes:

$$K_c = \frac{0.05\alpha \times 0.05\alpha}{(0.1 - 0.1\alpha)^2} = \frac{0.05\alpha \times 0.05\alpha}{0.01(1 - \alpha)^2}$$

Equating this to the earlier found  $K_c$ :

$$1.607 = \frac{(0.05)^2\alpha^2}{0.01(1 - \alpha)^2}$$

Solving for  $\alpha$ :

$$\alpha^2 = \frac{1.607 \times (0.01)^2}{(0.05)^2(1 - \alpha)^2}$$

$$\frac{\alpha}{1 - \alpha} = \frac{1.27 \times 0.1}{0.05}$$

$$\frac{\alpha}{1 - \alpha} = 2.54$$

$$\alpha = 2.54 - 2.54\alpha$$

$$3.54\alpha = 2.54$$

$$\alpha = \frac{2.54}{3.54} = 0.717$$

**Conclusion:** The degree of dissociation of NO(g) is 0.717, corresponding to option (4).

#### Quick Tip

Degree of dissociation can be calculated using the changes in concentration of reactants and products at equilibrium.

---

## BIOLOGY

**101. Auxin is used by gardeners to prepare weed-free lawns. But no damage is caused to grass as auxin:**

- (1) promotes apical dominance.
- (2) promotes abscission of mature leaves only.
- (3) does not affect mature monocotyledonous plants.
- (4) can help in cell division in grasses, to produce growth.

**Correct Answer:** (3) does not affect mature monocotyledonous plants.

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

#### Quick Tip

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

---

**102. How many molecules of ATP and NADPH are required for every molecule of CO<sub>2</sub> fixed in the Calvin cycle?**

- (1) 2 molecules of ATP and 3 molecules of NADPH
- (2) 2 molecules of ATP and 2 molecules of NADPH
- (3) 3 molecules of ATP and 3 molecules of NADPH
- (4) 3 molecules of ATP and 2 molecules of NADPH

**Correct Answer:** (4) 3 molecules of ATP and 2 molecules of NADPH

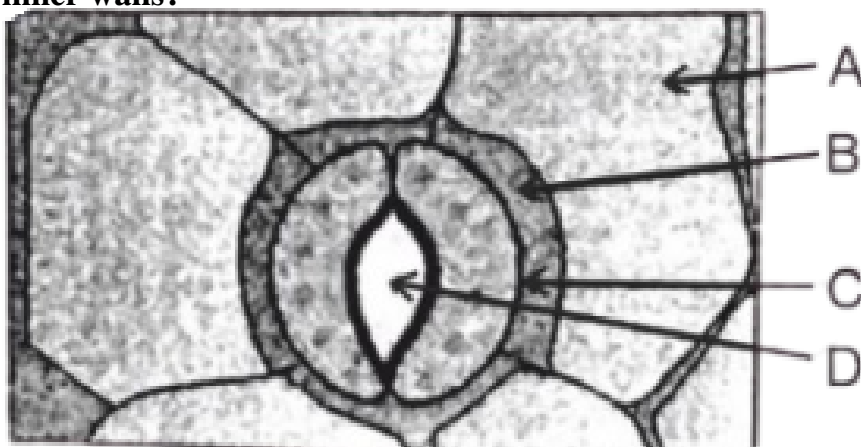
**Solution:** The Calvin cycle, also known as the light-independent reactions, requires 3 molecules of ATP and 2 molecules of NADPH for the fixation of each molecule of CO<sub>2</sub>. This is essential for synthesizing glucose and other carbohydrates.

**Conclusion:** The correct answer is (4), as 3 molecules of ATP and 2 molecules of NADPH are used for every molecule of CO<sub>2</sub> fixed.

**Quick Tip**

The Calvin cycle occurs in the stroma of the chloroplast and is crucial for carbon fixation during photosynthesis.

**103. In the given figure, which component has thin outer walls and highly thickened inner walls?**



- (1) C
- (2) D
- (3) A
- (4) B

**Correct Answer:** (1) C

**Solution:** The component with thin outer walls and highly thickened inner walls is usually a type of vascular tissue or specialized structure such as xylem vessels, which possess thickened inner walls to withstand pressure and transport water.

**Conclusion:** The component with thin outer walls and highly thickened inner walls is (1) C.

**Quick Tip**

Xylem vessels have thickened inner walls to provide structural support and facilitate the movement of water.

---

**104. Match List I with List II**

List-I	List-II
A. Nucleolus	I. Site of formation of glycolipid
B. Centriole	II. Organization like the cartwheel
C. Leucoplasts	III. Site for active ribosomal RNA synthesis
D. Golgi apparatus	IV. For storing nutrients

Choose the correct answer from the options given below:

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

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

**Solution:** Nucleolus (A) is involved in the synthesis of ribosomal RNA, hence matching with III.

Centriole (B) has a cartwheel-like organization, hence matching with II.

Leucoplasts (C) store nutrients, matching with IV.

Golgi apparatus (D) is responsible for forming glycolipids, hence matching with I.

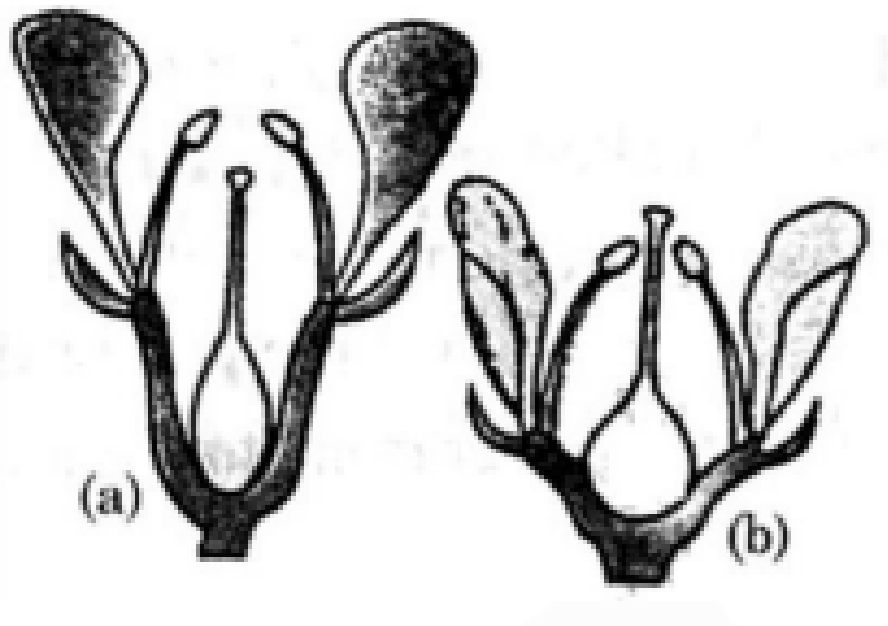
**Conclusion:** The correct match is (1) A-III, B-II, C-IV, D-I.

**Quick Tip**

The nucleolus is involved in ribosome production, while leucoplasts are specialized for storing nutrients like starch.

---

**105. 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) Epigynous; (b) Hypogynous  
 (2) (a) Hypogynous; (b) Epigynous  
 (3) (a) Perigynous; (b) Epigynous  
 (4) (a) Perigynous; (b) Perigynous

**Correct Answer:** (4) (a) Perigynous; (b) Perigynous

**Solution:** In both figures (a) and (b), the ovary is positioned between the calyx and corolla, a characteristic of perigynous flowers.

The position of floral parts indicates that both flowers are perigynous.

**Conclusion:** The correct answer is (4) (a) Perigynous; (b) Perigynous.

#### Quick Tip

Perigynous flowers have the ovary positioned between the calyx and corolla, with the stamens attached at the same level.

#### 106. Match List I with List II

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

Choose the correct

answer from the options given below:

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

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

**Solution:** Rhizopus is commonly known as Bread Mould, corresponding to III.

Ustilago is a Smut fungus, corresponding to II.

Puccinia is a Rust fungus, corresponding to IV.

Agaricus is commonly known as Mushroom, corresponding to I.

**Conclusion:** The correct match is (1) A-III, B-II, C-IV, D-I.

#### Quick Tip

Fungi like Rhizopus, Puccinia, and Ustilago are classified based on their morphology and the diseases they cause in plants.

**107. Which of the following is an example of actinomorphic flower?**

- (1) Datura
- (2) Cassia
- (3) Pisum
- (4) Sesbania

**Correct Answer:** (1) Datura

**Solution:** Actinomorphic flowers are radially symmetrical, meaning they can be divided into identical halves along multiple planes. Datura is an example of an actinomorphic flower.

**Conclusion:** The correct answer is (1) Datura.

#### Quick Tip

Actinomorphic flowers are radially symmetrical and can be divided into multiple identical parts.

---

#### 108. Identify the set of correct statements:

- A. The flowers of Vallisneria are colourful and produce nectar.
- B. The flowers of water lily are not pollinated by water.
- C. In most of water-pollinated species, the pollen grains are protected from wetting.
- D. Pollen grains of some hydrophytes are long and ribbon-like.
- E. In some hydrophytes, the pollen grains are carried passively inside water.

Choose the correct answer from the options given below:

- (1) C, D and E only
- (2) A, B, C and D only
- (3) A, C, D and E only
- (4) B, C, D and E only

**Correct Answer:** (4) B, C, D and E only

**Solution:** Vallisneria flowers are not colorful and do not produce nectar, so statement A is incorrect.

Water lilies are indeed pollinated by wind and not by water, so statement B is correct.

Water-pollinated species do protect their pollen grains from wetting, and some hydrophytes have ribbon-like pollen grains.

In some hydrophytes, the pollen grains are carried passively by the water.

**Conclusion:** The correct answer is (4) B, C, D and E only.

### Quick Tip

Hydrophytes exhibit specialized adaptations for water pollination and often have unique pollen characteristics.

---

**109. 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) Only red flowered plants
- (2) Red flowered as well as pink flowered plants
- (3) Only pink flowered plants
- (4) Red, Pink as well as white flowered plants

**Correct Answer:** (2) Red flowered as well as pink flowered plants

**Solution:** Snapdragon flower color is controlled by incomplete dominance. A cross between a red flowered and a pink flowered Snapdragon will produce both red and pink flowered progeny, with no white flowers expected.

**Conclusion:** The correct answer is (2) Red flowered as well as pink flowered plants.

### Quick Tip

Incomplete dominance results in offspring that show intermediate traits between the parental generations.

---

**110. Formation of interfascicular cambium from fully developed parenchyma cells is an example for**

- (1) Differentiation
- (2) Redifferentiation
- (3) Dedifferentiation
- (4) Maturation

**Correct Answer:** (3) Dedifferentiation

**Solution:** Dedifferentiation refers to the process where fully differentiated cells revert to a more meristematic state. In the case of interfascicular cambium formation, parenchyma cells

dedifferentiate to form the cambium tissue.

**Conclusion:** The correct answer is (3) Dedifferentiation.

#### Quick Tip

Dedifferentiation allows mature cells to regain the ability to divide and form new tissues, such as cambium.

### 111. Match List I with List II

List-I	List-II
A. Two or more alternative forms of a gene	I. Back cross
B. Cross of F1 progeny with homozygous	II. Ploidy
C. Cross of F1 progeny with any of the parents	III. Allele
D. Number of chromosome sets in plant	IV. Test cross

Choose the correct answer from the options given below:

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

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

**Solution:** A. "Two or more alternative forms of a gene" refers to "Allele," corresponding to III.

B. "Cross of F1 progeny with homozygous recessive parent" is termed a "Test cross," corresponding to IV.

C. "Cross of F1 progeny with any of the parents" refers to a "Back cross," corresponding to I.

D. "Number of chromosome sets in a plant" is referred to as "Ploidy," corresponding to II.

**Conclusion:** The correct match is (3), A-III, B-IV, C-I, D-II.

#### Quick Tip

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

**112. Which of the following are required for the dark reaction of photosynthesis? A.**

Light

B. Chlorophyll

C. CO<sub>2</sub>

D. ATP

E. NADPH

Choose the correct answer from the options given below:

(1) A, B and C only

(2) B, C and D only

(3) C, D and E only

(4) D and E only

**Correct Answer:** (3) C, D and E only

**Solution:** The dark reaction, or Calvin cycle, of photosynthesis requires CO<sub>2</sub>, ATP, and NADPH.

Light and chlorophyll are involved in the light-dependent reactions, not in the dark reactions.

**Conclusion:** The correct answer is (3), C, D, and E only.

#### Quick Tip

The dark reaction of photosynthesis, also known as the Calvin cycle, does not require light directly but uses ATP and NADPH produced in the light reaction.

---

**113. 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 true

(2) Both Statement I and Statement II are false

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

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

**Correct Answer:** (1) Both Statement I and Statement II are true

**Solution:** Statement I is correct: Chromosomes become visible under the light microscope during leptotene, which is the first phase of prophase I in meiosis.

Statement II is also correct: The diplotene stage begins when the synaptonemal complex starts to dissolve, causing homologous chromosomes to separate.

**Conclusion:** Both statements are correct, so the answer is (1).

#### Quick Tip

The synaptonemal complex is crucial for homologous chromosome pairing during meiosis, and its dissolution marks the beginning of the diplotene stage.

---

### 114. Spindle fibers attach to kinetochores of chromosomes during

- (1) Prophase
- (2) Metaphase
- (3) Anaphase
- (4) Telophase

**Correct Answer:** (2) Metaphase

**Solution:** During Metaphase, spindle fibers attach to the kinetochores of chromosomes. This attachment is essential for the alignment of chromosomes at the metaphase plate, which is a crucial step before they are separated during anaphase.

**Conclusion:** The correct answer is (2), Metaphase.

#### Quick Tip

Spindle fibers play a critical role in chromosome movement during cell division, and their attachment to kinetochores occurs during metaphase.

---

### 115. 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 ability to replicate.

Choose the correct answer from the options given below:

- (1) A and B only
- (2) D and E only
- (3) B and C only
- (4) A and E only

**Correct Answer:** (3) B and C only

**Solution:** The gene of interest may integrate into the host genome, where it can multiply and be inherited with the host's DNA. However, unless the foreign DNA is introduced with specific vectors like plasmids or viral vectors, it does not always multiply independently.

**Conclusion:** The correct answer is (3), B and C only.

#### Quick Tip

In genetic engineering, foreign DNA is integrated into the host genome and may be inherited by subsequent generations.

---

**116. The lactose present in the growth medium of bacteria is transported to the cell by the action of**

- (1) Beta-galactosidase
- (2) Acetylase
- (3) Permease
- (4) Polymerase

**Correct Answer:** (3) Permease

**Solution:** Lactose is a disaccharide composed of glucose and galactose. In bacteria, the transport of lactose across the cell membrane is facilitated by a protein called permease. Permease is a membrane protein responsible for the active transport of lactose into the cell. Beta-galactosidase is an enzyme that breaks down lactose into glucose and galactose but does not participate in transport.

**Conclusion:** The correct answer is (3), Permease, which is responsible for the transport of lactose into bacterial cells.

**Quick Tip**

Permease is a key component of the lac operon system in bacteria, which enables lactose transport into the cell.

---

**117. Given below are two statements:** Statement I: Parenchyma is living but collenchyma is dead tissue. Statement II: Gymnosperms lack xylem vessels but the 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 true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Statement I is false but Statement II is true

**Correct Answer:** (4) Statement I is false but Statement II is true

**Solution:** Statement I is incorrect: Both parenchyma and collenchyma are living tissues. Parenchyma is involved in metabolism and storage, while collenchyma provides flexible support in growing plant parts.

Statement II is correct: Gymnosperms lack xylem vessels and only have tracheids, while angiosperms possess xylem vessels that allow more efficient water conduction.

**Conclusion:** The correct answer is (4), Statement I is false but Statement II is true.

**Quick Tip**

Xylem vessels are present in angiosperms but absent in gymnosperms, where tracheids perform water conduction.

---

**118. Which one of the following is not a criterion for classification of fungi?**

- (1) Morphology of mycelium
- (2) Mode of nutrition

(3) Mode of spore formation

(4) Fruiting body

**Correct Answer:** (2) Mode of nutrition

**Solution:** Fungi are primarily classified based on their morphological traits, such as the structure of the mycelium, the mode of spore formation, and the characteristics of the fruiting body.

The mode of nutrition (whether the fungus is saprophytic, parasitic, or symbiotic) is not a primary classification criterion but rather important for understanding the ecological roles of fungi.

**Conclusion:** The correct answer is (2), Mode of nutrition, as it is not a main criterion for classifying fungi.

#### Quick Tip

Fungi are classified based on their reproductive structures and morphological traits like mycelial structure and spore formation.

---

**119. 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

(4) BB/Bb

**Correct Answer:** (2) bb

**Solution:** A test cross is performed to determine the genotype of the black-seeded plant. In a test cross, the organism with a dominant phenotype is crossed with a homozygous recessive individual (bb).

- If the black-seeded plant is homozygous dominant (BB), all offspring will have black seeds (Bb).

- If the black-seeded plant is heterozygous (Bb), approximately half of the offspring will

have black seeds, and the other half will have white seeds (bb).

**Conclusion:** The correct answer is (2), bb, as it is used in a test cross to determine the genotype of the black-seeded plant.

#### Quick Tip

A test cross helps determine whether an organism with a dominant phenotype is homozygous or heterozygous.

---

**120. Tropical regions show the greatest level of species richness because** A. Tropical latitudes have remained relatively undisturbed for millions of years, hence more time was available for species diversification.

B. Tropical environments are more seasonal.

C. More solar energy is available in tropics.

D. Constant environments promote niche specialization.

E. Tropical environments are constant and predictable.

Choose the correct answer from the options given below.

(1) A, C, D and E only

(2) A and B only

(3) A, B and E only

(4) A, B and D only

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

**Solution:** A is true: Tropical regions have had more time for species diversification due to their relatively undisturbed nature over millions of years, contributing to higher species richness.

C is true: The tropics receive more solar energy, supporting high primary productivity and greater species numbers.

D is true: The relatively constant environments in tropical regions allow ecological niches to specialize, leading to increased species richness.

E is true: Tropical environments are more stable and predictable, enabling species to adapt and thrive.

B is false: Seasonal environments tend to fluctuate, which may reduce species richness compared to the stable environments of the tropics.

**Conclusion:** The correct answer is (1), A, C, D, and E only.

#### Quick Tip

Tropical regions are biodiversity hotspots because their stable and resource-rich environments promote species diversification.

---

**121. 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, C and D only

(2) A, B, C and D only

(3) A, B and E only

(4) A, B and D only

**Correct Answer:** (4) A, B and D only

**Solution:** Over exploitation leads to depletion of species through excessive use.

Co-extinction occurs when one species goes extinct, causing linked species to also perish.

Habitat loss and fragmentation disrupt ecosystems, reducing biodiversity. Mutation is less a direct cause and more a process that might lead to diversity or extinction, depending on other ecological pressures. Migration typically involves movement rather than loss. The correct factors causing significant biodiversity loss are A, B, and D.

#### Quick Tip

Understanding the factors that lead to biodiversity loss is crucial for conservation efforts and ensuring sustainable environmental practices.

**122. A transcription unit in DNA is defined primarily by the three regions in DNA and these are with respect to upstream and downstream end:**

- (1) Repressor, Operator gene, Structural gene
- (2) Structural gene, Transposons, Operator gene
- (3) Inducer, Repressor, Structural gene
- (4) Promotor, Structural gene, Terminator

**Correct Answer:** (4) Promotor, Structural gene, Terminator

**Solution:** The transcription unit in DNA comprises the promotor, which initiates transcription; the structural gene, which is the sequence being transcribed; and the terminator, which signals the end of transcription. This organization ensures the correct expression of genes in response to cellular needs.

#### Quick Tip

Familiarity with the basic components of a transcription unit is fundamental in genetic and molecular biology studies, particularly for gene expression analysis.

---

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

- (1) 8 bp
- (2) 6 bp
- (3) 4 bp
- (4) 10 bp

**Correct Answer:** (2) 6 bp

**Solution:** Hind II enzyme is specific to a recognition sequence of 6 base pairs, which it consistently cuts. This predictability is crucial for genetic engineering applications, such as recombinant DNA technology, where precise cuts are necessary.

#### Quick Tip

The specificity of restriction enzymes like Hind II highlights their importance in molecular cloning techniques, where exact cuts in DNA are required.

---

**124. The cofactor of the enzyme carboxypeptidase is:**

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

**Correct Answer:** (1) Zinc

**Solution:** Carboxypeptidase is a metalloenzyme that requires zinc as a cofactor. Zinc plays a critical role in the catalytic activity of the enzyme, assisting in the hydrolysis of peptide bonds in proteins during digestion.

**Quick Tip**

Understanding the role of cofactors in enzyme activity is essential for biochemistry, particularly in enzyme kinetics and inhibition studies.

---

**125. 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 sp.</i>	IV. Cyclosporin-A

Choose the correct answer from the options given below:

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

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

**Solution:** *Clostridium butylicum* is known for producing butyric acid, hence A-III.

*Saccharomyces cerevisiae* is a yeast that produces ethanol, making B-I correct. *Trichoderma*

*polysporum* is associated with the production of cyclosporin-A, thus C-IV. *Streptococcus sp.* is known for producing streptokinase, therefore D-II.

#### Quick Tip

Linking microorganisms to their biochemical products is fundamental in biotechnology and pharmaceutical industries for the development of drugs and other bio-products.

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**126. List of endangered species was released by:**

- (1) GEAC
- (2) WWF
- (3) FOAM
- (4) IUCN

**Correct Answer:** (4) IUCN

**Solution:** The International Union for Conservation of Nature (IUCN) is renowned for its work in global conservation and sustainable use of natural resources, including publishing the Red List of Threatened Species, which categorizes species at risk of extinction.

#### Quick Tip

The IUCN Red List is a critical indicator of the health of the world's biodiversity, widely used for conservation planning.

---

**127. The type of conservation in which the threatened species are taken out from their natural habitat and placed in special setting where they can be protected and given special care is called:**

- (1) in-situ conservation
- (2) Biodiversity conservation
- (3) Semi-conservative method
- (4) Sustainable development

**Correct Answer:** (2) Biodiversity conservation

**Solution:** The question appears to describe ex-situ conservation, which involves the

preservation of components of biological diversity outside their natural habitats. The answer provided is incorrect as per standard terminology, which would classify it as ex-situ conservation. The term 'Biodiversity conservation' is broad and encompasses both in-situ and ex-situ conservation strategies.

#### Quick Tip

Understanding the distinction between in-situ and ex-situ conservation is key for effective species preservation strategies.

---

**128. The capacity to generate a whole plant from any cell of the plant is called:**

- (1) Totipotency
- (2) Micropropagation
- (3) Differentiation
- (4) Somatic hybridization

**Correct Answer:** (1) Totipotency

**Solution:** Totipotency is a fundamental property of plant cells that allows each cell to regenerate into a complete plant. This characteristic is harnessed in techniques such as tissue culture for cloning plants.

#### Quick Tip

Totipotency is a critical concept in plant biology and biotechnology, enabling the cloning of plants from single cells.

---

**129. The equation of Verhulst-Pearl logistic growth is  $\frac{dN}{dt} = rN \left( \frac{K-N}{K} \right)$ .**

**From this equation, K indicates:**

- (1) Intrinsic rate of natural increase
- (2) Biotic potential
- (3) Carrying capacity
- (4) Population density

**Correct Answer:** (3) Carrying capacity

**Solution:** In the logistic growth equation,  $K$  represents the carrying capacity of the environment, which is the maximum population size that the environment can sustain indefinitely given the food, habitat, water, and other necessities available in the environment.

#### Quick Tip

Carrying capacity is a key concept in ecology, representing the balance between the availability of habitat resources and the size of the population they can support.

---

**130. Bulliform cells are responsible for:**

- (1) Inward curling of leaves in monocots.
- (2) Protecting the plant from salt stress.
- (3) Increased photosynthesis in monocots.
- (4) Providing large spaces for storage of sugars.

**Correct Answer:** (1) Inward curling of leaves in monocots.

**Solution:** Bulliform cells are specialized cells found in the leaves of monocots that help in rolling or folding of the leaves during water stress, thus reducing water loss and overheating.

#### Quick Tip

Understanding the function of bulliform cells helps in studying drought resistance mechanisms in plants.

---

**131. Lecithin, a small molecular weight organic compound found in living tissues, is an example of:**

- (1) Amino acids
- (2) Phospholipids
- (3) Glycerides
- (4) Carbohydrates

**Correct Answer:** (2) Phospholipids

**Solution:** Lecithin is classified as a phospholipid, which plays a vital role in the structural framework of cell membranes. It is involved in maintaining cellular integrity and facilitating

various cell signaling processes, which are crucial for maintaining the function of living cells.

#### Quick Tip

Phospholipids like lecithin are essential components of cell membranes, contributing to membrane fluidity, signaling, and cellular function.

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**132. Inhibition of Succinic dehydrogenase enzyme by malonate is a classical example of:**

- (1) Cofactor inhibition
- (2) Feedback inhibition
- (3) Competitive inhibition
- (4) Enzyme activation

**Correct Answer:** (3) Competitive inhibition

**Solution:** Malonate acts as a competitive inhibitor of succinic dehydrogenase, an enzyme involved in the Krebs cycle. Competitive inhibition occurs when a substance similar in structure to the substrate competes for binding at the enzyme's active site, thereby preventing the substrate from binding and inhibiting the enzyme's activity. In this case, malonate mimics succinate, the actual substrate, and competes with it for binding to succinic dehydrogenase, effectively blocking its function in cellular respiration.

#### Quick Tip

Competitive inhibition can be overcome by increasing the concentration of the substrate, thereby outcompeting the inhibitor for the active site.

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**133. Given below are two statements:**

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

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

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

- (1) Both Statement I and Statement II are true

- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Statement I is false but Statement II is true

**Correct Answer:** (3) Statement I is true but Statement II is false

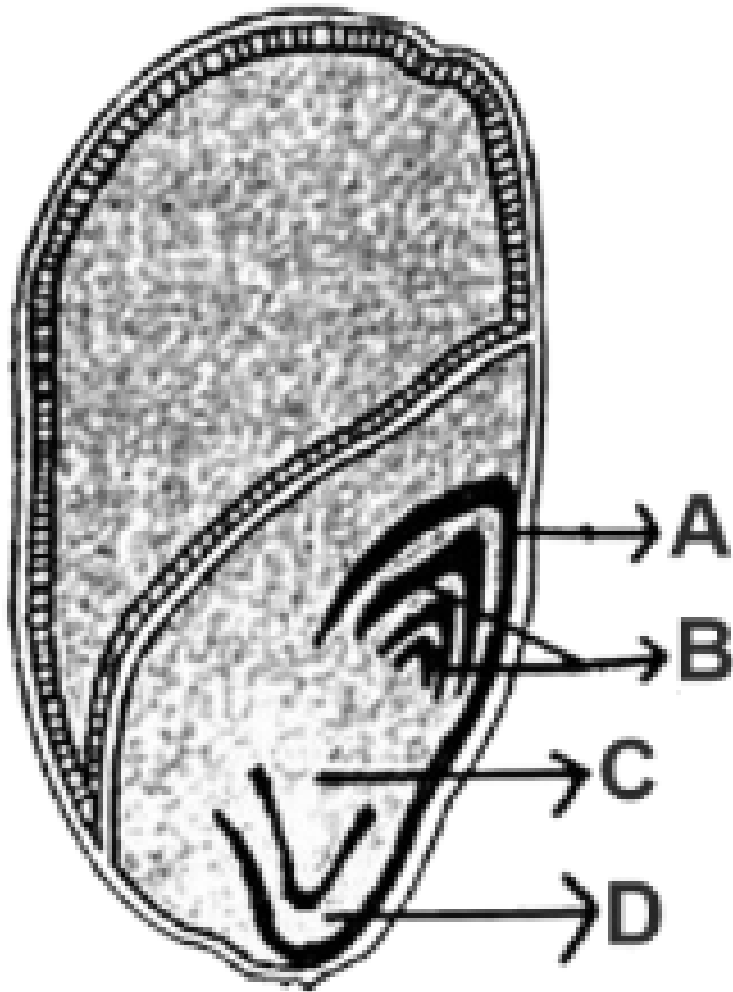
**Solution:** Statement I is correct because Bt toxins, including those encoded by the cry IAc gene, are specific to particular insect groups, targeting only those with the appropriate receptors in their gut. Statement II is false because the conversion of the inactive protoxin into its active form is triggered by an alkaline, not acidic, environment in the insect's gut. This mechanism ensures that the toxin is activated only in the digestive tract of the target insect, making it a highly specific and environmentally safe biocontrol agent.

#### Quick Tip

Bt crops are a great example of environmentally sustainable pest control, using the specificity of Bt toxins to target pests without affecting other organisms.

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



Choose the correct answer from the options given below:

- (1) A
- (2) B
- (3) C
- (4) D

**Correct Answer:** (3) C

**Solution:** In the seed, part C represents the radicle, which is the embryonic root. During seed germination, the radicle is the first structure to emerge from the seed, growing downwards to anchor the plant in the soil and begin the process of nutrient and water absorption. This is a critical step in the establishment of a new plant, as the radicle ensures the plant has access to essential resources for its growth.

### Quick Tip

The radicle's growth is influenced by gravity, a phenomenon known as gravitropism, which ensures the root grows in the correct direction for optimal resource acquisition.

---

### 135. 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<sub>2</sub> 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, B and C only
- (2) A, C, D and E only
- (3) B, C and D only
- (4) A, B, C, D and E

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

**Solution:** Mendel's Law of Dominance explains that in a pair of alleles, one will be dominant and mask the expression of the recessive allele, which is illustrated in option A. The dominant allele's trait is expressed in the F<sub>1</sub> generation, while the recessive allele is hidden. In a monohybrid cross, the expression of only the dominant trait in the F<sub>1</sub> generation, as stated in option E, is a direct application of this law. Option C, which refers to the occurrence of genes in pairs in diploid organisms, and option D, which defines a gene as a discrete unit controlling a trait, are consistent with Mendel's principles but are not specifically part of the Law of Dominance. Option B is incorrect, as it incorrectly describes allele behavior.

### Quick Tip

Mendel's Laws are fundamental to understanding inheritance and are crucial for studying genetics and breeding.

### 136. 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-I, B-II, C-III, D-IV
- (2) A-II, B-I, C-IV, D-III
- (3) A-III, B-IV, C-I, D-II
- (4) A-IV, B-III, C-II, D-I

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

**Solution:** The Citric acid cycle takes place in the mitochondrial matrix (A-II), where it completes the oxidation of substrates, generating electrons for the electron transport chain. Glycolysis occurs in the cytoplasm (B-I), where glucose is metabolized to pyruvate. The electron transport chain is located in the inner mitochondrial membrane (C-IV), using the electrons from the citric acid cycle to pump protons across the membrane, creating a proton gradient (D-III) in the intermembrane space. This proton gradient is essential for ATP synthesis via chemiosmosis.

### Quick Tip

The compartmentalization of metabolic pathways within the cell allows for efficient energy production and regulation during cellular respiration.

### 137. Match List I with List II

List I	List II
A. Robert May	I. Species-Area relationships
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-II, B-III, C-I, D-IV
- (2) A-III, B-I, C-IV, D-II
- (3) A-I, B-III, C-II, D-IV
- (4) A-III, B-IV, C-II, D-I

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

**Solution:** Robert May's work on predicting global species diversity at around 7 million species is foundational in ecology, linking mathematical models to biodiversity estimates (A-III). Alexander von Humboldt is credited with pioneering the species-area relationship, which describes how the number of species increases with area (B-I). Paul Ehrlich's contribution includes the Rivet popper hypothesis, which posits that ecosystem stability decreases as species are lost, represented by (C-IV). David Tilman is known for his long-term ecosystem experiments, using outdoor plots to study biodiversity and ecosystem dynamics (D-II).

#### Quick Tip

Historical ecological concepts and experiments have laid the foundation for modern biodiversity conservation and environmental studies.

**138. In an ecosystem if the Net Primary Productivity (NPP) of first trophic level is  $100x \text{ kcal m}^{-2}\text{yr}^{-1}$ , what would be the GPP (Gross Primary Productivity) of the third trophic level of the same ecosystem?**

- (1)  $\frac{x}{10} (\text{kcal m}^{-2}\text{yr}^{-1})$
- (2)  $x (\text{kcal m}^{-2}\text{yr}^{-1})$
- (3)  $10x (\text{kcal m}^{-2}\text{yr}^{-1})$
- (4)  $100x/3X (\text{kcal m}^{-2}\text{yr}^{-1})$

**Correct Answer:** (3)  $10x$  ( $\text{kcal m}^{-2}\text{yr}^{-1}$ )

**Solution:** In ecosystems, energy is transferred through trophic levels, with about 10% of the energy passing from one level to the next. If the NPP at the first trophic level is  $100x$ , the GPP of the second trophic level would be about  $10x$ , as energy is used for respiration and maintenance. For the third trophic level, the GPP would similarly be approximately  $10x$ , reflecting the typical energy transfer efficiency. This efficiency plays a crucial role in understanding energy flow within ecosystems and helps in modeling food webs.

#### Quick Tip

Energy efficiency in ecosystems is limited, with energy decreasing at each trophic level due to metabolic losses and inefficiencies.

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### 139. 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) A, B, C and D only
- (2) B, C, D and E only
- (3) A, C, D and E only
- (4) A, B, C and E only

**Correct Answer:** (3) A, C, D and E only

**Solution:** Phaeophyceae, or brown algae, reproduce asexually via biflagellate zoospores (A), and store carbohydrates such as mannitol and laminarin (C). Their pigments include chlorophyll a, chlorophyll c, carotenoids, and xanthophylls (D). Vegetative cells have a cellulosic wall, typically coated with a gelatinous layer of algin (E). However, sexual

reproduction in Phaeophyceae is not strictly oogamous, meaning (B) is incorrect. Understanding these features helps in identifying brown algae and their ecological and industrial significance.

#### Quick Tip

Brown algae's unique biochemical features, like the use of algin, have made them valuable in industries such as food, cosmetics, and biofuels.

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**140. Spraying sugarcane crop with which of the following plant growth regulators increases the length of stem, thus increasing the yield?**

- (1) Auxin
- (2) Gibberellin
- (3) Cytokinin
- (4) Abscisic acid

**Correct Answer:** (2) Gibberellin

**Solution:** Gibberellins are plant hormones that promote stem elongation, seed germination, and flowering. When applied to crops like sugarcane, gibberellins specifically stimulate stem growth, resulting in taller plants with potentially higher yields. This application is beneficial for increasing biomass, especially in crops where stem length correlates directly with yield. Gibberellins have a significant role in agriculture, aiding in crop optimization.

#### Quick Tip

Gibberellins are widely used in agriculture to promote growth, break seed dormancy, and enhance yields in various crops.

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**141. 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-II, C-I, D-III
- (2) A-IV, B-I, C-II, D-III
- (3) A-I, B-II, C-IV, D-III
- (4) A-III, B-I, C-IV, D-II

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

**Solution:** Monadelphous Androecium (China Rose)

In monadelphous androecium, the stamens are fused together to form a single group.

Specifically, the filaments of all the stamens are united, while the anthers may still remain separate. This arrangement is typically found in plants like China Rose (\*Hibiscus rosa-sinensis\*), where the stamens are united by their filaments to form a single bundle.

**Key Features of Monadelphous Androecium:**

- All the stamens are joined together by their filaments.
- The anthers, however, remain separate.
- Common in the Malvaceae family, e.g., Hibiscus.

This type of androecium is important for ensuring the transfer of pollen to the stigma, as it facilitates better coordination between the stamens during pollination.

**Diadelphous Androecium (Pea Plant)**

In diadelphous androecium, the stamens are divided into two groups: one group typically has a larger number of stamens, and the other group has fewer. The filaments of the stamens are fused in one group, and the other group is separate. This arrangement is common in plants like the Pea plant (\*Pisum sativum\*), where the stamens are divided into two groups: one group of 9 stamens is fused together and the remaining stamen is free.

### Key Features of Diadelphous Androecium:

- Stamens are divided into two groups based on the fusion of filaments.
- One group has a larger number of stamens, while the other has fewer.
- Common in the Fabaceae family, e.g., Pea, Bean, and some members of the Leguminosae family.

This arrangement is beneficial in some species because it can help to optimize the interaction between the anthers and the pollinators, especially in leguminous plants, facilitating better pollen transfer.

### Polyadelphous Androecium (Citrus)

In polyadelphous androecium, the stamens are divided into several groups. The filaments of the stamens are fused into more than two groups, which is different from the diadelphous condition. This type of androecium is found in plants like Citrus species (e.g., oranges, lemons), where the stamens are typically divided into multiple groups.

### Key Features of Polyadelphous Androecium:

- Stamens are grouped into multiple clusters (more than two).
- The number of groups can vary depending on the species.
- Common in plants of the Rutaceae family, such as Citrus (oranges, lemons).

Polyadelphous arrangements help enhance the effectiveness of pollen transfer because they can maximize contact with pollinators, especially in species that rely on external agents like insects for pollination.

### Epiphyllous Androecium (Lily)

In epiphyllous androecium, the stamens are attached to the petals, specifically the leaf-like structures, in a way that is unusual compared to most flowers. In this arrangement, the stamens are borne on the surface of the petals or on modified leaf structures (epiphylls). This type of androecium is found in plants like Lily (\*Lilium\*).

### Key Features of Epiphyllous Androecium:

- Stamens are attached to the petals or modified leaf structures (epiphylls).
- This is a unique arrangement found in certain plants like Lilies.
- The flowers exhibit a close relationship between the floral organs, allowing for effective pollen dispersal.

This arrangement ensures that the pollen is easily accessible to pollinators, facilitating

pollination while the flowers are in bloom.

#### Conclusion

- Monadelphous: Stamens fused into one group (e.g., China Rose).
- Diadelphous: Stamens fused into two groups (e.g., Pea plant).
- Polyadelphous: Stamens fused into multiple groups (e.g., Citrus).
- Epiphyllous: Stamens attached to the petals or leaf-like structures (e.g., Lily).

Each of these arrangements plays a key role in the reproductive strategies of the plants and ensures effective pollination mechanisms suited to their ecological needs.

#### Quick Tip

Floral morphology, including stamen structure, plays a key role in plant identification and taxonomy.

---

#### 142. Which of the following statement is correct regarding the process of replication in *E.coli*?

- (1) The DNA dependent DNA polymerase catalyses polymerization in one direction that is  $3' \rightarrow 5'$
- (2) The DNA dependent RNA polymerase catalyses polymerization in one direction, that is  $5' \rightarrow 3'$
- (3) The DNA dependent DNA polymerase catalyses polymerization in  $5' \rightarrow 3'$  as well as  $3' \rightarrow 5'$  direction
- (4) The DNA dependent DNA polymerase catalyses polymerization in  $5' \rightarrow 3'$  direction

**Correct Answer:** (4) The DNA dependent DNA polymerase catalyses polymerization in  $5' \rightarrow 3'$  direction

**Solution:** In the replication of DNA in *E.coli*, the enzyme DNA polymerase is responsible for synthesizing new strands of DNA. It adds nucleotides to the 3' end of the growing strand, thereby synthesizing in a 5' to 3' direction. This directional synthesis is critical for the semi-conservative replication process where each new DNA molecule consists of one old and one new strand, ensuring genetic continuity across generations. The specificity of this enzyme for the 5' to 3' direction is a fundamental aspect of molecular biology, underpinning

how genetic information is accurately replicated and maintained in living organisms.

#### Quick Tip

Understanding DNA replication is essential for fields like genetic engineering and biotechnology, where manipulation of genetic material is common.

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**143. Identify the step in tricarboxylic acid cycle, which does not involve oxidation of substrate.**

- (1) Malic acid → Oxaloacetic acid
- (2) Succinic acid → Malic acid
- (3) Succinyl-CoA → Succinic acid
- (4) Isocitrate →  $\alpha$  - ketoglutaric acid

**Correct Answer:** (3) Succinyl-CoA → Succinic acid

**Solution:** In the tricarboxylic acid (TCA) cycle, also known as the Krebs cycle, the conversion of Succinyl-CoA to Succinic acid is unique as it involves the cleavage of a high-energy thioester bond in Succinyl-CoA, which leads to the synthesis of ATP or GTP rather than direct oxidation of the substrate. This step is a substrate-level phosphorylation rather than an oxidation reaction, distinguishing it from other steps in the cycle that typically involve the removal of electrons and hydrogen ions. Understanding this step is important for grasping cellular energy production, particularly how ATP is generated in the mitochondria.

#### Quick Tip

The TCA cycle is central to cellular respiration, linking carbohydrate, fat, and protein metabolism with the production of ATP, highlighting the interconnected nature of metabolic pathways.

---

**144. Match List I with List II**

List I	List II
A. Frederick Griffith	I. Genetic code
B. Francois Jacob & Jacque Monod	II. Semi-conservative mode of DNA replication
C. Har Gobind Khorana	III. Transformation
D. Meselson & Stahl	IV. Lac operon

Choose the correct answer from the options given below:

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

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

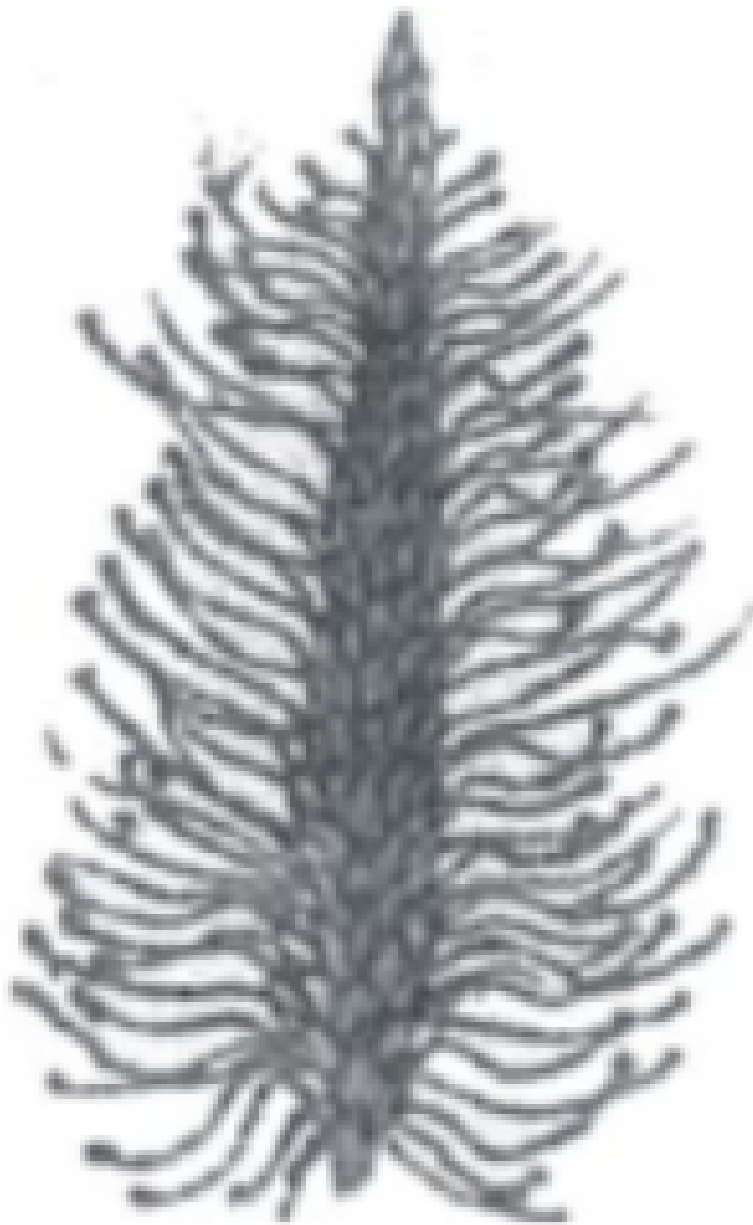
**Solution:** Frederick Griffith is known for discovering the phenomenon of transformation (A-III), which was a pivotal moment in understanding bacterial genetics. Francois Jacob and Jacque Monod elucidated the mechanism of gene regulation in the lac operon (B-IV), a fundamental concept in molecular biology. Har Gobind Khorana contributed significantly to the elucidation of the genetic code (C-I), decoding how sequences of nucleotides translate into proteins. Meselson and Stahl demonstrated the semi-conservative mode of DNA replication (D-II), providing a key piece of evidence in understanding DNA synthesis. This match pairs significant scientific discoveries with the researchers responsible for them, illustrating their impact on genetics and molecular biology.

#### Quick Tip

Each of these discoveries has played a crucial role in developing modern genetics, showing how scientific inquiry builds upon itself over time.

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**145. Identify the correct description about the given figure:**



- (1) Wind pollinated plant inflorescence showing flowers with well exposed stamens.
- (2) Water pollinated flowers showing stamens with mucilaginous covering.
- (3) Cleistogamous flowers showing autogamy.
- (4) Compact inflorescence showing complete autogamy

**Correct Answer:** (1) Wind pollinated plant inflorescence showing flowers with well exposed stamens.

**Solution:** Wind-pollinated plants typically feature flowers with well-exposed stamens to facilitate the dispersal of pollen by air currents. These plants are often characterized by a lack of bright colors and nectar, as they do not need to attract pollinators. Instead, their floral structures are adapted to maximize the efficiency of pollen transfer through wind, which includes having prominent, exposed stamens that readily release pollen into the environment. Understanding these adaptations helps in studying plant ecology and the evolution of pollination strategies.

#### Quick Tip

Floral adaptations to wind pollination include reduced petal size and increased stamen exposure, optimizing pollen dispersal by air.

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#### 146. The DNA present in chloroplast is:

- (1) Linear, double stranded
- (2) Circular, double stranded
- (3) Linear, single stranded
- (4) Circular, single stranded

**Correct Answer:** (2) Circular, double stranded

**Solution:** Chloroplast DNA is typically circular and double-stranded, mirroring some aspects of bacterial genomes, which is a nod to their evolutionary origins from endosymbiotic bacteria. This form of DNA is essential for the chloroplast's function in photosynthesis, as it encodes parts of the photosynthetic machinery and other proteins crucial for the organelle's operation. Understanding the structure and function of chloroplast DNA is key in studies on plant physiology, genetics, and evolutionary biology.

### Quick Tip

Chloroplast DNA's circular nature facilitates replication and expression of genes needed for photosynthesis and other cellular processes.

#### 147. Given below are two statements:

**Statement I:** In C3 plants, some O<sub>2</sub> binds to RuBisCO, hence CO<sub>2</sub> 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 true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Statement I is false but Statement II is true

**Correct Answer:** (3) Statement I is true but Statement II is false

**Solution:** Statement I is true as in C3 plants, RuBisCO can bind to O<sub>2</sub> instead of CO<sub>2</sub>, leading to photorespiration, which decreases the efficiency of CO<sub>2</sub> fixation. This process is energetically costly and reduces the overall photosynthetic output. Statement II is partially correct; while it is true that mesophyll cells in C4 plants show reduced photorespiration due to the spatial separation of initial CO<sub>2</sub> fixation and the Calvin cycle, bundle sheath cells do experience some level of photorespiration, although significantly reduced compared to C3 plants. This adaptation in C4 plants enhances their efficiency in hot and dry environments by minimizing photorespiration.

### Quick Tip

Understanding the differences between C3 and C4 photosynthesis is crucial for agricultural practices, especially in adapting crops to changing climates.

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**148. Match List-I with List-II**

List-I	List-II
A. GLUT-4	I. Hormone
B. Insulin	II. Enzyme
C. Trypsin	III. Intercellular ground substance
D. Collagen	IV. Enables glucose transport into cells

Choose the correct answer from the options given below:

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

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

**Solution:** GLUT-4 is a glucose transporter that facilitates the uptake of glucose into cells, particularly in muscle and fat tissues, and is regulated by insulin (A-IV). Insulin, a hormone produced by the pancreas, plays a critical role in regulating glucose levels in the blood (B-I). Trypsin is an enzyme involved in the digestion of proteins in the small intestine (C-II). Collagen is a major component of the extracellular matrix, providing structural support to various tissues (D-III). This matching emphasizes the importance of these molecules in metabolic and structural functions within the body.

**Quick Tip**

Each of these components plays a crucial role in maintaining homeostasis and structural integrity in the body, highlighting their importance in medical and biological sciences.

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

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

**Solution:** In this match, Rose is associated with perigynous flowers, where floral parts are attached around the base of the ovary (A-II). Pea plants exhibit marginal placentation, where ovules are attached along the seams of the ovary (B-IV). Cotton displays twisted aestivation, a floral arrangement where petals overlap each other in a twisted manner (C-I). Mangoes are classified as drupes, which are fruits with an outer fleshy part surrounding a single shell (pit) with a seed inside (D-III). These botanical classifications help in the study of plant morphology and taxonomy.

#### Quick Tip

Understanding plant morphology is essential for botanical classification, horticulture, and agriculture.

**150. Which of the following are fused in somatic hybridization involving two varieties of plants?**

- (1) Callus
- (2) Somatic embryos
- (3) Protoplasts
- (4) Pollens

**Correct Answer:** (3) Protoplasts

**Solution:** Somatic hybridization involves the fusion of protoplasts from two different plant varieties to combine their genetic material and create a hybrid. Protoplasts, which are cells with their cell walls removed, can be fused using techniques like electrofusion or chemical fusogens. This process enables the direct manipulation of plant genomes, allowing for the introduction of desirable traits from two different species. Somatic hybridization is a powerful tool in plant biotechnology for developing new cultivars with enhanced traits such as disease resistance or increased nutritional value.

**Quick Tip**

Somatic hybridization bypasses the sexual reproduction barriers, providing a unique approach to plant breeding and genetic research.

**151. 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-IV, B-II, C-III, D-I
- (2) A-II, B-I, C-IV, D-III
- (3) A-II, B-IV, C-I, D-III
- (4) A-IV, B-III, C-II, D-I

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

**Solution:** Pleurobrachia is a member of the phylum Ctenophora, known for its characteristic comb-like cilia used for propulsion (A-II). The radula is an organ found in mollusks, used for feeding by scraping or cutting food (B-I). The stomochord is a structure in Hemichordata, often confused with the chordate notochord, but it differs in function and structure (C-IV). The air bladder, also known as the swim bladder, is a gas-filled organ that helps bony fish (Osteichthyes) regulate buoyancy (D-III). This question evaluates your understanding of biological classification and the anatomical features of different animal groups.

#### Quick Tip

Understanding the unique structures within animal phyla can help identify evolutionary relationships and adaptive functions.

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**152. 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) C-E-D-A-B
- (2) E-B-D-A-C
- (3) B-D-E-A-C

(4) E-C-A-D-B

**Correct Answer:** (4) E-C-A-D-B

**Solution:** The sequence of stages in the cell cycle starts with the Gap 1 phase (E), where the cell grows and prepares for DNA replication. This is followed by the Synthesis phase (C), where DNA replication occurs. Next, the cell enters the Gap 2 phase (A), where further preparation for mitosis takes place. Karyokinesis (D), or nuclear division, follows, and finally, Cytokinesis (B) divides the cytoplasm to form two daughter cells. This understanding of the cell cycle is fundamental for studying cell division, its regulation, and its implications in diseases like cancer.

**Quick Tip**

Disruptions in the normal progression of the cell cycle can lead to uncontrolled cell growth, often observed in cancer.

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

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

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

**Solution:** The common cold is caused by rhinoviruses (A-III), which are known to cause upper respiratory tract infections. Haemozoin is a product of hemoglobin breakdown by Plasmodium, the parasite responsible for malaria (B-I). The Widal test is used to diagnose typhoid fever, which is caused by the bacterium Salmonella typhi (C-II). Allergies related to dust mites involve immune reactions to the proteins found in the waste products of dust mites (D-IV). This matching tests your knowledge of infectious agents and their associated diagnostic tools.

#### Quick Tip

Being able to identify the causative agents of diseases and their diagnostic tests is essential for effective disease management.

#### 154. Match List I with List II:

List I	List II
A. Typhoid	I. Fungus
B. Leishmaniasis	II. Nematode
C. Ringworm	III. Protozoa
D. Filariasis	IV. Bacteria

Choose the correct answer from the options given below:

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

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

**Solution:** Typhoid is caused by the bacterium *Salmonella typhi* (A-IV). Leishmaniasis is caused by protozoan parasites of the genus *Leishmania* (B-III). Ringworm, a fungal infection, is caused by fungi that live on the skin, hair, and nails (C-I). Filariasis is caused by nematodes (roundworms) of the family Filarioidea, transmitted by mosquito bites (D-II). This question helps in understanding the specific pathogens responsible for various infectious diseases and their classifications.

#### Quick Tip

Knowing the correct pathogen and the resulting disease is key for effective treatment and control.

---

**155. The flippers of the Penguins and Dolphins are an example of:**

- (1) Adaptive radiation
- (2) Natural selection
- (3) Convergent evolution
- (4) Divergent evolution

**Correct Answer:** (3) Convergent evolution

**Solution:** The flippers of penguins and dolphins provide an excellent example of convergent evolution. Although penguins are birds and dolphins are mammals, both species have evolved similar flippers as a result of living in similar aquatic environments. This convergence demonstrates how different evolutionary paths can lead to similar adaptations due to similar environmental pressures.

### Quick Tip

Convergent evolution occurs when unrelated species develop similar traits due to comparable selective pressures in their environment.

**156. Following are the stages of the 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 the pathway from the options given below:

- (1) E-C-A-D-B
- (2) A-E-C-B-D
- (3) B-D-E-C-A
- (4) E-A-D-B-C

**Correct Answer:** (1) E-C-A-D-B

**Solution:** The correct sequence for the conduction of an action potential through the heart begins at the sinoatrial (SA) node (E), which generates the electrical impulse that triggers heartbeats. The impulse travels to the atrioventricular (AV) node (C), then passes through the AV bundle (A) and bundle branches (D), before reaching the Purkinje fibers (B), which carry the impulse to the ventricular muscles, leading to contraction. This orderly conduction ensures synchronized heartbeats and efficient blood flow.

### Quick Tip

Understanding the heart's conduction system is crucial for diagnosing and treating cardiac arrhythmias and other heart conditions.

---

**157. Which of the following statements is incorrect?**

- (1) A bio-reactor provides optimal growth conditions for achieving the desired product
- (2) Most commonly used bio-reactors are of stirring type
- (3) Bio-reactors are used to produce small scale bacterial cultures
- (4) Bio-reactors have an agitator system, an oxygen delivery system, and foam control system

**Correct Answer:** (3) Bio-reactors are used to produce small scale bacterial cultures

**Solution:** The incorrect statement is that bio-reactors are used to produce small-scale bacterial cultures (3). Bio-reactors are typically designed for large-scale production, used in industries like pharmaceuticals, biotechnology, and food processing, where optimal conditions for the growth of microorganisms are maintained. They are equipped with systems for temperature control, pH regulation, oxygen supply, and foam control to maximize production efficiency.

**Quick Tip**

Bio-reactors are essential for large-scale production in the biotechnology industry, enabling the efficient manufacture of biological products.

---

**158. Which of the following is not a component of the Fallopian tube?**

- (1) Uterine fundus
- (2) Isthmus
- (3) Infundibulum
- (4) Ampulla

**Correct Answer:** (1) Uterine fundus

**Solution:** The uterine fundus is the upper part of the uterus, above the openings of the Fallopian tubes, and is not a part of the Fallopian tube. The Fallopian tube consists of the in-

fundibulum, isthmus, and ampulla, which are involved in transporting the egg from the ovary to the uterus. Understanding the anatomy of the female reproductive system is essential for reproductive health studies and gynecological practices.

#### Quick Tip

Knowledge of the female reproductive anatomy is critical for diagnosing and treating various reproductive health conditions.

---

#### 159. Given below are two statements:

**Statement I:** In the nephron, the descending limb of the loop of Henle is impermeable to water and permeable to electrolytes.

**Statement II:** The proximal convoluted tubule is lined by simple columnar brush border epithelium and increases the surface area for reabsorption.

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

- (1) Both Statement I and Statement II are true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Statement I is false but Statement II is true

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

**Solution:** Statement I is incorrect because the descending limb of the loop of Henle is permeable to water, allowing water reabsorption, but is largely impermeable to electrolytes. Statement II is also incorrect, as the proximal convoluted tubule is lined by simple cuboidal epithelium, not columnar, and this epithelium has a brush border that increases the surface area for absorption. These facts are important for understanding kidney function and fluid balance in the body.

### Quick Tip

Accurate knowledge of nephron structure and its function is essential for understanding kidney physiology and diagnosing renal disorders.

---

**160. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?**

- (1) Genetic recombination
- (2) Genetic drift
- (3) Gene migration
- (4) Constant gene pool

**Correct Answer:** (4) Constant gene pool

**Solution:** The Hardy-Weinberg equilibrium assumes no changes in allele frequencies, which is maintained in a constant gene pool (4). Factors such as genetic recombination, genetic drift, and gene migration lead to changes in allele frequencies, disrupting the equilibrium. A constant gene pool means no changes in allele frequencies over generations, which aligns with Hardy-Weinberg conditions. This principle is fundamental in population genetics and the study of evolutionary processes.

### Quick Tip

The Hardy-Weinberg equilibrium provides a baseline for studying genetic variation and evolutionary forces within populations.

---

**161. Which of the following is not a steroid hormone?**

- (1) Cortisol
- (2) Testosterone
- (3) Progesterone
- (4) Glucagon

**Correct Answer:** (4) Glucagon

**Solution:** Glucagon is a peptide hormone, not a steroid hormone. It is produced by the alpha cells of the pancreas and plays a critical role in regulating blood glucose levels by promoting the breakdown of glycogen to glucose in the liver. Steroid hormones, like cortisol, testosterone, and progesterone, are derived from cholesterol and are involved in a range of physiological processes from stress response to reproductive functions. Understanding the differences between peptide and steroid hormones is fundamental in endocrinology, emphasizing their distinct synthesis pathways and mechanisms of action.

**Quick Tip**

Steroid hormones can cross cell membranes due to their lipophilic nature, binding to intracellular receptors, unlike peptide hormones that bind to surface receptors.

**162. 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-III, B-I, C-II, D-IV
- (2) A-I, B-III, C-IV, D-II
- (3) A-IV, B-I, C-II, D-III
- (4) A-III, B-I, C-IV, D-II

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

**Solution:** The correct matches for each type of IUD and implant are: Non-medicated IUDs like the Lippes loop (A-III) are simple devices that do not release any hormones or copper. Copper releasing IUDs such as Multiload 375 (B-I) release copper to increase contraceptive efficacy. Hormone releasing IUDs like LNG-20 (C-IV) release levonorgestrel, a hormone, to help prevent pregnancy. Lastly, implants such as those that release progestogens (D-II) are subdermal devices that provide long-term contraception. This question highlights various contraceptive technologies and their mechanisms of action.

#### Quick Tip

Choosing the right contraceptive method involves considering both the mechanism of action and individual health needs.

---

**163. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on:**

- (1) 5th segment
- (2) 10th segment
- (3) 8th and 9th segment
- (4) 11th segment

**Correct Answer:** (2) 10th segment

**Solution:** In cockroaches, the anal cerci are located at the 10th segment of the abdomen. These structures are sensitive to air currents, helping the cockroach detect movements around it, which is crucial for its survival as it allows the cockroach to respond quickly to potential threats. This anatomical feature is an example of how morphology can be linked to behavioral adaptations in insects.

### Quick Tip

Anal cerci are used in various insects not only for sensing but also in mating rituals, showcasing the diverse functions of similar structures.

#### 164. Match List I with List II:

List I	List II
A. Expiratory capacity	I. Expiratory reserve volume + Tidal vol + Inspiratory reserve vol
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-II, B-IV, C-I, D-III
- (2) A-III, B-II, C-IV, D-I
- (3) A-II, B-I, C-IV, D-III
- (4) A-I, B-III, C-II, D-IV

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

**Solution:** Expiratory capacity (A) is the combination of tidal volume and expiratory reserve volume (A-II), representing the total volume of air expelled from the lungs during a normal exhalation followed by a forced exhalation. Functional residual capacity (B) includes the expiratory reserve volume plus the residual volume (B-IV), indicating the volume of air remaining in the lungs after a normal exhalation. Vital capacity (C) is the total volume of air that can be exhaled after a maximal inhalation, including tidal volume, inspiratory reserve volume, and expiratory reserve volume (C-I). Inspiratory capacity (D) is the sum of tidal volume and inspiratory reserve volume (D-III), representing the total volume of air that can be inhaled after a normal exhalation. Understanding these lung capacities is crucial for respiratory physiology and clinical assessments.

### Quick Tip

Lung capacity measurements are essential in diagnosing and monitoring respiratory conditions such as asthma and COPD.

### 165. 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-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-II, B-I, C-IV, D-III

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

**Solution:** The pons acts as a bridge connecting different regions of the brain, facilitating communication between them (A-III). The hypothalamus contains neurosecretory cells that are crucial for hormone production and regulation of the autonomic nervous system (B-IV). The medulla controls essential autonomic functions such as respiration and digestion (C-II). The cerebellum is critical for motor control, including the regulation of posture and balance (D-I). This question tests knowledge of the functions and locations of major brain structures, important for understanding neural control and integration.

### Quick Tip

The central nervous system's complexity is organized functionally and anatomically to optimize neural processing and bodily control.

**166. 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 true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false

**Correct Answer:** (3) Statement I is true but Statement II is false

**Solution:** Statement I is true because the hymen can vary significantly in appearance and can be absent, torn, or stretched from activities other than sexual intercourse, such as physical activities or tampon use. Statement II is false as the hymen can be elastic or already have openings that do not tear during sexual activity; it does not always tear during the first coitus. This underscores the importance of understanding human anatomy and debunking myths related to physical indicators of virginity.

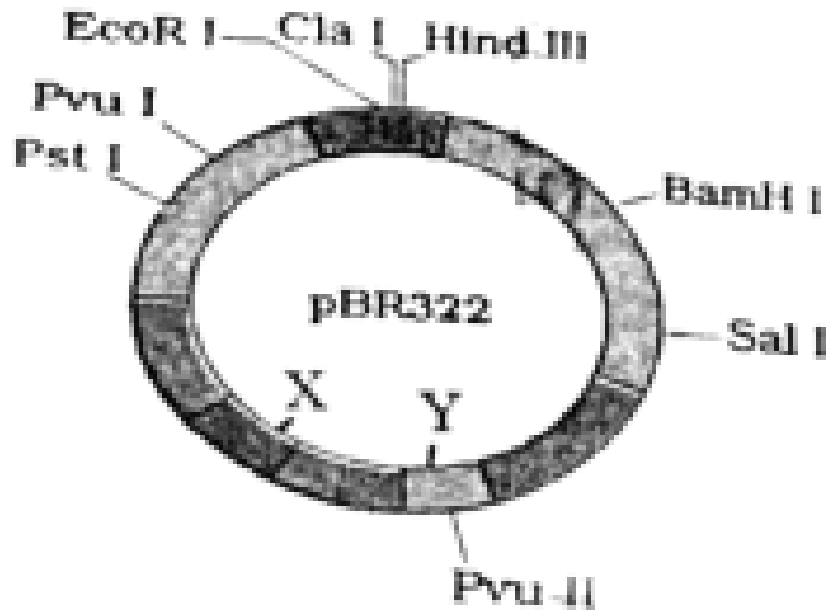
#### Quick Tip

Educational efforts are essential to dispel myths regarding the hymen and virginity, promoting a more scientifically accurate understanding of human anatomy.

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**167. The following diagram showing restriction sites in *E. coli* cloning vector pBR322.**

**Find the role of 'X' and 'Y' genes:**



- (1) The gene 'X' is responsible for resistance to antibiotics and 'Y' for protein involved in the replication of Plasmid.
- (2) The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.
- (3) The gene 'X' is for protein involved in replication of Plasmid and 'Y' for resistance to antibiotics.
- (4) Gene 'X' is responsible for recognitions sites and 'Y' is responsible for antibiotic resistance.

**Correct Answer:** (2) The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

**Solution:** In the pBR322 vector, gene 'X' typically refers to elements like the *rop* gene that helps control the plasmid's copy number within the host cell, whereas gene 'Y' could refer to a gene like the *rep* gene involved in the initiation of plasmid DNA replication. This setup ensures that the plasmid can maintain itself efficiently within bacterial cells, crucial for its use in cloning and genetic engineering.

### Quick Tip

Understanding plasmid functions such as copy number control and replication is critical in biotechnology and genetic engineering.

**168. Which one is the correct product of DNA dependent RNA polymerase to the given template?**

3' TACATGGCAAATATCCATTCA 5'

- (1) 5' AUGUACCGUUUUAUAGGUAAGU 3'
- (2) 5' AUGUAAAGUUUUAUAGGUAAGU 3'
- (3) 5' AUGUACCGUUUUAUAGGGAAGU 3'
- (4) 5' ATGTACCGTTTATAGGTAAGT 3'

**Correct Answer:** (1) 5' AUGUACCGUUUUAUAGGUAAGU 3'

**Solution:** The correct RNA sequence is synthesized by RNA polymerase which reads the DNA template strand from 3' to 5' and synthesizes RNA from 5' to 3'. The RNA sequence matching the DNA template 'TACATGGCAAATATCCATTCA' would be 'AUGUACCGU-UUAUAGGUAAGU', where each DNA base is transcribed to its complementary RNA base (A to U, T to A, C to G, G to C).

### Quick Tip

Understanding transcription fidelity is crucial for techniques in molecular biology, such as RNA synthesis and gene expression studies.

**169. 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 & D only
- (2) A, B & E only
- (3) B, C & E only
- (4) C, D & E only

**Correct Answer:** (2) A, B & E only

**Solution:** Autoimmune disorders are conditions where the immune system mistakenly attacks the body's own tissues. Myasthenia gravis (A) involves antibodies that block or destroy muscle receptor cells, Rheumatoid arthritis (B) is characterized by immune-mediated destruction of joint linings, and Systemic Lupus Erythematosus (E) affects multiple organs with widespread inflammation and tissue damage. Gout and Muscular dystrophy, however, are not autoimmune; gout is a metabolic disorder and muscular dystrophy is a genetic disorder.

**Quick Tip**

Recognition of autoimmune mechanisms can aid in the development of targeted therapies that modulate the immune response.

**170. Match List I with List II:**

List I	List II
A. Pterophyllum	I. Hag fish
B. Myxine	II. Saw fish
C. Pristis	III. Angel fish
D. Exocoetus	IV. Flying fish

Choose the correct

answer from the options given below:

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

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

**Solution:** Pterophyllum is commonly known as the angel fish (A-III), an elegant, flat-bodied freshwater fish. Myxine, or hagfish (B-I), are jawless marine creatures known for their slime production. Pristis represents the sawfish (C-II), known for its long, toothed rostrum resembling a saw. Exocoetus, or flying fish (D-IV), are known for their ability to glide above the water's surface to escape predators. This question tests knowledge of common names and characteristics of various fish species, useful in studies of marine biology and ecology.

#### Quick Tip

Linking scientific names with common names enhances understanding of biodiversity and aids in more effective communication in biological sciences.

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**171. 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 males.

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

- (1) Both A and R are true and R is the correct explanation of A
- (2) Both A and R are true but R is NOT the correct explanation of A
- (3) A is true but R is false
- (4) A is false but R is true

**Correct Answer:** (4) A is false but R is true

**Solution:** Assertion (A) is incorrect because FSH acts on Sertoli cells in males, not Leydig cells, which are instead stimulated by LH. On the other hand, Reason (R) is accurate because it correctly explains the hormonal activity in females and males, where ovarian follicles release estrogen and interstitial cells produce androgens.

### Quick Tip

Having a clear understanding of the specific actions of FSH and LH is essential for comprehending reproductive physiology and disorders related to hormone imbalances.

### 172. 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-IV, B-II, C-III, D-I
- (2) A-III, B-II, C-I, D-IV
- (3) A-II, B-IV, C-I, D-III
- (4) A-IV, B-I, C-III, D-II

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

**Solution:** Lipase is an enzyme that specifically breaks down ester bonds found in lipids (A-II). Nuclease is responsible for cutting phosphodiester bonds in nucleic acids (B-IV). Protease breaks peptide bonds in proteins (C-I). Amylase catalyzes the breakdown of glycosidic bonds in starch (D-III). This matching evaluates the enzymatic specificity and their role in biochemical reactions.

### Quick Tip

Recognizing the specific bonds targeted by different enzymes is fundamental in biochemistry, especially in the context of molecular biology and medicine.

#### 173. 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-III, C-II, D-I
- (2) A-IV, B-II, C-III, D-I
- (3) A-II, B-IV, C-I, D-III
- (4) A-II, B-I, C-IV, D-III

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

**Solution:** Axoneme, which is the central structure of cilia and flagella, is crucial for their movement (A-II). The cartwheel pattern is characteristic of centrioles, visible during their replication (B-I). Cristae are folds inside mitochondria that increase the surface area for ATP production (C-IV). Satellites are repetitive DNA sequences typically found near centromeres on chromosomes (D-III). This matching tests knowledge of cellular structures and their specialized functions.

### Quick Tip

Understanding the relationship between structure and function in cells enhances our ability to comprehend cellular activities and diseases.

#### 174. 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-IV, B-II, C-III, D-I
- (2) A-I, B-II, C-IV, D-III
- (3) A-II, B-IV, C-I, D-III
- (4) A-IV, B-III, C-II, D-I

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

**Solution:** Diakinesis is marked by the completion of the terminalization of chiasmata (A-II), where chromosomes prepare for their separation. Pachytene is characterized by the appearance of recombination nodules (B-IV), essential for genetic recombination. Zygotene is the stage where synaptonemal complexes form to facilitate the pairing of chromosomes (C-I). During Leptotene, chromosomes first appear as thin threads under the microscope (D-III). This is fundamental to understanding genetic recombination and meiosis.

### Quick Tip

Understanding the key events of meiosis, especially during prophase I, is vital for insights into genetic inheritance and variation.

**175. 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) B only
- (2) A only
- (3) C only
- (4) D only

**Correct Answer:** (2) A only

**Solution:** Annelids are true coelomates, meaning they have a coelom fully lined with mesoderm (A). Poriferans lack a body cavity and are not pseudocoelomates (B is incorrect). Aschelminthes are pseudocoelomates, not acoelomates (C is incorrect). Platyhelminthes are acoelomates, having no body cavity (D is incorrect). Understanding these terms is essential for recognizing different types of body plans in animals.

**Quick Tip**

Correctly identifying body cavity types helps in distinguishing between various animal phyla, crucial for understanding evolutionary biology and classification.

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**176. Match List I with List II:**

List I	List II
A. $\alpha$ -I antitrypsin	I. Cotton bollworm
B. Cry IAb	II. ADA deficiency
C. Cry IAc	III. Emphysema
D. Enzyme replacement therapy	IV. Corn borer

Choose the correct

answer from the options given below:

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

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

**Solution:**  $\alpha$ -I antitrypsin is a protein that protects tissues from enzymes of inflammatory cells, especially in the lungs; deficiency can lead to emphysema (A-III). Cry IAb and Cry IAc are insecticidal proteins produced by *Bacillus thuringiensis*; Cry IAb targets the corn borer (B-IV) and Cry IAc targets the cotton bollworm (C-I). Enzyme replacement therapy is used to treat various deficiencies, such as ADA deficiency (D-II). This question helps in understanding biotechnological applications and their impact on medicine and agriculture.

#### Quick Tip

Biotechnology utilizes biological systems to develop technologies that improve our lives and the health of our planet.

---

**177. 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-IV, B-II, C-III, D-I
- (2) A-I, B-III, C-II, D-IV
- (3) A-II, B-III, C-I, D-IV
- (4) A-III, B-I, C-IV, D-II

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

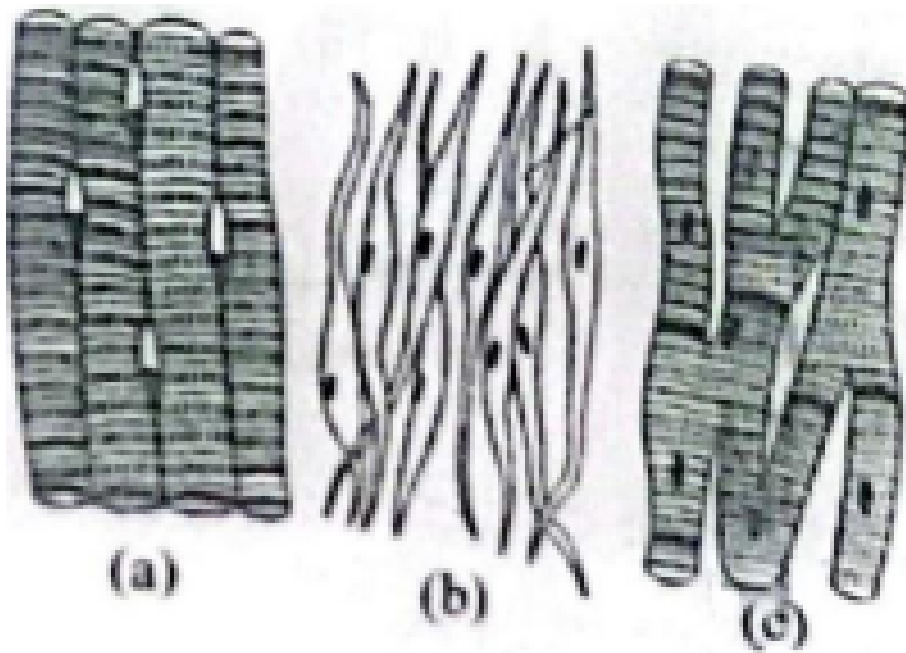
**Solution:** Fibrous joints, such as those in the skull, do not permit movement (A-III). Cartilaginous joints, like those found between adjacent vertebrae, allow limited movement (B-I). Hinge joints, such as the knee joint, facilitate movement in one plane, helping with locomotion (C-IV). Ball and socket joints, such as the shoulder joint between the humerus and pectoral girdle, permit rotational and other movements (D-II). This question helps in understanding the anatomy and function of various joint types.

#### Quick Tip

Recognizing the types of joints and their movements is important for diagnosing musculoskeletal disorders and improving physical therapy treatments.

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**178. Three types of muscles are given as a, b, and c. Identify the correct matching pair along with their location in the human body:**



Name of muscle/location

- (1) (a) Smooth - Toes, (b) Skeletal – Legs, (c) Cardiac – Heart
- (2) (a) Skeletal - Triceps, (b) Smooth – Stomach, (c) Cardiac – Heart
- (3) (a) Skeletal - Biceps, (b) Involuntary – Intestine, (c) Smooth – Heart
- (4) (a) Involuntary – Nose tip, (b) Skeletal – Bone, (c) Cardiac – Heart

**Correct Answer:** (2) (a) Skeletal - Triceps, (b) Smooth – Stomach, (c) Cardiac – Heart

**Solution:** The correct matching of muscle types to their locations in the human body is: (a) Skeletal muscles like the triceps are located in the arms, enabling movement; (b) Smooth muscles are found in organs such as the stomach, aiding in involuntary functions like digestion; (c) Cardiac muscle, which is found exclusively in the heart, is crucial for pumping blood throughout the body. This question assesses knowledge of muscle types and their anatomical locations, important for understanding human physiology.

### Quick Tip

Knowing the function and location of different muscle types helps in understanding their roles in health and disease.

### 179. Match List I with List II:

List I	List II
A. Down's syndrome	I. 11 <sup>th</sup> chromosome
B. $\alpha$ -Thalassemia	II. X chromosome
C. $\beta$ -Thalassemia	III. 21 <sup>st</sup> chromosome
D. Klinefelter's syndrome	IV. 16 <sup>th</sup> chromosome

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

**Solution:** Down's syndrome is associated with an extra copy of the 21st chromosome (A-III),  $\alpha$ -Thalassemia is linked to defects on the 16th chromosome (B-IV),  $\beta$ -Thalassemia involves the 11th chromosome (C-I), and Klinefelter's syndrome is characterized by an extra 'X' chromosome (D-II). This question helps in understanding genetic disorders and their chromosomal bases.

### Quick Tip

Accurate knowledge of genetic disorders and their chromosomal links is crucial for diagnosis and genetic counseling.

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**180. Which of the following factors are favorable for the formation of oxyhaemoglobin in alveoli?**

- (1) High pO<sub>2</sub> and High pCO<sub>2</sub>
- (2) High pO<sub>2</sub> and Lesser H<sup>+</sup> concentration
- (3) Low pCO<sub>2</sub> and High H<sup>+</sup> concentration
- (4) Low pCO<sub>2</sub> and High temperature

**Correct Answer:** (2) High pO<sub>2</sub> and Lesser H<sup>+</sup> concentration

**Solution:** High partial pressure of oxygen (pO<sub>2</sub>) and lower hydrogen ion (H<sup>+</sup>) concentration enhance the formation of oxyhaemoglobin in the alveoli. High pO<sub>2</sub> increases the oxygen saturation of haemoglobin, while lower H<sup>+</sup> concentration reduces the Bohr effect, thereby facilitating the uptake of oxygen by haemoglobin.

**Quick Tip**

Understanding the conditions that favor oxyhaemoglobin formation can help in assessing respiratory efficiency and the oxygen-carrying capacity of the blood.

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**181. 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) D-A-C-B
- (2) B-A-D-C

(3) C-B-D-A

(4) A-D-C-B

**Correct Answer:** (4) A-D-C-B

**Solution:** The correct chronological sequence of human evolution, from earliest to most recent, is: Homo habilis (A) as one of the earliest known species using tools, Homo erectus (D) known for significant brain enlargement and use of fire, Homo neanderthalensis (C) known for robust build and adaptability to cold climates, and Homo sapiens (B) which represents modern humans, known for advanced tools and complex social structures.

#### Quick Tip

Studying human evolution provides insights into our biological history and the evolutionary processes that influence our current form and behaviors.

#### 182. 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-IV, B-III, C-I, D-II

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

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

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

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

**Solution:** Cocaine is derived from the *Erythroxylum coca* plant (A-III), heroin is processed from morphine, which comes from *Papaver somniferum*, the opium poppy (B-IV), morphine is also derived from *Papaver somniferum* (C-I), and marijuana comes from *Cannabis sativa* (D-II). This question tests knowledge of the source plants of various drugs, important for understanding their effects and regulation.

#### Quick Tip

Knowledge of the origins and effects of psychoactive substances can aid in their proper regulation and in public health education.

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**183. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R): Assertion (A):** Breast-feeding during initial period of infant growth is recommended by doctors for bringing a healthy baby.

**Reason (R):** Colostrum contains several antibodies absolutely essential to develop resistance for the new born baby.

In the light of the above statements, choose the most appropriate answer from the options given below: (1) Both A and R are correct and R is the correct explanation of A

(2) Both A and R are correct but R is NOT the correct explanation of A

(3) A is correct but R is not correct

(4) A is not correct but R is correct

**Correct Answer:** (1) Both A and R are correct and R is the correct explanation of A

**Solution:** Both statements are correct and Reason (R) is the correct explanation for Assertion (A). Breastfeeding is highly recommended as it not only provides complete nutrition but also passes essential antibodies found in colostrum, which protect the newborn against various diseases, boosting their immune system early in life.

### Quick Tip

The benefits of breastfeeding extend beyond basic nutrition, including enhanced immunity and improved health outcomes for babies.

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**184. Which of the following is not a natural/traditional contraceptive method?** (1) Coitus interruptus

- (2) Periodic abstinence
- (3) Lactational amenorrhea
- (4) Vaults

**Correct Answer:** (4) Vaults

**Solution:** Vaults, or cervical caps, are not traditional methods; they are barrier methods of contraception that involve a device placed over the cervix to prevent sperm from entering the uterus. The other options listed are considered natural or traditional methods, relying on behavior rather than devices.

### Quick Tip

Understanding the range of contraceptive methods available can aid individuals in choosing the most appropriate method for their needs.

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**185. The “Ti plasmid” of *Agrobacterium tumefaciens* stands for** (1) Tumour inhibiting plasmid

- (2) Tumor independent plasmid
- (3) Tumor inducing plasmid
- (4) Temperature independent plasmid

**Correct Answer:** (3) Tumor inducing plasmid

**Solution:** The "Ti plasmid" in *Agrobacterium tumefaciens* stands for "tumor inducing" plasmid. This plasmid is responsible for transferring part of its DNA to plant cells, leading to the formation of tumors or galls. This mechanism has been harnessed in genetic engineering to introduce new genes into plants.

#### Quick Tip

The manipulation of the Ti plasmid has significant applications in biotechnology, especially in creating genetically modified plants.

#### 186. 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 eyeballs.
D. Cretinism	IV. Excessive secretion of growth hormone.

Choose the correct answer from the options given below:

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

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

**Solution:** A. Exophthalmic goiter is associated with hypersecretion of thyroid hormones and protruding eyeballs, which corresponds to III.

B. Acromegaly is caused by the excessive secretion of growth hormone, corresponding to IV.

C. Cushing's syndrome involves excess secretion of cortisol, leading to symptoms like moon face and hyperglycemia, corresponding to I.

D. Cretinism is caused by hypothyroidism in early childhood, leading to stunted growth, corresponding to II.

**Conclusion:** The correct answer is (4) A-III, B-IV, C-I, D-II.

#### Quick Tip

Exophthalmic goiter is another name for Graves' disease, characterized by hyperthyroidism and protruding eyeballs.

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**187. Given below are two statements:** Statement I: Mitochondria and chloroplasts both are double-membrane-bound organelles. Statement II: The inner membrane of mitochondria is relatively less permeable, as 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 correct.
- (2) Both Statement I and Statement II are incorrect.
- (3) Statement I is correct but Statement II is incorrect.
- (4) Statement I is incorrect but Statement II is correct.

**Correct Answer:** (3) Statement I is correct but Statement II is incorrect.

**Solution:** - Statement I is correct because both mitochondria and chloroplasts are double-membrane-bound organelles, which are essential for their respective roles in energy metabolism (mitochondria) and photosynthesis (chloroplasts). - Statement II is incorrect because the inner membrane of mitochondria is more impermeable compared to the outer membrane, whereas in chloroplasts, both membranes are relatively permeable to ions and molecules.

**Conclusion:** The correct answer is (3) Statement I is correct but Statement II is incorrect.

### Quick Tip

Both mitochondria and chloroplasts have double membranes, but their permeability characteristics are different.

**188. 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 the active site.

Choose the correct answer from the options given below:

- (1) E, A, D, C, B
- (2) A, E, B, D, C
- (3) B, A, C, D, E
- (4) E, D, C, B, A

**Correct Answer:** (1) E, A, D, C, B

**Solution:** The correct sequence for the catalytic cycle of enzyme action is:

E. Substrate binding to the active site: The enzyme's active site binds to the substrate, initiating the reaction.

A. Substrate-enzyme complex formation: After the substrate binds, an enzyme-substrate complex forms.

D. Chemical bonds of the substrate broken: The enzyme catalyzes the breaking of chemical bonds in the substrate.

C. Release of products: The products of the reaction are released from the enzyme.

B. Free enzyme ready to bind with another substrate: The enzyme is now free to bind with another substrate and repeat the process.

**Conclusion:** The correct answer is (1) E, A, D, C, B.

### Quick Tip

Enzyme catalysis involves the formation of an enzyme-substrate complex, followed by product formation and release, after which the enzyme is free to catalyze further reactions.

### 189. Match List I with List II related to the digestive system of a 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

Choose the correct answer from the options given below:

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

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

**Solution:** A. The structures used for storing food: The crop is responsible for storing food in a cockroach, corresponding to IV.

B. Ring of 6-8 blind tubules at junction of foregut and midgut: These structures are gastric caeca, corresponding to II.

C. Ring of 100-150 yellow colored thin filaments at junction of midgut and hindgut: These are Malpighian tubules, corresponding to III.

D. The structures used for grinding the food: The gizzard is responsible for grinding food, corresponding to I.

**Conclusion:** The correct answer is (1) A-IV, B-II, C-III, D-I.

### Quick Tip

In cockroaches, the crop stores food, the gastric caeca aid digestion, the Malpighian tubules excrete waste, and the gizzard grinds food.

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**190. 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 & C only
- (2) A, B & D only
- (3) B, D & E only
- (4) B, C & D only

**Correct Answer:** (3) B, D & E only

**Solution:** A is true for chordates but not for all non-chordates.

B is true for non-chordates as they do not possess a notochord.

D is true for many non-chordates, as their heart is dorsal (e.g., arthropods).

E is true for some non-chordates, as they lack a post-anal tail (e.g., arthropods).

C is false for all non-chordates, as their central nervous system is not dorsal.

**Conclusion:** The correct answer is (3) B, D & E only.

### Quick Tip

Non-chordates typically lack a notochord, dorsal nervous system, and a post-anal tail, distinguishing them from chordates.

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**191. Choose the correct statement given below regarding juxtamedullary nephron.**

- (1) Juxtamedullary nephrons are located in the columns of Bertini.
- (2) Renal corpuscle of juxtamedullary nephron lies in the outer portion of the renal medulla.
- (3) Loop of Henle of juxtamedullary nephron runs deep into medulla.
- (4) Juxtamedullary nephrons outnumber the cortical nephrons.

**Correct Answer:** (3) Loop of Henle of juxtamedullary nephron runs deep into medulla.

**Solution:** Juxtamedullary nephrons are defined by their long loops of Henle, which extend deep into the renal medulla. This structure is key for the concentration of urine through a countercurrent exchange mechanism.

The renal corpuscle of juxtamedullary nephrons is positioned at the boundary between the renal cortex and medulla, not in the outer medulla. Additionally, juxtamedullary nephrons are fewer in number compared to cortical nephrons.

Columns of Bertini, which are found in the renal cortex, do not house juxtamedullary nephrons.

**Conclusion:** The correct answer is (3) Loop of Henle of juxtamedullary nephron runs deep into medulla.

#### Quick Tip

Juxtamedullary nephrons play a vital role in producing concentrated urine through their long loops of Henle, crucial for water balance.

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**192. 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 light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both Statement I and Statement II are correct.
- (2) Both Statement I and Statement II are incorrect.

- (3) Statement I is correct but Statement II is incorrect.  
 (4) Statement I is incorrect but Statement II is correct.

**Correct Answer:** (3) Statement I is correct but Statement II is incorrect.

**Solution:** Statement I is accurate as the corpus callosum is a large bundle of nerve fibers that connects the right and left cerebral hemispheres, allowing communication between them. Statement II is incorrect because the brainstem consists of the medulla oblongata, pons, and midbrain, not the cerebrum, which is part of the forebrain and not involved in the brainstem.

**Conclusion:** The correct answer is (3) Statement I is correct but Statement II is incorrect.

#### Quick Tip

The brainstem controls basic life functions, whereas the cerebrum is responsible for higher functions such as thinking, memory, and voluntary movement.

#### 193. Match List I with List II:

List-I	List-II
A. P wave	I. Heart muscles are electrically silent.
B. QRS complex	II. Depolarization of ventricles.
C. T wave	III. Depolarization of atria.
D. T-P gap	IV. Repolarization of ventricles.

Choose the correct answer from the options given below:

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

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

- Solution:** - A. P wave represents the depolarization of the atria, corresponding to III.  
 - B. QRS complex is linked to the depolarization of the ventricles, corresponding to II.  
 - C. T wave corresponds to the repolarization of the ventricles, linked to IV.  
 - D. T-P gap refers to the period during which heart muscles are electrically silent, corresponding to I.

**Conclusion:** The correct match is (2) A-III, B-II, C-IV, D-I.

**Quick Tip**

ECG provides critical insights into the heart's electrical activity, with each wave representing specific phases of depolarization and repolarization in the cardiac cycle.

**194. Match List I with List II:**

List-I	List-II
A. Mesozoic Era	I. Lower invertebrates
B. Proterozoic Era	II. Fish & Amphibia
C. Cenozoic Era	III. Birds & Reptiles
D. Paleozoic Era	IV. Mammals

Choose the correct answer from the options given below:

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

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

**Solution:**

- A. Mesozoic Era is known for the rise of birds and reptiles, corresponding to III.
- B. Proterozoic Era is marked by the appearance of lower invertebrates, corresponding to I.
- C. Cenozoic Era is the age of mammals, corresponding to IV.
- D. Paleozoic Era is characterized by the emergence of fish and amphibians, corresponding to II.

**Conclusion:** The correct match is (4) A-III, B-I, C-IV, D-II.

#### Quick Tip

Each geological era highlights the development and dominance of different life forms, with the Mesozoic known for reptiles and the Cenozoic for mammals.

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**195. As per ABO blood grouping system, the blood group of father is B+, mother is A+ and child is O+. Their respective genotype can be**

- A.  $I^B I^A / ii$
- B.  $I^B I^B / I^A I^A$
- C.  $I^A I^B / ii$
- D.  $I^A I^B / I^A I^i$
- E.  $ii / I^A I^B / I^A I^B$

- (1) A only
- (2) B only
- (3) C & B only
- (4) D & E only

**Correct Answer:** (1) A only

**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).

#### Quick Tip

For a child to have blood group O, both parents must carry the  $i$  allele.

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#### 196. 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 true.
- (2) Both Statement I and Statement II are false.
- (3) Statement I is true but Statement II is false.
- (4) Statement I is false but Statement II is true.

**Correct Answer:** (4) Statement I is false but Statement II is true.

**Solution:** Statement I is false because Gause's competitive exclusion principle actually states that two closely related species competing for the *same* resources cannot coexist indefinitely. Statement II is true as it correctly reflects that in competitive scenarios under limited resources, typically the inferior competitor will be eliminated.

### Quick Tip

Understanding ecological principles like Gause's can help in conservation efforts by predicting the outcomes of species interactions.

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#### 197. Given below are two statements:

**Statement I:** Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

**Statement II:** Both bone marrow and thymus provide microenvironments for the development and maturation of T-lymphocytes.

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

- (1) Both Statement I and Statement II are correct.
- (2) Both Statement I and Statement II are incorrect.
- (3) Statement I is correct but Statement II is incorrect.
- (4) Statement I is incorrect but Statement II is correct.

**Correct Answer:** (3) Statement I is correct but Statement II is incorrect.

**Solution:** Statement I is correct; bone marrow is indeed the primary site for the production of all types of blood cells, including lymphocytes. However, Statement II is incorrect because while the thymus is involved in the maturation of T-lymphocytes, bone marrow does not directly contribute to the maturation of T-lymphocytes; it is involved in their initial formation.

### Quick Tip

Knowledge of where blood cells are formed and matured is essential in medical sciences, especially in immunology and hematology.

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#### 198. Match List I with List II:

List I	List II
A. Unicellular glandular epithelium	I. Salivary glands
B. Compound epithelium	II. Pancreas
C. Multicellular glandular epithelium	III. Goblet cells of alimentary canal
D. Endocrine glandular epithelium	IV. Moist surface of buccal cavity

Choose the correct answer from the options given below:

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

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

**Solution:** Unicellular glandular epithelium like goblet cells are found in the alimentary canal (A-III). Compound epithelium is found on moist surfaces like the buccal cavity (B-IV). Multicellular glandular epithelium like that in salivary glands produces various secretions (C-I). Endocrine glandular epithelium, such as in the pancreas, secretes hormones directly into the bloodstream (D-II).

#### Quick Tip

Understanding the structure and function of different types of epithelial tissue is crucial in anatomy and physiology for insights into how various body systems operate.

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**199. Match List I with List II:**

List I	List II
A. RNA polymerase III	I. snRNPs
B. Termination of transcription	II. Promotor
C. Splicing of Exons	III. Rho factor
D. TATA box	IV. SnRNAs, tRNA

Choose the correct answer from the options given below:

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

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

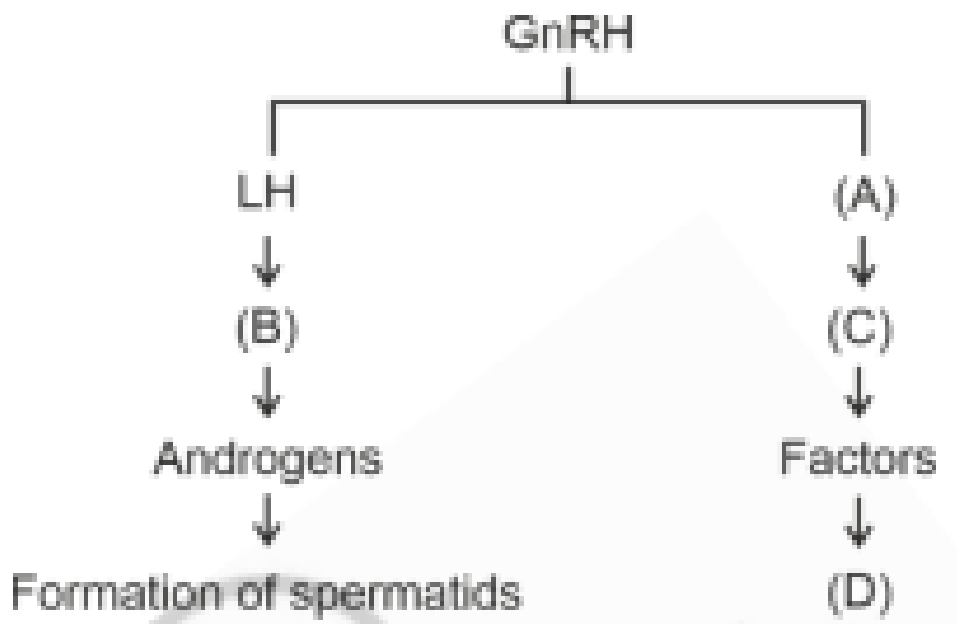
**Solution:** RNA polymerase III transcribes genes encoding tRNAs and some snRNAs (A-IV). The termination of transcription in prokaryotes often involves the Rho factor (B-III). Splicing of exons is facilitated by snRNPs, which are part of the spliceosome complex (C-I). The TATA box is a core promotor element found in many genes (D-II).

#### Quick Tip

Familiarity with molecular biology's core concepts, like transcription and splicing, is vital for understanding genetic expression and regulation.

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**200. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis.**



- (1) FSH, Leydig cells, Sertoli cells, spermiogenesis.
- (2) ICSH, Interstitial cells, Leydig cells, spermiogenesis.
- (3) FSH, Sertoli cells, Leydig cells, spermatogenesis.
- (4) ICSH, Leydig cells, Sertoli cells, spermatogenesis.

**Correct Answer:** (1) FSH, Leydig cells, Sertoli cells, spermiogenesis.

**Solution:** FSH stimulates Sertoli cells, which in turn support spermatogenesis. Leydig cells, stimulated by LH (also known as ICSH in males), produce testosterone, crucial for the final stages of spermatogenesis, known as spermiogenesis.

#### Quick Tip

Understanding hormonal regulation of spermatogenesis is important in fields like endocrinology and reproductive medicine.