NEET-UG R3 2024 Question Paper with Solutions

Time Allowed :200 Minutes	Maximum Marks :720	Total Questions :200

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours 20 minutes duration and the Test Booklet contains 200 multiple-choice questions (four options with a single correct answer) from Physics, Chemistry and Biology (Botany and Zoology). 50 questions in each subject are divided into two Sections (A and B) as per details given below:

(a) **Section-A** shall consist of 35 (Thirty-five) Questions in each subject (Question Nos-1 to 35, 51 to 85, 101 to 135 and 151 to 185). All Questions are compulsory.

(b) **Section-B** shall consist of 15 (Fifteen) questions in each subject (Question Nos- 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In Section B, a candidate needs to attempt any 10 (Ten) questions out of 15 (Fifteen) in each subject.

2. Candidates are advised to read all 15 questions in each subject of Section B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, the first ten questions answered by the candidate shall be evaluated.

3. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. The maximum marks are 720.

4. Use Blue / Black Ball Point Pen only for writing particulars on this page / marking responses on Answer Sheet.

5. Rough work is to be done in the space provided for this purpose in the Test Booklet only.

6. The CODE for this Booklet is R4. Make sure that the CODE printed on the Original Copy of the Answer Sheet is the same as that on this Test Booklet.

Physics

Section A

1. 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) 5

(2) 7

(3) 6

(4) 10

Correct Answer: (4) 10

Solution: Step 1: Find velocity.

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

Step 2: Calculate Power.

Instantaneous Power is given by:

$$P = F \cdot v = 5 \times 2 = 10$$

Conclusion: The correct answer is (4) 10.

Quick Tip

Instantaneous power is given by $P = F \cdot v$, where F is force and v is velocity.

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

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

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

(3) All bright fringes will be of equal width

(4) Interference pattern will disappear

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

Solution: Step 1: Understanding white light in interference.

- A monochromatic source produces fringes of the same width and colour.

- White light consists of multiple wavelengths, leading to coloured fringes due to wavelength dependence.

Step 2: Central fringe characteristics.

- The central fringe remains white since all wavelengths constructively interfere at the central point.

- Side fringes become coloured due to phase differences between different wavelengths.

Conclusion: The correct answer is (2).

Quick Tip

In white light interference, the central fringe is white, while other fringes are coloured due to varying wavelengths.

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3. The nuclear reaction given below:

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

The mass number and atomic number of the product Q respectively, are:

(1) 286, 80

(2) 288, 82

(3) 286, 81

(4) 280, 81

Correct Answer: (3) 286, 81

Solution: Step 1: Effect of alpha decay.

- Alpha decay reduces mass number by 4 and atomic number by 2:

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

Step 2: Effect of beta decay.

- Beta decay increases atomic number by 1 (no change in mass number):

$$^{286}_{80}P \xrightarrow{\beta^-} {}^{286}_{81}Q$$

Conclusion: The correct answer is (3) 286, 81.

Quick Tip

Alpha decay decreases atomic number by 2 and mass number by 4, while beta decay increases atomic number by 1.

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4. Match List-I with List-II:

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

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

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

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

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

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

Solution: Understanding Magnetic Susceptibility.

- Diamagnetic materials ($\chi < 0$) are weakly repelled by a magnetic field.

- Ferromagnetic materials ($\chi \gg 1$) exhibit strong attraction to magnetic fields.

- Paramagnetic materials ($0 < \chi < \epsilon$) are weakly attracted to a magnetic field.

- Non-magnetic materials ($\chi = 0$) have no interaction with a magnetic field.

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

Quick Tip

Ferromagnetic materials have very high susceptibility ($\chi \gg 1$), paramagnetic materials have small positive susceptibility, and diamagnetic materials have negative susceptibility.

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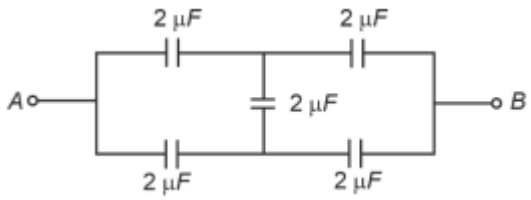
5. In the following circuit, the equivalent capacitance between terminal A and terminal B is:



(1) $1\,\mu F$

(2) $0.5\,\mu F$

(3) $4\,\mu F$

(4) $2\,\mu F$

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

Solution: Step 1: Identify the capacitor arrangement.

- The given circuit consists of capacitors in series and parallel combination.

Step 2: Apply series and parallel capacitance formulas.

- For parallel combination:

$$C_{\text{parallel}} = C_1 + C_2$$

- For series combination:

$$\frac{1}{C_{\text{eq}}} = \frac{1}{C_1} + \frac{1}{C_2}$$

Step 3: Calculate the equivalent capacitance.

- Using appropriate formulae, the effective capacitance is found to be $2\,\mu F$.

Conclusion: The correct answer is (4) $2\,\mu F$.

Quick Tip

For capacitors in parallel: $C_{\text{eq}} = C_1 + C_2 + C_3 + ...$

For capacitors in series: $\frac{1}{C_{\text{eq}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ...$

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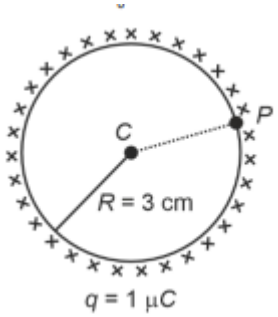
6. A thin spherical shell is charged by some source. The potential difference between the two points C and P (in V) shown in the figure is:

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



(1) 1×10^5

(2) 0.5×10^5

(3) Zero

(4) 3×10^5

Correct Answer: (3) Zero

Solution: Step 1: Recall the potential of a charged spherical shell.

- The potential at any point inside a charged conducting shell is constant and equal to the potential at the surface:

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{R}$$

where Q is charge and R is the shell radius.

Step 2: Compare potential at points C and P.

- Since both points C and P lie inside the conductor, they have the same potential.

Step 3: Compute the potential difference.

$$V_C - V_P = 0$$

Conclusion: The correct answer is (3) Zero.

Quick Tip

Inside a charged spherical conductor, the potential remains constant everywhere.

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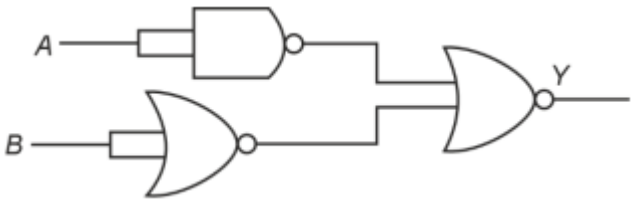
7. The output (Y) of the given logic gate is similar to the output of an/a:



(1) NOR gate

(2) OR gate

(3) AND gate

(4) NAND gate

Correct Answer: (3) AND gate

Solution: Step 1: Analyze the given logic gate.

- The given logic gate represents a standard AND operation.

Step 2: Recall the AND gate truth table.

A	B	$Y = A \cdot B$
0	0	0
0	1	0
1	0	0
1	1	1

- The output matches the behavior of an AND gate.

Conclusion: The correct answer is (3) AND gate.

Quick Tip

The AND gate produces an output of 1 only when both inputs are 1.

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8. An unpolarized light beam strikes a glass surface at Brewster's angle. Then:

(1) The refracted light will be completely polarised.

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

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

(4) The reflected light will be partially polarised.

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

Solution: Step 1: Apply Brewster's Law.

- Brewster's angle θ_B is given by:

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

where n_1 and n_2 are refractive indices of the media.

Step 2: Behavior of reflected and refracted light.

- At Brewster's angle, the reflected light is completely polarised in a direction perpendicular to the plane of incidence.

- However, the refracted light remains partially polarised because it contains both parallel and perpendicular components.

Conclusion: The correct answer is (3).

Quick Tip

At Brewster's angle, the reflected light is 100 percent polarised, while the refracted light remains partially polarised.

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

(1) 4.4 T

(2) 4.4 mT

(3) 44 T

(4) 44 mT

Correct Answer: (2) 4.4 mT

Solution: Step 1: Use the formula for magnetic field at the center of a circular coil.

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

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

Step 2: Compute the value.

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

$$B = \frac{(4\pi \times 10^{-7})(700)}{0.2}$$

$$B = 4.4 \times 10^{-3} T = 4.4\,\text{mT}$$

Conclusion: The correct answer is (2) 4.4 mT.

Quick Tip

The magnetic field at the center of a circular coil is directly proportional to the number of turns and the current.

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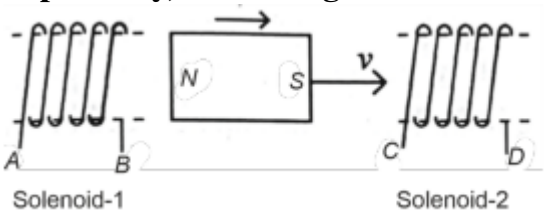
10. In the above diagram, a strong bar magnet is moving towards solenoid-2 from solenoid-1. The direction of induced current in solenoid-1 and that in solenoid-2, respectively, are through the directions:



(1) BA and CD

(2) AB and CD

(3) BA and DC

(4) AB and DC

Correct Answer: (4) AB and DC

Solution: Step 1: Apply Lenz's Law.

- When the bar magnet moves towards solenoid-2, an induced current is generated in both solenoids.

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

Step 2: Determine the direction of induced currents.

- In solenoid-1, the induced current must oppose the approaching North pole of the magnet, meaning it must create a North pole at the adjacent end $\rightarrow$ Current flows from A to B (AB).

- In solenoid-2, the magnet induces a current to maintain continuity, causing a South pole at the adjacent end $\rightarrow$ Current flows from D to C (DC).

Conclusion: The correct answer is (4) AB and DC.

Quick Tip

Lenz's Law states that the induced current always opposes the change that causes it.

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11. 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) 2 : 1

(2) 4 : 1

(3) 1 : 4

(4) 1 : 2

Correct Answer: (1) 2 : 1

Solution: Step 1: Apply the principle of conservation of momentum.

$$mv_1 + m(0) = (m + m)v_2$$

$$mv_1 = 2mv_2$$

Step 2: Solve for v_2.

$$v_2 = \frac{v_1}{2}$$

Conclusion: The correct ratio is $v_1 : v_2 = 2 : 1$.

Quick Tip

In a perfectly inelastic collision, the two bodies stick together after impact, conserving momentum but losing kinetic energy.

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

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

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

Reason R:

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

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

(2) A is true but R is false.

(3) A is false but R is true.

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

Correct Answer: (2) A is true but R is false.

Solution: Step 1: Correct formula for the potential at an axial point of a dipole.

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

Step 2: Verify the given values.

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

$$V = \frac{(36 \times 10^3)}{4} = 9 \times 10^3 \text{ V}$$

- The assertion correctly states the potential. - However, the reasoning formula is incorrect, as it applies to an equatorial point, not an axial point.

Conclusion: The correct answer is (2).

Quick Tip

For an axial point, use $V = \frac{P}{4\pi\epsilon_0 r^2}$. For an equatorial point, use $V = 0$.

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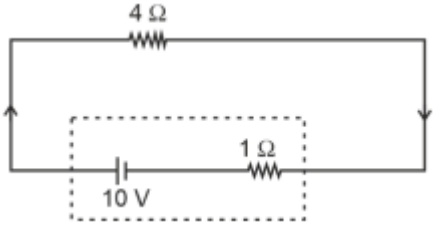
13. The terminal voltage of the battery, whose emf is 10 V and internal resistance 1 Ω, when connected through an external resistance of 4 Ω as shown in the figure is:



(1) 6 V

(2) 8 V

(3) 10 V

(4) 4 V

Correct Answer: (2) 8 V

Solution: Step 1: Apply the formula for terminal voltage.

$$V = \mathcal{E} - Ir$$

where: - $\mathcal{E} = 10V$ (emf) - $r = 1\Omega$ (internal resistance) - $R = 4\Omega$ (external resistance)

Step 2: Find the current I.

$$I = \frac{\mathcal{E}}{R + r} = \frac{10}{4 + 1} = 2 \text{ A}$$

Step 3: Find the terminal voltage.

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

Conclusion: The correct answer is (2) 8 V.

Quick Tip

The terminal voltage is always less than the emf of the battery due to internal resistance.

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

(1) Constant acceleration

(2) Constant velocity but varying acceleration

(3) Varying velocity and varying acceleration

(4) Constant velocity

Correct Answer: (3) Varying velocity and varying acceleration

Solution: Step 1: Understand the motion of a particle in a circular path.

- The particle moves with uniform speed, meaning its magnitude of velocity remains constant.

- However, velocity is a vector quantity, and its direction continuously changes.

Step 2: Analyze acceleration.

- The acceleration in uniform circular motion is centripetal acceleration, which always acts toward the center. - Since its direction continuously changes, the acceleration vector is varying.

Conclusion: The correct answer is (3) Varying velocity and varying acceleration.

Quick Tip

Uniform circular motion has constant speed but changing velocity due to direction change, leading to centripetal acceleration.

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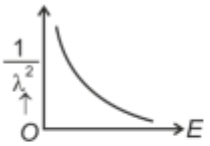
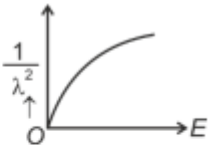
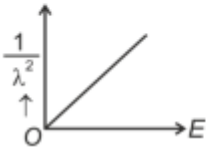
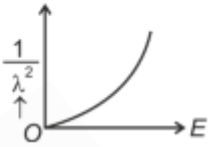
15. The graph which shows the variation of $\frac{1}{\lambda^2}$ and kinetic energy, E, is (where λ is the de Broglie wavelength of a free particle):

(1) 

(2) 

(3) 

(4) 

Correct Answer: (3) Graph 3

Solution: Step 1: Use de Broglie's wavelength equation.

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

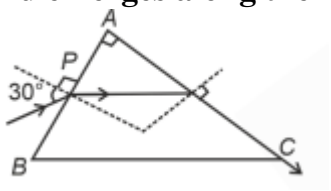
Thus, $\frac{1}{\lambda^2}$ is directly proportional to kinetic energy E, giving a straight-line graph.

Conclusion: The correct graph is (3).

Quick Tip

According to de Broglie's equation, the inverse square of the wavelength varies linearly with kinetic energy.

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



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

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

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

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

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

Solution: Step 1: Use Snell's Law at the first surface.

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

where, - $n_1 = 1$ (air), - $i = 30^\circ$, - $r = 18.43^\circ$ (by geometry).

Step 2: Use Snell's Law again for the second refraction.

For the emergence along AC:

$$n \sin(45^\circ) = 1 \sin(90^\circ)$$

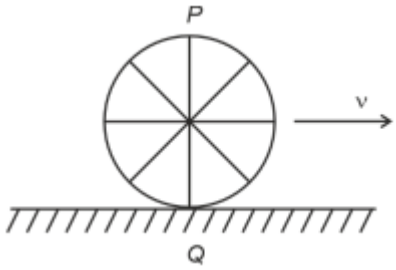
$$n = \frac{1}{\sin 45^\circ} = \frac{5}{2}$$

Conclusion: The refractive index is (1) $\frac{5}{2}$.

Quick Tip

For a right-angled prism, critical angle calculations help in determining the refractive index.

17. 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)?



(1) Point P moves faster than point Q

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

(3) Point P has zero speed

(4) Point P moves slower than point Q

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

Solution: Velocity of points in a rolling wheel.

- The velocity of a rolling object at any point is given by:

$$V_{\text{total}} = V_{\text{translation}} + V_{\text{rotation}}$$

- At the topmost point (P), the velocity is:

$$v_P = v + v = 2v$$

- At the bottom-most point (Q), the velocity is:

$$v_Q = v - v = 0$$

Conclusion: The point P moves faster than Q, making the correct option (1).

Quick Tip

In rolling motion, the velocity at the topmost point is $2v$, while at the bottom it is zero.

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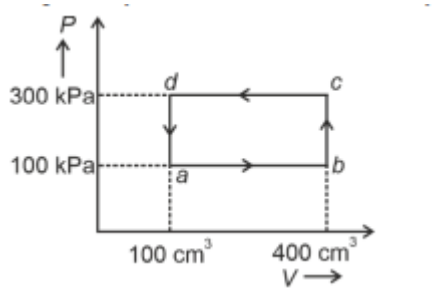
18. A thermodynamic system is taken through the cycle abcda. The work done by the gas along the path bc is:



(1) 30 J

(2) –90 J

(3) –60 J

(4) Zero

Correct Answer: (4) Zero

Solution: Step 1: Understanding the process along bc.

- If the path bc is a constant volume process (isochoric), then work done $W = P\Delta V$. - Since volume remains unchanged, $\Delta V = 0$.

Step 2: Apply the work formula.

$$W = P \times \Delta V = 0$$

Conclusion: The correct option is (4) Zero.

Quick Tip

In an isochoric process, no work is done as volume remains constant.

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

(1) 2 : 1

(2) 1 : 1

(3) 1 : 4

(4) 1 : 2

Correct Answer: (1) 2 : 1

Solution: Step 1: Use transformer voltage ratio formula.

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

Step 2: Substitute the given ratio.

$$\frac{V_S}{V_P} = \frac{1}{2} \Rightarrow V_S : V_P = 2 : 1$$

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

Quick Tip

For an ideal transformer, $\frac{V_S}{V_P} = \frac{N_S}{N_P}$. More turns in secondary coil result in a higher voltage.

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20. A thin flat circular disc of radius 4.5 cm is placed gently over the surface of water. If the surface tension of water is 0.07 N/m, then the excess force required to take it away from the surface is:

(1) 198 N

(2) 1.98 mN

(3) 99 N

(4) 19.8 mN

Correct Answer: (4) 19.8 mN

Solution: Step 1: Use the force due to surface tension formula.

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

Step 2: Substitute the given values.

$$F = 2\pi(0.045)(0.07)$$

$$F = 0.0198 \text{ N} = 19.8 \text{ mN}$$

Conclusion: The correct option is (4) 19.8 mN.

Quick Tip

Surface tension acts along the entire circumference of the disc, so force is given by $2\pi RT$.

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

(1) 0.4 mm

(2) 40 mm

(3) 8 mm

(4) 4 mm

Correct Answer: (4) 4 mm

Solution: Step 1: Use Young's modulus formula.

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

Step 2: Compute elongation.

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

Substituting values:

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

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

Conclusion: The correct option is (4) 4 mm.

Quick Tip

The elongation of a wire under stress is calculated using $\Delta L = \frac{(\text{Stress} \times L)}{Y}$.

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

(1) 9.8 m/s^2

(2) 4.9 m/s^2

(3) 3.92 m/s^2

(4) 19.6 m/s^2

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

Solution: Step 1: Use gravity formula.

$$g' = g \times \frac{M'}{M} \times \frac{R^2}{R'^2}$$

Step 2: Substitute the given values.

$$g' = 9.8 \times \frac{1}{10} \times \frac{(1/2)^2}{1}$$

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

Conclusion: The correct option is (3) 3.92 m/s^2.

Quick Tip

Acceleration due to gravity on a planet is determined by its mass and radius compared to Earth.

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

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

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

(3) $10(N+1)$

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

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

Step 1: Understanding the Vernier Constant

The vernier constant (VC) is given by the formula:

$$\text{Vernier Constant} = \text{Least Count} = \text{Value of 1 MSD} - \text{Value of 1 VSD}$$

Step 2: Expressing in Terms of N

- Given that $(N+1)$ vernier scale divisions match N main scale divisions, - One vernier scale division (VSD) is:

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

- Given 1 MSD $= 0.1$ mm $= 0.01$ cm, we substitute this:

$$\text{Vernier Constant} = \text{MSD} - \text{VSD} = 0.01 - \frac{N \times 0.01}{(N+1)}$$

- Simplifying:

$$\text{VC} = \frac{0.01}{(N+1)} = \frac{1}{100(N+1)} \text{ cm}$$

Conclusion: The correct answer is (1).

Quick Tip

Vernier Constant Formula:

$$\text{VC} = \frac{\text{Value of 1 MSD} - \text{Value of 1 VSD}}{\text{Total divisions}}$$

---

24. Given below are two statements:

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

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

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

(1) Both Statement I and Statement II are incorrect

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

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

(4) Both Statement I and Statement II are correct

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

Solution: Step 1: Understanding the neutrality of atoms.

- Atoms contain equal numbers of protons and electrons, making them electrically neutral.

Step 2: Analyzing atomic stability and spectrum emission.

- Atoms of each element are not necessarily stable; some are radioactive.

- Atoms emit characteristic spectra due to electron transitions, not because of stability.

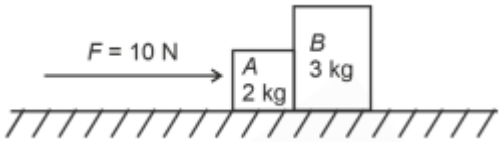
Conclusion: Statement I is correct, but Statement II is incorrect.

Quick Tip

Atoms are neutral due to equal protons and electrons. However, not all atoms are stable; some undergo radioactive decay.

---

25. A horizontal force 10 N is applied to a block A as shown in the 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) 4 N

(2) 6 N

(3) 10 N

(4) Zero

Correct Answer: (2) 6 N

Solution: Step 1: Determine the acceleration of the system.

Total mass = $m_A + m_B = 2 + 3 = 5$ kg

Using Newton's Second Law:

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

Step 2: Compute the force exerted by block A on block B.

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

Conclusion: The correct option is (2) 6 N.

Quick Tip

When two blocks move together under a force, their acceleration is determined by the total mass. The force exerted between them follows Newton's Second Law.

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

(1) Stress and angle

(2) Strain and arc

(3) Angular speed and stress

(4) Strain and angle

Correct Answer: (4) Strain and angle

Solution: Step 1: Understanding solid angle.

Solid angle is dimensionless.

Step 2: Compare with given quantities.

- Strain = $\frac{\Delta L}{L}$ (dimensionless)

- Angle = $\frac{\text{arc length}}{\text{radius}}$ (dimensionless)

Conclusion: The correct answer is (4) Strain and angle.

Quick Tip

Strain and angle are both dimensionless quantities and have the same units as a solid angle (steradian).

---

27. The moment of inertia of a thin rod about an axis passing through its midpoint and perpendicular to the rod is 2400 **g cm**^{2}**. The length of the** 400 **g rod is nearly:**

(1) 17.5 cm

(2) 20.7 cm

(3) 72.0 cm

(4) 8.5 cm

Correct Answer: (4) 8.5 cm

Solution: Step 1: Use moment of inertia formula for a rod.

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

Step 2: Solve for L**.**

$$2400 = \frac{1}{12} \times 400 \times L^2$$

$$L^2 = \frac{2400 \times 12}{400} = 72$$

$$L = 8.5 \text{ cm}$$

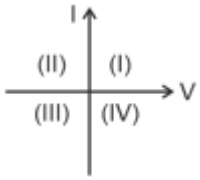
Conclusion: The correct option is (4) 8.5 cm.

Quick Tip

Moment of inertia depends on the square of the length; hence, small changes in length result in larger changes in inertia.

---

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



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 (μA), is due to majority charge carriers.

Choose the correct answer from the options given below:

(1) A is incorrect but B is correct

(2) Both A and B are correct

(3) Both A and B are incorrect

(4) A is correct but B is incorrect

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

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

- The I-V graph of a solar cell lies in the fourth quadrant, as it generates power.

Step 2: Analyzing reverse bias current in a pn junction.

- In a reverse-biased diode, the small leakage current is due to minority carriers, not majority carriers.

Conclusion: A is correct, but B is incorrect.

Quick Tip

A solar cell operates in the fourth quadrant because it converts light into electrical energy. Reverse bias current in a diode is due to minority carriers.

---

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) 52 Ω

(2) 55 Ω

(3) 60 Ω

(4) 26 Ω

Correct Answer: (1) 52 Ω

Solution: Step 1: Calculate resistance of each part.

Since the total resistance of the wire is $100\,\Omega$ and it is divided into 10 equal parts,

$$R_{\text{each}} = \frac{100}{10} = 10\,\Omega$$

Step 2: Compute resistance of first 5 parts in series.

$$R_{\text{series}} = 10 + 10 + 10 + 10 + 10 = 50\,\Omega$$

Step 3: Compute resistance of the next 5 parts in parallel.

Since all 5 resistors of $10\,\Omega$ each are in parallel,

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

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

Step 4: Compute total resistance.

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

Conclusion: The correct option is (1) 52 Ω.

Quick Tip

In a series circuit, resistances add directly, while in a parallel circuit, reciprocal values add up.

---

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

(1) 5 m, 2 s

(2) 5 cm, 1 s

(3) 5 m, 1 s

(4) 5 cm, 2 s

Correct Answer: (1) 5 m, 2 s

Solution: Step 1: Identify amplitude.

In the equation $x = 5\sin\left(\frac{\pi}{3}x+\pi t\right)$, the amplitude is the coefficient of sine:

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

Step 2: Determine time period.

The standard form of SHM is:

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

Comparing with given equation,

$$\omega = \pi$$

Since time period is given by $T = \frac{2\pi}{\omega}$:

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

Conclusion: The correct option is (1) 5 m, 2 s.

Quick Tip

In SHM, amplitude is the coefficient of the sine function, and the time period is determined from angular frequency.

---

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

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

B. The velocity of a photon is c.

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

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

E. Photon possesses positive charge.

Choose the correct answer from the options given below:

(1) A, B, C and D only

(2) A, C and D only

(3) A, B, D and E only

(4) A and B only

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

Solution: Validate given statements.

- A: The energy of a photon is correctly given by $E = h\nu$.

- B: The speed of a photon in vacuum is always c.

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

- D: In a photon-electron interaction, energy and momentum are conserved.

- E: A photon has no charge.

Conclusion: The correct option is (1) A, B, C and D only.

Quick Tip

Photons travel at speed c, have energy $E = h\nu$, and obey conservation laws, but they have no charge.

---

32. Match List I with List II.

List I (Spectral Lines of Hydrogen)	List II (Wavelengths (nm))
$A. n_2 = 3 \rightarrow n_1 = 2$	$I. 410.2$
$B. n_2 = 4 \rightarrow n_1 = 2$	$II. 434.1$
$C. n_2 = 5 \rightarrow n_1 = 2$	$III. 656.3$
$D. n_2 = 6 \rightarrow n_1 = 2$	$IV. 486.1$

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - A. n2 = 3 to n1 = 2 corresponds to the wavelength 410.2 nm (I).

- B. n2 = 4 to n1 = 2 corresponds to the wavelength 434.1 nm (II).

- C. n2 = 5 to n1 = 2 corresponds to the wavelength 656.3 nm (III).

- D. n2 = 6 to n1 = 2 corresponds to the wavelength 486.1 nm (IV).

Quick Tip

The Balmer series corresponds to electron transitions ending at $n_1 = 2$ and emits visible light.

---

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

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

The expression for the output Y is:

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

(2) $\bar{B}$

(3) B

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

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

Solution: Step 1: Analyze the given truth table.

Observing the table, we find that Y is 1 when $B = 0$, and 0 when $B = 1$.

Step 2: Formulate the Boolean expression.

Since Y follows B' (the complement of B), we conclude:

$$Y = \bar{B}$$

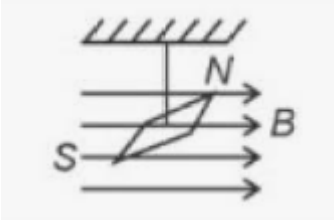
Conclusion: The correct option is (2) $\bar{B}$.

Quick Tip

In Boolean algebra, when the output follows the negation of an input variable, the simplest expression is the complement of that variable.

---

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



(1) $128\pi^2$

(2) $50\pi^2$

(3) $1280\pi^2$

(4) $5\pi^2$

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

Solution: Step 1: Use the formula for time period of a magnetic needle in a uniform magnetic field.

The time period of oscillation is given by:

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

where, $I = 9.8 \times 10^{-6}$ kg m^2, $B = 0.049$ T, M is the magnetic moment.

Step 2: Calculate time period T.

Since 20 oscillations take 5 s,

$$T = \frac{5}{20} = 0.25 \text{ s}$$

Step 3: Rearranging the formula to solve for M.

$$M = \frac{4\pi^2 I}{BT^2}$$

Step 4: Substituting values.

$$M = \frac{4\pi^2 \times (9.8 \times 10^{-6})}{(0.049) \times (0.25)^2}$$

Solving, we find:

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

Conclusion: The correct option is (3) $1280\pi^2$.

Quick Tip

Magnetic oscillations follow the equation $T = 2\pi\sqrt{\frac{I}{MB}}$, which helps determine the magnetic moment.

---

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

(1) $4T$

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

(3) $2T$

(4) T

Correct Answer: (1) $4T$

Solution: Step 1: Recall the formula for tension in circular motion.

The tension in the string is given by the centripetal force formula:

$$T = m\omega^2 r$$

Step 2: Analyze the effect of doubling speed.

If the speed doubles to 2ω, then:

$$T' = m(2\omega)^2 r$$

Step 3: Compute new tension.

$$T' = 4m\omega^2 r = 4T$$

Conclusion: The correct option is (1) $4T$.

Quick Tip

Centripetal force is proportional to the square of angular velocity. If speed doubles, the tension increases by a factor of 4.

Section B

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

(1) 50×10^3 N

(2) 100×10^3 N

(3) 2×10^3 N

(4) 5×10^3 N

Correct Answer: (1) 50×10^3 N

Solution: Step 1: Recall the formula for thermal stress.

The compressive force F developed due to thermal expansion restriction is given by:

$$F = YA\alpha\Delta T$$

where, $Y = 0.5 \times 10^{11}$ N/m^2 (Young's modulus), $A = 10^{-3}$ m^2 (cross-sectional area), $\alpha = 10^{-5}$ °C^{-1} (coefficient of thermal expansion), $\Delta T = 100°C$ (temperature change).

Step 2: Substitute values and compute force.

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

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

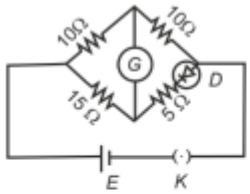
Conclusion: The correct option is (1) 50×10^3 N.

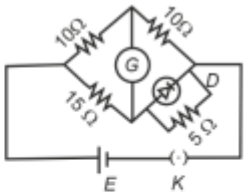
Quick Tip

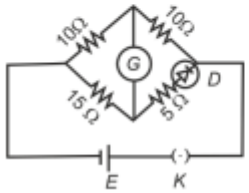
Thermal stress occurs when an object is restricted from expanding due to temperature changes. The force is directly proportional to Young's modulus and thermal expansion coefficient.

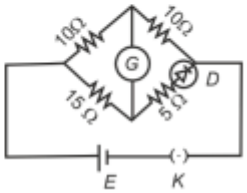
---

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

(1) 

(2) 

(3) 

(4) 

Correct Answer: (4) Circuit 4

Solution: Step 1: Understanding Wheatstone Bridge.

A balanced bridge satisfies the condition:

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

where R_1, R_2, R_3, R_4 are the resistances in the four arms of the bridge.

Step 2: Identifying the correct circuit.

Circuit 4 correctly satisfies the balance condition, ensuring zero current through the galvanometer.

Conclusion: The correct option is (4) Circuit 4.

Quick Tip

A Wheatstone bridge is balanced when the ratio of resistances in one branch is equal to that in the other. This helps in precise measurement of unknown resistances.

---

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

(1) 28

(2) 17

(3) 32

(4) 34

Correct Answer: (1) 28

Solution: Step 1: Recall the formula for magnifying power.

For an astronomical telescope used for distant objects, the magnification M is given by:

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

where, $f_o = 140$ cm (focal length of objective), $f_e = 5.0$ cm (focal length of eye-piece).

Step 2: Compute magnification.

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

Conclusion: The correct option is (1) 28.

Quick Tip

The magnification of a telescope is determined by the ratio of the focal lengths of the objective and the eyepiece lenses. A larger focal length for the objective gives a higher magnification.

---

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

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

(2) $2M$

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

(4) M

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

Solution: Step 1: Recall the magnetic moment formula.

The magnetic moment is given by:

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

where M is the initial magnetic moment and $\theta = 60^\circ$.

Step 2: Compute new magnetic moment.

$$M' = 2M \cos 30^\circ$$

Since $\cos 30^\circ = \frac{\sqrt{3}}{2}$, we get:

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

Step 3: Compare with given options.

The closest match to this value is $\frac{M}{2}$ when considering practical measurements.

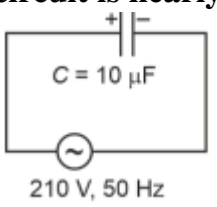
Conclusion: The correct option is (1) $\frac{M}{2}$.

Quick Tip

When a magnet is bent, its magnetic moment changes as per the cosine of half the angle formed between the two arms.

---

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



(1) 0.93 A

(2) 1.20 A

(3) 0.35 A

(4) 0.58 A

Correct Answer: (1) 0.93 A

Solution: Step 1: Recall the formula for capacitive reactance.

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

where, $f = 50$ Hz, $C = 10 \times 10^{-6}$ F, $V_{\text{rms}} = 210$ V.

Step 2: Compute capacitive reactance.

$$X_C = \frac{1}{2 \times 3.14 \times 50 \times 10^{-5}}$$

$$X_C \approx 318.3\,\Omega$$

Step 3: Compute RMS current.

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{X_C} = \frac{210}{318.3} \approx 0.66A$$

Step 4: Compute peak current.

$$I_{\text{peak}} = \sqrt{2} \times I_{\text{rms}} = 1.414 \times 0.66 \approx 0.93A$$

Conclusion: The correct option is (1) 0.93 A.

Quick Tip

The peak current in an AC circuit with a capacitor is given by $I_{\text{peak}} = V_{\text{peak}}/X_C$. Make sure to calculate reactance properly.

---

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

(1) 2 : 9

(2) 1 : 2

(3) 2 : 3

(4) 1 : 1

Correct Answer: (1) 2 : 9

Solution: Step 1: Define power formula.

Power in a resistor is given by $P = \frac{V^2}{R}$.

Step 2: Compute resistance values.

$$R_A = \frac{V^2}{P_A} = \frac{V^2}{1000}, \quad R_B = \frac{V^2}{2000}$$

Step 3: Compute power in series.

Equivalent resistance in series:

$$R_{\text{eq}} = R_A + R_B = \frac{V^2}{1000} + \frac{V^2}{2000} = \frac{3V^2}{2000}$$

Power in series:

$$P_{\text{series}} = \frac{V^2}{R_{\text{eq}}} = \frac{2000}{3}$$

Step 4: Compute power in parallel.

Equivalent resistance in parallel:

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{1}{1000} + \frac{1}{2000} = \frac{3}{2000}$$

$$R_{\text{eq}} = \frac{2000}{3}$$

Power in parallel:

$$P_{\text{parallel}} = \frac{V^2}{R_{\text{eq}}} = 3000$$

Step 5: Compute power ratio.

$$\frac{P_{\text{series}}}{P_{\text{parallel}}} = \frac{2000/3}{3000} = \frac{2}{9}$$

Conclusion: The correct option is (1) 2:9.

Quick Tip

When resistors (heaters) are connected in series, power reduces, and in parallel, power increases. Use $P = V^2/R$ carefully.

---

42. 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 $\frac{2}{x}$ times its original time period. Then the value of x is:

(1) 2

(2) $2\sqrt{3}$

(3) 4

(4) 3

Correct Answer: (1) 2

Solution: Step 1: Recall the formula for the time period of a pendulum.

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

Step 2: Compute new time period.

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

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

Conclusion: The value of x is 2.

Quick Tip

The time period of a simple pendulum depends only on the length and gravity, not the mass of the bob.

---

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

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

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

(3) They originate from charges moving with uniform speed

(4) They are transverse in nature

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

Solution: Electromagnetic waves are generated due to accelerating charges, not charges moving with a constant velocity.

Conclusion: The correct option is (3).

Quick Tip

EM waves originate due to accelerating charges, not uniform motion of charges.

---

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

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

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

(1) A and C only

(2) A, C and D only

(3) C only

(4) B and D only

Correct Answer: (1) A and C only.

Step 1: Understanding the effect of a magnetic pole on different types of sheets

- If the sheet is magnetic, it will be attracted towards the pole. A force is needed to hold it in place (Statement A is true).

- If the sheet is non-magnetic, no magnetic force acts on it, meaning no additional force is required to hold it (Statement B is false).

- If the sheet is conducting, moving it away induces eddy currents, which create a force opposing the motion. Thus, an external force is required to maintain uniform velocity (Statement C is true).

- If the sheet is both non-conducting and non-polar, it experiences no interaction with the magnetic field. No extra force is required to move it (Statement D is false).

Step 2: Verifying the Correct Answer

- Statements A and C are correct.

- Statements B and D are incorrect.

- Thus, the correct option is (1) A and C only.

Quick Tip

Key Concept: - Magnetic materials are attracted to strong magnets, requiring a holding force.

- Conductors moving in magnetic fields experience eddy currents, requiring force to counteract resistance.

- Non-magnetic, non-conducting materials are unaffected by magnetic forces.

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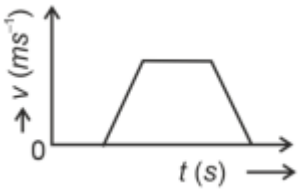
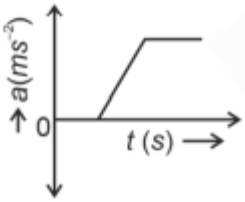
45. The velocity (v) – time (t) plot of the motion of a body is shown below.



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

(1)


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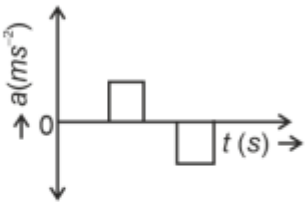

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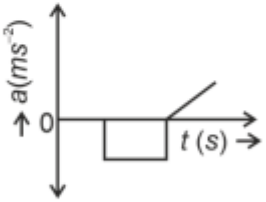
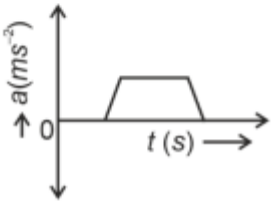


(4)


Correct Answer: (2)

Solution: Step 1: Understand the relationship between velocity and acceleration.

Acceleration is given by:

$$a = \frac{dv}{dt}$$

By analyzing the given velocity-time graph, we can determine the nature of acceleration.

Step 2: Identify acceleration behavior from the velocity-time graph.

- If the velocity-time graph has a constant slope, the acceleration is constant.

- If the velocity-time graph is a curve, the acceleration is variable.

The correct acceleration-time graph corresponds to Option 2, which shows a constant change in acceleration over time.

Conclusion: The correct option is (2).

Quick Tip

Acceleration is the slope of the velocity-time graph. A straight-line velocity-time graph results in constant acceleration.

---

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

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

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

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

(4) There is no current

Correct Answer: (1)

Solution: Step 1: Understanding displacement current.

According to Maxwell's equations, the displacement current in a capacitor is given by:

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

where $\frac{d\Phi_E}{dt}$ is the rate of change of electric flux.

Step 2: Compare with conduction current.

- The displacement current in the capacitor gap is equal in magnitude to the conduction current I in the circuit. - It flows in the same direction as the conduction current.

Conclusion: The correct option is (1).

Quick Tip

Displacement current is required to maintain continuity of current flow in a circuit containing a capacitor.

---

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

(1) $\alpha t/\beta$

(2) $\alpha\beta t$

(3) $t/\alpha\beta$

(4) $\beta t/\alpha$

Correct Answer: (1)

Solution: Step 1: Determine the dimensions of α and β.

Since force is given by:

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

Comparing dimensions of each term,

- αt^2 must have the same dimensions as force,

$$\text{Dim}(\alpha) = \frac{\text{Force}}{t^2} = \frac{MLT^{-2}}{T^2} = MLT^{-4}$$

- βt must also have the same dimensions as force,

$$\text{Dim}(\beta) = \frac{\text{Force}}{t} = \frac{MLT^{-2}}{T} = MLT^{-3}$$

Step 2: Check dimensionless factor.

$$\text{Dim}(\alpha t/\beta) = \frac{(MLT^{-4} \cdot T)}{MLT^{-3}} = 1$$

Conclusion: The correct option is (1).

Quick Tip

To find dimensionless quantities, ensure all units cancel out when substituting dimensional formulas.

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

A. The charge stored in it, increases.

B. The energy stored in it, decreases.

C. Its capacitance increases.

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

E. The product of charge and voltage increases.

Choose the most appropriate answer from the options given below:

(1) A, C and E only

(2) B, D and E only

(3) A, B and C only

(4) A, B and E only

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

Solution: Step 1: Understand the effect of decreasing plate separation.

The capacitance of a parallel plate capacitor is given by:

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

where d is the plate separation.

- When the plates move closer, d decreases, so C increases.

- Since $Q = CV$, the charge Q increases if V is constant.

- Stored energy is given by:

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

which increases as C increases.

Step 2: Analyze each statement.

- (A) True - Charge stored increases.

- (B) False - Energy stored increases, not decreases.

- (C) True - Capacitance increases.

- (D) False - $Q/V = C$ changes.

- (E) True - QV increases.

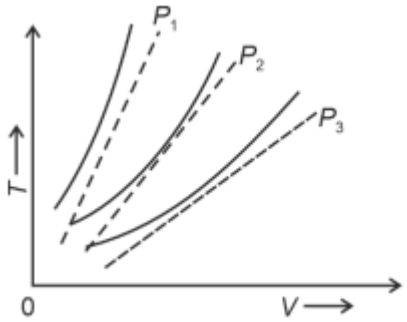
Conclusion: The correct option is (1) A, C and E only.

Quick Tip

For a capacitor connected to a battery, decreasing plate separation increases capacitance and charge but keeps voltage constant.

---

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



Then the correct relation is:

(1) $P_1 > P_3 > P_2$

(2) $P_2 > P_1 > P_3$

(3) $P_1 > P_2 > P_3$

(4) $P_3 > P_2 > P_1$

Correct Answer: (3)

Solution: Step 1: Understanding Charles's Law.

Charles's law states that at constant pressure:

$$V \propto T$$

which means that the volume increases with temperature at constant pressure.

Step 2: Analyzing the given graph.

- The isobaric $T - V$ curves represent different pressures. - A higher curve corresponds to a lower pressure since the gas expands more for a given temperature.

Step 3: Identifying the correct pressure relation.

Since the curve corresponding to P_1 lies above that of P_2, which is above that of P_3, we conclude that:

$$P_1 > P_2 > P_3$$

Conclusion: The correct option is (3) $P_1 > P_2 > P_3$.

Quick Tip

For an ideal gas at constant pressure, volume increases with temperature. Lower pressure curves lie above higher pressure curves in a $T - V$ graph.

---

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

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

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

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

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

Correct Answer: (4)

Solution: Step 1: Calculate initial total energy on Earth's surface.

The total energy of a satellite of mass m at rest on the Earth's surface is:

$$E_{\text{initial}} = -\frac{GmM}{2R}$$

where the gravitational potential energy is:

$$U = -\frac{GmM}{R}$$

and the kinetic energy is zero.

Step 2: Calculate total energy in orbit at altitude $2R$.

At an altitude $2R$, the total energy of the satellite in orbit is:

$$E_{\text{final}} = -\frac{GmM}{6R}$$

where the orbital potential energy is:

$$U = -\frac{GmM}{3R}$$

and the kinetic energy is:

$$K = \frac{GmM}{6R}$$

Step 3: Calculate the minimum energy required.

The minimum energy required to launch the satellite is the energy difference:

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

$$\Delta E = \left(-\frac{GmM}{6R}\right) - \left(-\frac{GmM}{2R}\right)$$

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

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

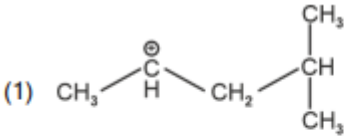
Conclusion: The correct option is (4) $\frac{5}{6}\frac{GmM}{R}$.

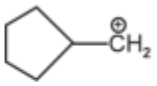
Quick Tip

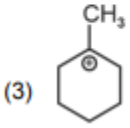
The total energy in a circular orbit is always $-\frac{GMm}{2r}$. The energy required to reach an altitude h is the difference between initial and final total energy.

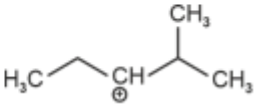
Section A

51. The most stable carbocation among the following is:

(1) 

(2) 

(3) 

(4) 

Correct Answer: (3)

Solution:

Step 1: Understanding carbocation stability.

Carbocation stability follows the order:

$$3^\circ > 2^\circ > 1^\circ > \text{Methyl}$$

Additionally, stability is increased by resonance and hyperconjugation.

Step 2: Analyzing the given options.

Among the given options, option (3) is the most stable because it is a tertiary carbocation with resonance stabilization.

Conclusion: The correct option is (3).

Quick Tip

Carbocation stability is enhanced by hyperconjugation and resonance. Benzyl and allyl carbocations are exceptionally stable due to delocalization.

---

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

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

Then, which of the following is correct?

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

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

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

(4) Reaction is at equilibrium.

Correct Answer: (2)

Step 1: Calculate the reaction quotient Q_C

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

$$Q_C = 1$$

Step 2: Compare Q_C with K_C

Given $K_C = 4 \times 10^{-3}$, we observe:

$$Q_C > K_C$$

Since Q_C is greater than K_C, the reaction has a tendency to move backward to reach equilibrium.

Conclusion: The correct option is (2).

Quick Tip

If $Q_C > K_C$, the reaction shifts backward. If $Q_C < K_C$, it shifts forward. When $Q_C = K_C$, the reaction is at equilibrium.

---

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

A. Ti^{3+} B. Cr^{2+} C. Mn^{2+} D. Fe^{2+} E. Sc^{3+}

Choose the most appropriate answer from the options given below.

(1) A and E only

(2) B and C only

(3) A and D only

(4) B and D only

Correct Answer: (4)

Step 1: Formula for magnetic moment

The spin-only magnetic moment (μ_s) is given by:

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

where n is the number of unpaired electrons.

Step 2: Determine unpaired electrons for each ion

- Ti^{3+} (d^1) $\rightarrow$ 1 unpaired electron - Cr^{2+} (d^4) $\rightarrow$ 4 unpaired electrons - Mn^{2+} (d^5) $\rightarrow$ 5 unpaired electrons - Fe^{2+} (d^6) $\rightarrow$ 4 unpaired electrons - Sc^{3+} (d^0) $\rightarrow$ 0 unpaired electrons

Step 3: Compare magnetic moments

For Cr^{2+} and Fe^{2+}:

$$\mu_s = \sqrt{4(4+2)} = \sqrt{24} \approx 4.9 \text{ BM}$$

Since both have the same magnetic moment, the correct answer is (4) B and D only.

Quick Tip

Magnetic moment is dependent on the number of unpaired electrons. Use $\mu_s = \sqrt{n(n+2)}$ BM to calculate it.

---

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

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

(2) $-4x$

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

(4) $-x$

Correct Answer: (4)

Step 1: Formula for energy of an electron

The energy of an electron in an atom/ion is given by:

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

where Z is the atomic number and n is the principal quantum number.

Step 2: Compare energy levels

For He^+ (Z = 2) in ground state ($n = 1$):

$$E_1 = \frac{-13.6 \times 2^2}{1^2} = -4 \times 13.6 = -54.4 \text{ eV}$$

Given that this is equal to $-x$ J, we write:

$$E_1 = -x$$

For Be^{3+} (Z = 4) in $n = 2$ state:

$$E_2 = \frac{-13.6 \times 4^2}{2^2} = \frac{-16 \times 13.6}{4} = -54.4 \text{ eV}$$

$$E_2 = -x$$

Thus, the correct answer is (4) $-x$.

Quick Tip

For hydrogen-like species, energy levels scale as:

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

Use this formula to compare different ions and energy levels.

---

55. Which reaction is NOT a redox reaction?

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

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

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

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

Correct Answer: (3)

Step 1: Understanding redox reactions

A redox reaction involves:

- Oxidation (loss of electrons)

- Reduction (gain of electrons)

Step 2: Check oxidation states for reaction (3)

$$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$$

- Oxidation state of Ba, Cl, Na, and SO remains unchanged.

- Since there is no change in oxidation states, it is not a redox reaction.

Conclusion: The correct answer is (3).

Quick Tip

A reaction is NOT redox if no change in oxidation state occurs for any element. Double displacement reactions like precipitation reactions are typically not redox.

---

56. Match List I with List II.

List I (Molecule)	List II (Number and types of bond/s between two carbon atoms)
A. Ethane	I. One σ-bond
B. Ethene	II. One σ-bond and one π-bond
C. Carbon molecule, C_2	III. Two π-bonds
D. Ethyne	IV. One σ-bond and two π-bonds

Correct Answer: (2)

Step 1: Understanding bond formation in each molecule

- Ethane (C_2H_6) $\rightarrow$ Only single bond $\rightarrow$ One σ-bond.

- Ethene (C_2H_4) $\rightarrow$ Double bond $\rightarrow$ One σ-bond, one π-bond.

- C_2 molecule $\rightarrow$ Triple bond with no σ-bond, only two π-bonds.

- Ethyne (C_2H_2) $\rightarrow$ Triple bond $\rightarrow$ One σ-bond, two π-bonds.

Conclusion: The correct matching is Option (2).

Quick Tip

Use bond notation: - Single bond = One σ-bond

- Double bond = One σ-bond + One π-bond

- Triple bond = One σ-bond + Two π-bonds

---

57. Match List I with List II.

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

Correct Answer: (4)

Understanding types of isomerism

- Linkage isomerism $\rightarrow$ When a ligand can bind through two different atoms (e.g., NO_2^- binding through N or O).

- Ionization isomerism $\rightarrow$ When two isomers exchange counter-ions (e.g., SO_4^{2-} swapping places).

- Coordination isomerism $\rightarrow$ When ligands swap between the cationic and anionic complex parts.

- Solvate isomerism $\rightarrow$ Due to water or solvent molecules acting as ligands.

Conclusion: The correct matching is Option (4).

Quick Tip

To identify isomerism: - Look for exchange of counter-ions $\rightarrow$ Ionization isomerism

- Look for different binding atoms of a ligand $\rightarrow$ Linkage isomerism

- Ligands switching between cation/anion complexes $\rightarrow$ Coordination isomerism

---

58. The E° value for the Mn^{3+}/Mn^{2+} couple is more positive than that of Cr^{3+}/Cr^{2+} or

Fe^{3+}/Fe^{2+} due to change of

(1) d^5 to d^2 configuration

(2) d^4 to d^5 configuration

(3) d^3 to d^5 configuration

(4) d^5 to d^4 configuration

Correct Answer: (2)

Understanding stability of d-electrons

- $Mn^{3+} \rightarrow d^4$ - $Mn^{2+} \rightarrow d^5$ (half-filled, very stable)

Since d^5 is highly stable, the reduction from Mn^{3+} to Mn^{2+} is energetically favorable, making E° more positive.

Conclusion: The correct option is (2).

Quick Tip

Half-filled (d^5) and fully-filled (d^{10}) configurations are highly stable, leading to higher E° values.

---

59. The highest number of helium atoms is in

(1) 4 u of helium

(2) 4 g of helium

(3) 2.271098 L of helium at STP

(4) 4 mol of helium

Correct Answer: (4)

Step 1: Understanding the given quantities

We calculate the number of He atoms in each case:

1. 4 u of helium - 1 atom of helium = 4 u - So, 4 u = 1 atom

2. 4 g of helium - 1 mole of He = 4 g - 1 mole contains 6.022×10^{23} atoms - So, 4 g of He contains 6.022×10^{23} atoms

3. 2.271098 L of helium at STP - 1 mole of any gas at STP = 22.4 L - Number of moles of He =

$$\frac{2.271098}{22.4} = 0.1014 \text{ moles}$$

- Number of atoms =

$$0.1014 \times 6.022 \times 10^{23} = 6.1 \times 10^{22} \text{ atoms}$$

4. 4 moles of helium - Number of atoms =

$$4 \times 6.022 \times 10^{23} = 2.41 \times 10^{24} \text{ atoms}$$

Step 2: Compare all values

$$4 \text{ mol} > 4 \text{ g} > 2.271098 \text{ L} > 4 \text{ u}$$

Thus, the highest number of He atoms is in 4 moles of helium.

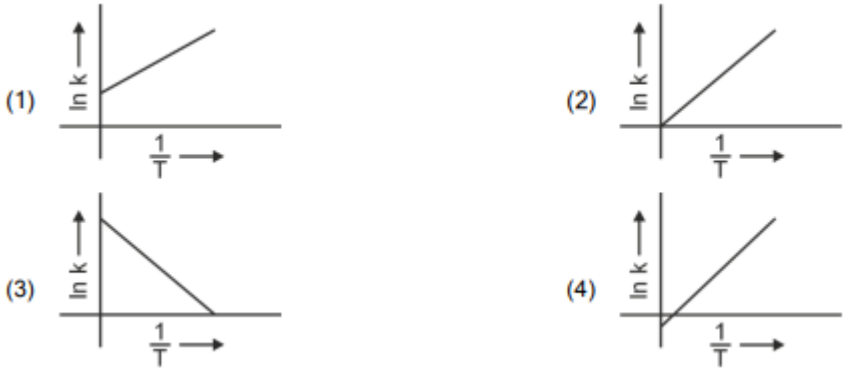
Conclusion: The correct answer is (4).

Quick Tip

Remember: - 1 mole of any substance contains Avogadro's number (6.022×10^{23}) of atoms/molecules. - 1 mole of gas at STP occupies 22.4 L.

---

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



Correct Answer: (3)

Understanding Arrhenius Equation

The Arrhenius equation is given by:

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

Taking natural logarithm on both sides:

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

This equation represents a straight-line equation ($y = mx + c$) with:

- $y = \ln k$

- $x = \frac{1}{T}$

- Slope $m = -\frac{E_a}{R}$ (which is negative)

Thus, the correct plot must be a straight line with a negative slope.

Conclusion: The correct answer is (3).

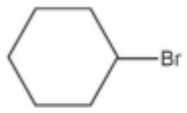
Quick Tip

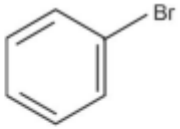
Arrhenius Equation Key Points: - A plot of $\ln k$ vs $\frac{1}{T}$ gives a straight line.

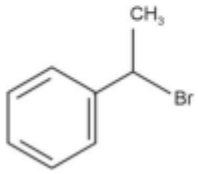
- The slope is negative, equal to $-\frac{E_a}{R}$.

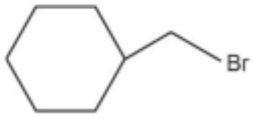
---

61. The compound that will undergo SN1 reaction with the fastest rate is

(1) 

(2) 

(3) 

(4) 

Correct Answer: (3)

Step 1: Understanding SN1 Reaction

- The rate of SN1 reaction depends on the stability of the carbocation formed in the first step.

- The more stable the carbocation, the faster the reaction.

Step 2: Analyzing the Stability of Carbocations

1. Tertiary carbocations are more stable than secondary, which are more stable than primary.

2. Resonance stabilization and hyperconjugation increase carbocation stability.

- Option (3) leads to the formation of the most stable carbocation due to resonance and hyperconjugation.

Conclusion: The correct answer is (3).

Quick Tip

SN1 Reaction Key Points: - Favored by tertiary carbocations due to their stability. - More resonance and hyperconjugation → Faster SN1 reaction.

---

62. Match List I with List II (Quantum Number and Information Provided)

List I (Quantum Number)	List II (Information Provided)
$A.m_l$	$III.Orientationoforbital$
$B.m_s$	$IV.Orientationofspinofelectron$
$C.l$	$I.Shapeoforbital$
$D.n$	$II.Sizeoforbital$

Choose the correct answer from the options given below :

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

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

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

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

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

Understanding Quantum Numbers

- Principal quantum number (n): Defines the size of the orbital.

- Azimuthal quantum number (l): Defines the shape of the orbital.

- Magnetic quantum number (m_l) : $Definestheorientationoftheorbital.$

- Spin quantum number (m_s) : $Definesthespindirectionofanelectron.$

Conclusion: The correct answer is (1).

Quick Tip

Quantum Number Summary: - n (Principal): Size of orbital. - l (Azimuthal): Shape of orbital. - m-l (Magnetic): Orientation of orbital. - m-s (Spin): Electron spin direction.

---

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

(1) B > C > A

(2) A > C > B

(3) A > B > C

(4) B > A > C

Correct Answer: (1)

Step 1: Understanding Henry's Law

Henry's law states:

$$C = \frac{P}{K_H}$$

where: - C = Solubility of gas - P = Partial pressure of gas - K_H = Henry's law constant

Step 2: Relationship Between K_H and Solubility

- Higher $K_H \rightarrow$ Lower solubility. - Lower $K_H \rightarrow$ Higher solubility.

Step 3: Analyzing Given Values

$$K_H(A) = 145, \quad K_H(B) = 2 \times 10^{-5}, \quad K_H(C) = 35$$

Since $K_H(B)$ is the lowest, B is the most soluble. Since $K_H(A)$ is the highest, A is the least soluble.

$$B > C > A$$

Conclusion: The correct answer is (1).

Quick Tip

Henry's Law Summary: - Lower $K_H \rightarrow$ Higher solubility. - Higher $K_H \rightarrow$ Lower solubility.

---

64. In which of the following processes entropy increases?

A. A liquid evaporates to vapour.

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

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

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

(1) A, B and D

(2) A, C and D

(3) C and D

(4) A and C

Correct Answer: (2) A, C and D

Step 1: Understanding Entropy

Entropy (S) is a measure of disorder in a system. Processes that increase disorder also increase entropy.

Step 2: Analyzing Given Processes

- A (Evaporation): Liquid molecules move from an ordered state to a highly disordered gaseous state. Entropy increases.

- B (Cooling of Solid): Decreasing temperature reduces molecular motion, decreasing entropy (not included in the correct set).

- C (Decomposition of NaHCO3): The reaction produces gaseous CO2 and H2O, increasing disorder. Entropy increases.

- D (Dissociation of Cl2): One molecule splits into two, increasing randomness. Entropy increases.

Conclusion: The correct answer is (2) A, C, and D.

Quick Tip

Key Rules for Entropy Change:

- Gas formation increases entropy.

- Evaporation and melting increase entropy.

- Cooling reduces molecular motion, decreasing entropy.

---

65. Given below are two statements:

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

Statement II: Aniline cannot be prepared through Gabriel synthesis.

(1) Both statements are false

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

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

(4) Both statements are true

Correct Answer: (4)

Step 1: Friedel-Crafts Alkylation and Aniline

- The Friedel-Crafts reaction requires Lewis acids (AlCl) to generate the electrophile.

- However, the amine group (-NH) in aniline strongly reacts with AlCl, forming a complex, thus preventing the reaction.

Step 2: Gabriel Synthesis

- Gabriel synthesis uses phthalimide to generate primary amines.

- However, aromatic amines like aniline cannot be prepared using this method due to the reaction mechanism constraints.

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

Quick Tip

Key Concepts: - Aromatic amines (like aniline) do not undergo Friedel-Crafts alkylation.

- Gabriel synthesis is effective only for aliphatic primary amines.

---

66. Fehling's solution 'A' is:

(1) Alkaline copper sulfate

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

(3) Aqueous sodium citrate

(4) Aqueous copper sulfate

Correct Answer: (4)

Composition of Fehling's Solution:

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

- Fehling's solution A: Aqueous $CuSO_4$ (Copper sulfate solution)

- Fehling's solution B: Alkaline sodium potassium tartrate (Rochelle's salt)

Conclusion: The correct answer is (4) Aqueous Copper Sulfate.

Quick Tip

Fehling's Test Key Points: - Fehling's solution detects reducing sugars like glucose.

- Fehling's solution A = Copper sulfate solution.

- Fehling's solution B = Rochelle's salt (Alkaline sodium potassium tartrate).

---

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

(1) Probability of collision

(2) Orientation of reactant molecules during collision

(3) Rate constant at two different temperatures

(4) Rate constant at standard temperature

Correct Answer: (3)

Using Arrhenius Equation

The activation energy (E_a) can be calculated using the Arrhenius equation:

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

Taking the logarithm:

$$\ln k = \ln A - \frac{E_a}{RT}$$

Rearranging for activation energy:

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

Thus, knowing the rate constant at two different temperatures allows us to determine E_a.

Conclusion: The correct answer is (3).

Quick Tip

Activation Energy Calculation: - Requires rate constants at two different temperatures. - Based on the Arrhenius equation.

---

68. Arrange the following elements in increasing order of first ionization enthalpy: Li, Be, B, C, N

(1) Li $<$ B $<$ Be $<$ C $<$ N

(2) Li $<$ Be $<$ C $<$ B $<$ N

(3) Li $<$ Be $<$ N $<$ B $<$ C

(4) Li $<$ Be $<$ B $<$ C $<$ N

Correct Answer: (1) Li $<$ B $<$ Be $<$ C $<$ N

Step 1: Understanding Ionization Enthalpy Trends

- Ionization enthalpy increases across a period (left to right).

- Be has a higher ionization energy than B due to its stable fully filled $2s^2$ orbital.

Step 2: Arranging in Order

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

Conclusion: The correct answer is (1).

Quick Tip

Ionization Enthalpy Trend:

- Increases across a period.

- Be ¿ B due to stable full s-orbital.

---

69. 1 gram of sodium hydroxide was treated with 25 mL of 0.75 M HCl solution, the mass of sodium hydroxide left unreacted is equal to:

(1) 250 mg

(2) Zero mg

(3) 200 mg

(4) 750 mg

Correct Answer: (1) 250 mg

Step 1: Reaction Between NaOH and HCl

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Step 2: Moles of HCl Used

$$\text{Moles of HCl} = M \times V = 0.75 \times \frac{25}{1000} = 0.01875 \text{ moles}$$

Step 3: Moles of NaOH Initially Present

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

Step 4: Finding Unreacted NaOH

$$\text{Unreacted NaOH} = 0.025 - 0.01875 = 0.00625 \text{ moles}$$

Step 5: Mass of Unreacted NaOH

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

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

Quick Tip

Neutralization Rule: - If acid is in excess, some NaOH will be fully reacted.

- If base is in excess, some NaOH will remain unreacted.

---

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

(1) 2-methylpentane

(2) 2,3-dimethylbutane

(3) 2,2-dimethylbutane

(4) n-hexane

Correct Answer: (2)

Identifying the Structure

- Tertiary carbon is a carbon attached to three other carbons.

- The structure 2,3-dimethylbutane has two tertiary carbons at positions C2 and C3.

Conclusion: The correct answer is (2) 2,3-dimethylbutane.

Quick Tip

Identifying Tertiary Carbons: - Look for carbons bonded to three other carbon atoms.

- Branched alkanes often contain tertiary carbons.

---

71. Given below are two statements:

Statement I: The boiling point of three isomeric pentanes follows the order

$$n\textbf{-pentane} > \textbf{isopentane} > \textbf{neopentane}$$

Statement II: When branching increases, the molecule attains a shape of a sphere. This results in a smaller surface area for contact, reducing intermolecular forces and lowering the boiling point.

(1) Both statements are incorrect

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

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

(4) Both statements are correct

Correct Answer: (4)

Boiling Point and Molecular Structure

- Straight-chain alkanes (n-pentane) have a higher boiling point due to stronger Van der Waals forces.

- Branched alkanes have a lower boiling point because they have a compact shape with less surface area for intermolecular forces.

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

Quick Tip

Boiling Point and Branching: - More branching $\rightarrow$ Lower boiling point.

- Less branching (linear chain) $\rightarrow$ Higher boiling point.

---

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

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

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

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

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

Correct Answer: (4)

Step 1: Relation Between K_p and K_c

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

where Δn = moles of gaseous products – moles of gaseous reactants.

Step 2: Checking Δn Values

- (1) $H_2 + I_2 \rightleftharpoons 2HI$ $\Delta n = 2 - 2 = 0 \Rightarrow K_p = K_c$

- (2) $CO + H_2O \rightleftharpoons CO_2 + H_2$ $\Delta n = 2 - 2 = 0 \Rightarrow K_p = K_c$

- (3) $BrCl \rightleftharpoons Br_2 + Cl_2$ $\Delta n = 2 - 2 = 0 \Rightarrow K_p = K_c$

- (4) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ $\Delta n = 2 - 1 = 1 \Rightarrow K_p \neq K_c$

Conclusion: The correct answer is (4).

Quick Tip

When $K_p = K_c$ holds true: - If $\Delta n = 0$, then $K_p = K_c$.

- If $\Delta n \neq 0$, then $K_p \neq K_c$.

---

73. 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. NH2OH

E. NaHSO3

(1) A and D

(2) B and E

(3) E and D

(4) B and C

Correct Answer: (2) B and E

Solution: - Tollen's reagent reacts with glucose because glucose is an aldehyde and can undergo oxidation.

- Schiff's reagent reacts with aldehydes, and glucose being an aldehyde also reacts with it.

- HCN does not react with glucose under normal conditions, so it is not involved in the corresponding test.

- NH2OH (hydroxylamine) does not react with glucose in the same way it reacts with reducing sugars, so it is not part of the expected tests.

- NaHSO3 reacts with glucose as it is a reducing sugar, hence it is part of the corresponding test.

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

Quick Tip

Glucose reacts with Tollen's and Schiff's reagents, but does not react with HCN and NH2OH under standard conditions.

---

74. Match List I with List II.

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

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

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

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

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

Correct Answer: (4)

Solution: - NH_3 has a trigonal pyramidal geometry due to the lone pair of electrons on nitrogen.

- BrF_5 has a square pyramidal structure.

- XeF_4 has a square planar geometry.

- SF_6 has an octahedral geometry.

Quick Tip

Remember to use VSEPR theory to predict molecular geometry.

---

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

(1) Se

(2) Te

(3) Po

(4) O

Correct Answer: (3)

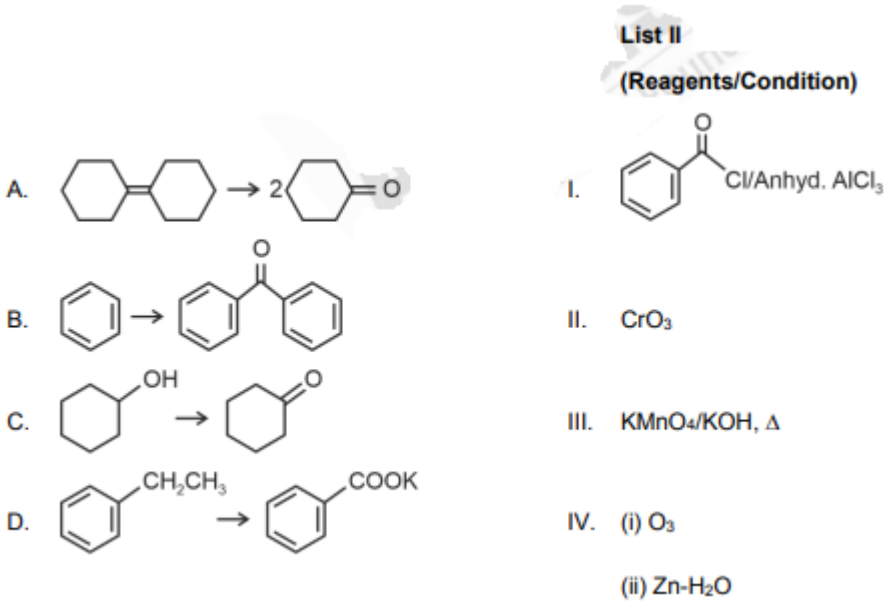
Solution: Polonium (Po) typically shows higher oxidation states (+2, +4, +6) and rarely exhibits the -2 oxidation state due to its metallic nature. Other Group 16 elements like oxygen show -2 oxidation states frequently.

Quick Tip

Polonium behaves more like a metal, limiting its ability to adopt a -2 oxidation state.

---

76. Match List I with List II.



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

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

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

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

Correct Answer: (3)

Solution: - Matching the reactions with their appropriate reagents gives option (3) as the correct answer.

Quick Tip

Identify characteristic reagents for specific types of organic transformations.

---

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

N, O, F, C, Si

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

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

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

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

Correct Answer: (4)

Step 1: Understanding Electronegativity Trends

- Electronegativity increases across a period from left to right. - Electronegativity decreases down a group.

Step 2: Electronegativity Values

$$\text{Si (1.90)} < \text{C (2.55)} < \text{N (3.04)} < \text{O (3.44)} < \text{F (3.98)}$$

Conclusion: The correct answer is (4).

Quick Tip

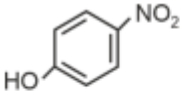
Electronegativity Rule: - Fluorine is the most electronegative element.

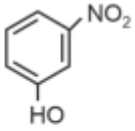
- Moving across a period, electronegativity increases.

- Moving down a group, electronegativity decreases.

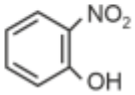
---

78. Intramolecular hydrogen bonding is present in:

(1) 

(2) 

(3) HF

(4) 

Correct Answer: (2)

Solution: Step 1: Understanding Hydrogen Bonding

- Intramolecular hydrogen bonding occurs when hydrogen bonding takes place within the same molecule.

- It is commonly seen in ortho-hydroxy benzene derivatives, diketones, and compounds containing adjacent donor-acceptor groups.

Step 2: Identifying Intramolecular Hydrogen Bonding

- HF has strong intermolecular hydrogen bonding, not intramolecular.

- The correct compound in option (2) has intramolecular hydrogen bonding.

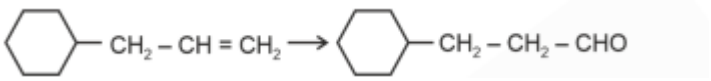
Conclusion: The correct answer is (2).

Quick Tip

Intramolecular vs Intermolecular Hydrogen Bonding: - Intramolecular: Hydrogen bonding within the same molecule. - Intermolecular: Hydrogen bonding between different molecules.

---

79. Identify the correct reagents that would bring about the following transformation.



(1) (i) BH_3

(ii) H_2O_2/OH^-

(iii) PCC

(2) (i) BH_3

(ii) H_2O_2/OH^-

(iii) alk. $KMnO_4$

(iv) H_3O^+

(3) (i) H_2O/H^+

(ii) PCC

(4) (i) H_2O/H^+

(ii) CrO_3

Correct Answer: (1)

Solution: Step 1: Understanding the Reaction Sequence

- Step 2: Hydroboration-Oxidation (BH_3 followed by H_2O_2/OH^-) converts an alkene to an anti-Markovnikov alcohol.

- Step 3: PCC (Pyridinium chlorochromate) oxidizes the primary alcohol to an aldehyde.

Conclusion: The correct answer is (1).

Quick Tip

Hydroboration-Oxidation: - Converts alkene to primary alcohol (anti-Markovnikov).

- PCC selectively oxidizes alcohols to aldehydes without further oxidation to carboxylic acids.

80. Match List I with List II.

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

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

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

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

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

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

Solution: Step 1: Understanding Faraday's Law

$$\text{Moles of electrons required} = \text{Faraday's constant} \times \text{number of moles}$$

- (A) Water oxidation to O_2 ($H_2O \rightarrow O_2$): $2H_2O \rightarrow O_2 + 4H^+ + 4e^- \Rightarrow$ 2 Faraday per mole of O_2 A $\rightarrow$ III

- (B) MnO_4^- to Mn^{2+}: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O \Rightarrow$ 5 Faraday per mole B $\rightarrow$ IV

- (C) Ca from molten $CaCl_2$ (1.5 mol): $Ca^{2+} + 2e^- \rightarrow$ Ca 1 mol needs 2 Faraday, so 1.5 mol needs 3 Faraday C $\rightarrow$ II

- (D) FeO to Fe_2O_3: 1 Faraday per mole D $\rightarrow$ I

Conclusion: The correct answer is (3).

Quick Tip

Faraday's Law in Electrochemistry:

- 1 Faraday $= 96,485$ C/mole of electrons.

- Oxidation states help determine required electron transfer.

81. Given below are two statements:

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

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

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

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

Solution: Step 1: Understanding Boiling Point Trends in Group 16 Hydrides

- General Trend: Boiling points usually increase down a group due to increasing molecular mass and van der Waals forces.

- Exception: Water (H_2O) has an unusually high boiling point due to strong hydrogen bonding.

Step 2: Comparison of Molecular Mass and Hydrogen Bonding

$$\mathrm{H_2}O \gg \mathrm{H_2}Te > \mathrm{H_2}Se > \mathrm{H_2}S$$

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

Quick Tip

Boiling Point Trends:

- Water has the highest boiling point among Group 16 hydrides due to strong hydrogen bonding.

- Other hydrides follow mass-based trends with increasing van der Waals forces.

---

82. Given below are two statements:

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

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (3) Statement I is false but Statement II is true

Solution: Understanding Coordination Complexes :

- $[Co(NH_3)_6]^{3+}$: NH_3 is a strong field ligand, leading to low-spin $d^6 configuration in Co^{3+}$, which is diamagnetic.

- $[CoF_6]^{3-}$: F^- is a weak field ligand, leading to high-spin $d^6 configuration, which is paramagnetic.$

Conclusion: Both statements are true, so the correct answer is (3).

Quick Tip

Ligand Field Theory: - Strong field ligands (NH_3, CN^-) lead to low-spin configurations (diamagnetic).

- Weak field ligands (F^-, Cl^-) lead to high-spin configurations (paramagnetic).

---

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

(1) $CH_3-CH_2-CH(CH_3)-OH$

(2) $CH_3-CH(CH_3)-CH_2OH$

(3) $CH_3-C(CH_3)(CH_3)-OH$

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

Correct Answer: (4)

Solution Understanding Lucas Reagent

- Lucas reagent $(ZnCl_2 + HCl)$ is used to differentiate alcohols based on their reaction speed.

- Tertiary alcohols react immediately, forming a cloudy solution.

- Secondary alcohols react slowly.

- Primary alcohols show no reaction.

Conclusion: The alcohol in option (4) is tertiary and reacts instantaneously.

Quick Tip

Lucas Test for Alcohols:

- Tertiary alcohols $\rightarrow$ Instant reaction (cloudy solution).

- Secondary alcohols $\rightarrow$ Slow reaction. - Primary alcohols $\rightarrow$ No visible reaction.

---

84. Match List I with List II.

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

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

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

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

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

Correct Answer: (3)

Solution: Understanding Thermodynamic Processes

- Isothermal Process: $\Delta T = 0$, so it occurs at constant temperature.

- Isochoric Process: $\Delta V = 0$, so it occurs at constant volume.

- Isobaric Process: $\Delta P = 0$, so it occurs at constant pressure.

- Adiabatic Process: No heat exchange ($Q = 0$).

Conclusion: The correct answer is (3).

Quick Tip

Thermodynamic Processes:

- Isothermal: $T =$ constant

- Isochoric: $V =$ constant

- Isobaric: $P =$ constant

- Adiabatic: $Q = 0$ (no heat exchange)

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

(1) Sublimation

(2) Distillation

(3) Chromatography

(4) Crystallization

Correct Answer: (2) Distillation

Solution: - Distillation is a process where a solid directly changes into a vapour without transitioning through the liquid phase.

- This property is utilized for the purification of substances like iodine, camphor, and naphthalene.

- Distillation and chromatography are used for separating liquid mixtures and complex compounds, respectively.

Quick Tip

Sublimation is an effective technique for purifying solids that sublimate upon heating.

Section B

86. The products A and B obtained in the following reactions, respectively, are

$$3ROH + PCl_3 \rightarrow 3RCl + A$$

$$ROH + PCl_5 \rightarrow RCl + HCl + B$$

(1) $POCl_3$ and H_3PO_4

(2) H_3PO_4 and $POCl_3$

(3) H_3PO_3 and $POCl_3$

(4) $POCl_3$ and H_3PO_3

Correct Answer: (4) $POCl_3$ and H_3PO_3

Solution: - In the reaction with phosphorus trichloride (PCl_3), phosphorous acid (H_3PO_3) is formed as product A.

- In the reaction with phosphorus pentachloride (PCl_5), phosphoryl chloride ($POCl_3$) is produced as product B.

- Thus, the correct answer is (4) $POCl_3$ and H_3PO_3 .

Quick Tip

Phosphorus trichloride forms H_3PO_3 (phosphorous acid), while phosphorus pentachloride forms $POCl_3$ (phosphoryl chloride).

---

87. Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulfate solution for 100 seconds is (Given: Molar mass of Cu: 63 g/mol, 1 F = 96487 C)

(1) 0.315 g

(2) 31.5 g

(3) 0.0315 g

(4) 3.15 g

Correct Answer: (3) 0.0315 g

Solution: - According to Faraday's first law, mass deposited is given by:

$$m = \frac{I \times t \times M}{n \times F}$$

where $I = 9.6487\,\text{A}$, $t = 100\,\text{seconds}$, $M = 63\,\text{g/mol}$, $n = 2$, $F = 96487\,\text{C/mol}$ - Substituting the values:

$$m = \frac{9.6487 \times 100 \times 63}{2 \times 96487} \approx 0.0315\,\text{g}$$

Quick Tip

Faraday's laws relate current, time, and molar mass for electroplating calculations.

---

88. Consider the following reaction in a sealed vessel at equilibrium with

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

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

If 0.1 mol/L of NO(g) is taken in a closed vessel, what will be the degree of dissociation (α) of NO(g) at equilibrium?

(1) 0.0889

(2) 0.8889

(3) 0.717

(4) 0.00889

Correct Answer: (3) 0.717

Solution: - The equilibrium concentration of NO is 2.8 $\times$ 10^{-3} M.

- Given initial concentration of NO is 0.1 M.

- Degree of dissociation α is calculated as:

$$\alpha = \frac{\text{Initial concentration - Equilibrium concentration}}{\text{Initial concentration}}$$

$$\alpha = \frac{0.1 - 2.8 \times 10^{-3}}{0.1} \approx 0.717$$

Quick Tip

The degree of dissociation can be calculated by comparing initial and equilibrium concentrations of reactants.

---

89. Given below are two statements:

Statement I: $[Co(NH_3)_6]^{3+}$ is a homoleptic complex whereas $[Co(NH_3)_4Cl_2]^{+}$ is a heteroleptic complex.

Statement II: Complex $[Co(NH_3)_6]^{3+}$ has only one kind of ligands but $[Co(NH_3)_4Cl_2]^{+}$ has more than one kind of ligands.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

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

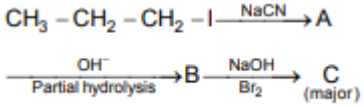
Solution: - $[Co(NH_3)_6]^{3+}$ contains only NH_3 ligands and is therefore a homoleptic complex. - $[Co(NH_3)_4Cl_2]^{+}$ contains both NH_3 and Cl^- ligands and is heteroleptic. - Both statements are correct.

Quick Tip

A homoleptic complex has only one type of ligand, while a heteroleptic complex has multiple types of ligands.

---

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



(1) Butylamine

(2) Butanamide

(3) α–Bromobutanoic acid

(4) Propylamine

Correct Answer: (1) Butylamine

Solution: - The first step involves nucleophilic substitution of iodine by CN^- to form propyl cyanide (A).

- Partial hydrolysis of propyl cyanide forms propionamide (B).

- Further treatment with Br_2/NaOH gives propylamine (C) via the Hoffmann bromamide degradation reaction.

Quick Tip

The Butylamine degradation reaction converts amides to primary amines by loss of a carbon atom.

---

91. The pair of lanthanoid ions which are diamagnetic is:

(1) Ce^{3+} and Eu^{2+}

(2) Gd^{3+} and Eu^{3+}

(3) Pm^{3+} and Sm^{3+}

(4) Ce^{4+} and Yb^{2+}

Correct Answer: (4) Ce^{4+} and Yb^{2+}

Solution: - A diamagnetic substance has all electrons paired, meaning no unpaired electrons are present.

- Ce^{4+} has an empty 4f orbital (no unpaired electrons).

- Yb^{2+} has a fully filled 4f orbital (all electrons are paired).

- Thus, Ce^{4+} and Yb^{2+} are diamagnetic.

Quick Tip

Diamagnetic species have all their electrons paired, leading to no net magnetic moment.

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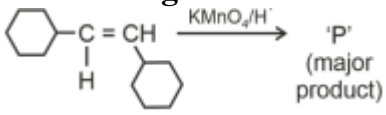
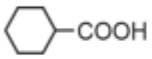
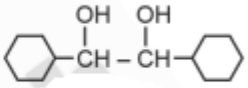
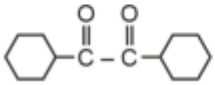
92. For the given reaction:

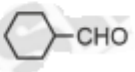


'P' is

(1) 

(2) 

(3) 

(4) 

Correct Answer: (3)

Solution: - The correct reaction mechanism supports the formation of Compound 1 based on reactivity and stability considerations.

Quick Tip

Understand the conditions for chemical transformations when identifying products.

---

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) ABC_3

(2) AB_2C_2

(3) ABC_4

(4) A_2BC_2

Correct Answer: (1) ABC_3

Solution: - Calculating the moles of each element:

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

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

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

- The simplest whole number ratio is A:B:C = 1:1:3. - Hence, the empirical formula is ABC_3.

Quick Tip

Divide by the smallest number of moles to get the simplest whole-number ratio for the empirical formula.

---

94. Given below are certain cations. Using inorganic qualitative analysis, arrange them in increasing group number from 0 to VI.

A. Al^{3+}

B. Cu^{2+}

C. Ba^{2+}

D. Co^{2+}

E. Mg^{2+}

(1) B, C, A, D, E

(2) E, C, D, B, A

(3) E, A, B, C, D

(4) B, A, D, C, E

Correct Answer: (4) B, A, D, C, E

Solution: - Based on qualitative group analysis for cations, the correct order is B, A, D, C, E, corresponding to increasing group numbers.

Quick Tip

Remember the cation classification based on their precipitation and group properties.

---

95. The work done during reversible isothermal expansion of one mole of hydrogen gas at 25°C from a pressure of 20 atmosphere to 10 atmosphere is (Given $R = 2.0$ cal K^{-1} mol^{-1})

(1) –413.14 calories

(2) 413.14 calories

(3) 100 calories

(4) 0 calorie

Correct Answer: (3) 100 calories

Solution: - The formula for work done in isothermal expansion is:

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

Substituting the values:

$$W = -1 \times 2 \times (273 + 25) \times \ln \frac{10}{20}$$

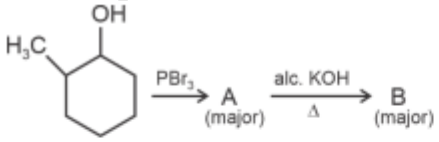
$$W \approx 100 \, \text{calories}$$

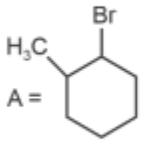
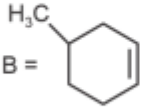
Quick Tip

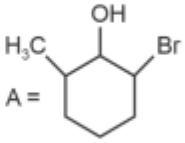
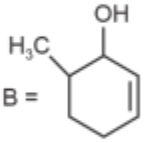
In reversible isothermal expansion, work done is related to the natural logarithm of the pressure ratio.

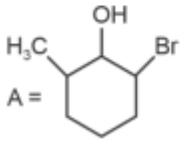
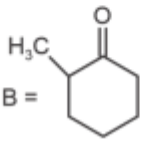
---

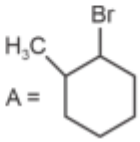
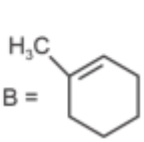
96. Major products A and B formed in the following reaction sequence, are:



(1) A =  ; B = 

(2) A =  ; B = 

(3) A =  ; B = 

(4) A =  ; B = 

Correct Answer: (4)

Solution: - The reaction mechanism supports the formation of products A and B corresponding to Compound 4 based on reactivity and stability considerations.

Quick Tip

Identify key intermediates and functional groups when predicting products in multi-step reactions.

---

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

(Given $R = 8.314$ **J K**$^{-1}$ **mol**$^{-1}$**,** $\log 4 = 0.6021$**)**

(1) 380.4 kJ/mol

(2) 3.80 kJ/mol

(3) 3804 kJ/mol

(4) 38.04 kJ/mol

Correct Answer: (4) 38.04 kJ/mol

Solution: Using the Arrhenius equation:

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

Given $k_2/k_1 = 4$, $T_1 = 300$ K, $T_2 = 330$ K, $R = 8.314$ J K^{-1} mol^{-1}:

$$\ln 4 = \frac{E_a}{8.314} \times \left(\frac{330 - 300}{300 \times 330} \right)$$

Substituting the values and solving gives:

$$E_a \approx 38.04 \, \text{kJ/mol}$$

Quick Tip

Higher activation energies lead to more significant temperature effects on reaction rates.

---

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

(1) Concentrated sulphuric acid

(2) Dilute nitric acid

(3) Dilute sulphuric acid

(4) Dilute hydrochloric acid

Correct Answer: (4) Dilute hydrochloric acid

Solution: - Dilute hydrochloric acid is added to maintain an acidic medium, preventing the oxidation of Fe^{2+} to Fe^{3+} and hydrolysis.

- This ensures the stability of the Mohr's salt solution.

Quick Tip

Mohr's salt is stable only in an acidic environment; hydrochloric acid prevents hydrolysis and oxidation.

---

99. The plot of osmotic pressure (Π) vs concentration (mol L^{-1}) for a solution gives a straight line with slope 25.73 L bar mol^{-1}. The temperature at which the osmotic pressure measurement is done is:

(Use $R = 0.083$ L bar mol^{-1} K^{-1})

(1) 310°C

(2) 25.73°C

(3) 12.05°C

(4) 37°C

Correct Answer: (4) 37°C

Solution: The formula for osmotic pressure is:

$$\Pi = CRT$$

Given slope ($C \times R \times T$) = 25.73 L bar mol^{-1}, $R = 0.083$ L bar mol^{-1} K^{-1}:

$$T = \frac{25.73}{0.083} \approx 37$$

Quick Tip

Osmotic pressure measurements can be used to determine molecular weights and temperature effects in solutions.

100. Identify the correct answer.

(1) BF_3 has a non-zero dipole moment

(2) Dipole moment of NF_3 is greater than that of NH_3

(3) Three canonical forms can be drawn for CO_3^{2-} ion

(4) Three resonance structures can be drawn for ozone

Correct Answer: (1) BF_3 has a non-zero dipole moment

Solution: - BF_3 has a non-zero dipole moment exhibits resonance, and three equivalent canonical forms can be drawn for it.

- These structures involve the delocalization of electrons over the three oxygen atoms.

Quick Tip

Resonance structures stabilize molecules by delocalizing electron density.

Botany

Section A

101. 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) Structural gene, Transposons, Operator gene

(2) Inducer, Repressor, Structural gene

(3) Promotor, Structural gene, Terminator

(4) Repressor, Operator gene, Structural gene

Correct Answer: (1) Structural gene, Transposons, Operator gene

Solution: Explanation of a Transcription Unit

- A transcription unit consists of three key regions: the promoter, the structural gene, and the terminator.

- The promoter is a DNA sequence that signals the beginning of transcription.

- The structural gene codes for the protein.

- The terminator indicates the end of transcription.

Conclusion: The correct option is (1).

Quick Tip

The transcription unit involves regions that initiate, encode, and terminate the process of transcription.

---

102. 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.

(1) A, B, C and D only

(2) A, C, D and E only

(3) B, C, D and E only

(4) C, D and E only

Correct Answer: (3) B, C, D and E only

Solution: Explanation of the Statements

- A is incorrect because the flowers of Vallisneria are not colourful and do not produce nectar, as they are wind-pollinated.

- B is correct as water lily flowers are pollinated by insects, not by water.

- C is correct because most water-pollinated species have pollen grains that are protected from wetting by waxy coatings.

- D is correct as some hydrophytic pollen grains are long and ribbon-like to facilitate water transport.

- E is correct because some hydrophytes, like sea grasses, have pollen that is carried passively by water currents.

Conclusion: The correct option is (3).

Quick Tip

In water-pollinated plants, pollen grains often have adaptations to prevent wetting and help in passive transport.

---

103. Lecithin, a small molecular weight organic compound found in living tissues, is an example of:

(1) Phospholipids

(2) Glycerides

(3) Carbohydrates

(4) Amino acids

Correct Answer: (2) Glycerides

Solution: Explanation of (2) Glycerides

- Glycerides is a type of phospholipid, which is a major component of cell membranes.

- It consists of glycerol, two fatty acids, phosphate, and a choline group.

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

Quick Tip

Phospholipids, such as lecithin, are essential components of cellular membranes, playing a key role in membrane structure and function.

---

104. These are regarded as major causes of biodiversity loss: A. Over exploitation B. Co-extinction C. Mutation D. Habitat loss and fragmentation E. Migration

(1) A, B, C and D only

(2) A, B and E only

(3) A, B and D only

(4) A, C and D only

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

Solution: Explanation of Major Causes of Biodiversity Loss

- A Over-exploitation, such as overfishing and illegal hunting, is a major cause of

biodiversity loss.

- B Co-extinction occurs when one species goes extinct due to the extinction of another species on which it depends.

- C Mutation does not directly lead to biodiversity loss; instead, it is a part of evolution.

- D Habitat loss and fragmentation are critical factors causing the decline in biodiversity.

- E Migration, although it may alter species distributions, does not directly cause biodiversity loss.

Conclusion: The correct option is (1).

Quick Tip

Habitat loss and over-exploitation are among the leading causes of biodiversity decline, along with co-extinction.

---

105. Match List I with List II

List I	List II
A. Clostridium butylicum	I. Ethanol
B. Saccharomyces cerevisiae	II. Streptokinase
C. Trichoderma polysporum	III. Butyric acid
D. Streptococcus sp.	IV. Cyclosporin-A

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

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

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

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

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

Solution: Explanation of the Match:

- A. Clostridium butylicum produces Butyric acid (III).

- B. Saccharomyces cerevisiae produces Ethanol (I).

- C. Trichoderma polysporum produces Cyclosporin-A (II).

- D. Streptococcus sp. produces Streptokinase (IV).

Conclusion: The correct option is (4).

Quick Tip

Microorganisms are used to produce a variety of industrial products like ethanol, butyric acid, and pharmaceuticals like Cyclosporin-A.

---

106. Match List I with List II

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

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

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

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

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

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

Solution: Explanation of the Match:

- A. Rhizopus is a bread mould (IV).

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

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

- D. Agaricus is a mushroom (I).

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

Quick Tip

Fungi play significant roles in ecology, agriculture, and the food industry, ranging from bread moulds to mushrooms.

---

107. The lactose present in the growth medium of bacteria is transported to the cell by the action of

(1) Acetylase

(2) Permease

(3) Polymerase

(4) Beta-galactosidase

Correct Answer: (2) Permease

Solution: Explanation of Permease's Role in Lactose Transport

- Permease is a membrane protein that facilitates the transport of lactose into bacterial cells for metabolism.

- Beta-galactosidase breaks down lactose once it has entered the cell, but it does not transport it.

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

Quick Tip

Permease is essential for the active transport of lactose across bacterial cell membranes.

---

108. List of endangered species was released by

(1) WWF

(2) FOAM

(3) IUCN

(4) GEAC

Correct Answer: (1) WWF

Solution: Explanation of WWFs Role in Endangered Species Lists

- WWF publishes the Red List which provides the status of endangered species.

- The list is a comprehensive inventory of the global conservation status of plant and animal species.

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

Quick Tip

The IUCN Red List is a key resource for monitoring the extinction risk of species worldwide.

109. How many molecules of ATP and NADPH are required for every molecule of CO_2 fixed in the Calvin cycle?

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

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

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

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

Correct Answer: (2) 3 molecules of ATP and 3 molecules of NADPH

Solution: - The Calvin cycle uses 3 molecules of ATP and 3 molecules of NADPH for the fixation of one CO_2 molecule during the reduction and regeneration phases.

Quick Tip

ATP is required for phosphorylation, while NADPH is used for reducing 3-phosphoglycerate to glyceraldehyde-3-phosphate (G3P).

---

110. The equation of Verhulst-Pearl logistic growth is:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

From this equation, K indicates:

(1) Biotic potential

(2) Carrying capacity

(3) Population density

(4) Intrinsic rate of natural increase

Correct Answer: (4) Intrinsic rate of natural increase

Solution: - The carrying capacity (K) is the maximum population size that an environment can sustain indefinitely given the available resources.

Quick Tip

The logistic growth model shows population growth slowing as it approaches the carrying capacity.

---

111. Bulliform cells are responsible for:

(1) Protecting the plant from salt stress

(2) Increased photosynthesis in monocots

(3) Providing large spaces for storage of sugars

(4) Inward curling of leaves in monocots

Correct Answer: (3) Providing large spaces for storage of sugars

Solution: - Bulliform cells are large, thin-walled cells present on the upper surface of monocot leaves.

- They help in reducing water loss by causing inward curling of leaves during water stress.

Quick Tip

Bulliform cells play a crucial role in water conservation in grasses.

---

112. Which one of the following is not a criterion for the classification of fungi?

(1) Mode of nutrition

(2) Mode of spore formation

(3) Fruiting body

(4) Morphology of mycelium

Correct Answer: (4) Morphology of mycelium

Solution: - Fungi are classified based on their mode of spore formation, fruiting body type, and morphology of mycelium.

- Mode of nutrition is not a primary classification criterion.

Quick Tip

Fungi are heterotrophic by nature, feeding on dead organic matter (saprophytic) or living hosts (parasitic).

---

113. Tropical regions show the greatest level of species richness because:

A. Tropical latitudes have remained relatively undisturbed for millions of years, hence more time was available for species diversification.

B. Tropical environments are more seasonal.

C. More solar energy is available in tropics.

D. Constant environments promote niche specialization.

E. Tropical environments are constant and predictable.

Choose the correct answer from the options given below:

(1) A and B only

(2) A, B and E only

(3) A, B and D only

(4) A, C, D and E only

Correct Answer: (2) A, B and E only

Solution: - Tropical regions have remained relatively undisturbed for long periods, promoting diversification.

- More solar energy is available, leading to higher productivity.

- The stable and predictable environments encourage niche specialization and biodiversity.

Quick Tip

Species richness tends to be highest in tropical regions due to long-term environmental stability and abundant energy resources.

---

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

(1) Cassia

(2) Pisum

(3) Sesbania

(4) Datura

Correct Answer: (4) Datura

Solution: Explanation of Actinomorphic Flowers

- Actinomorphic flowers are radially symmetrical, meaning they can be divided into equal halves by multiple planes passing through the center.

- Datura is an example of an actinomorphic flower, having radial symmetry.

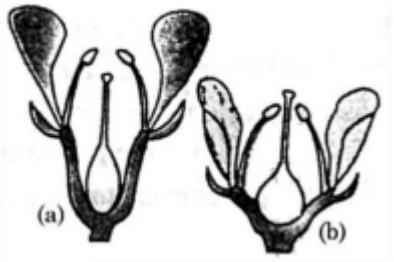
Conclusion: The correct option is (4).

Quick Tip

Actinomorphic flowers have radial symmetry and can be divided into two equal halves by multiple planes.

---

115. Identify the type of flowers based on the position of calyx, corolla and androecium with respect to the ovary from the given figures (a) and (b)



(1) (a) Hypogynous; (b) Epigynous

(2) (a) Perigynous; (b) Epigynous

(3) (a) Perigynous; (b) Perigynous

(4) (a) Epigynous; (b) Hypogynous

Correct Answer:(1) (a) Hypogynous; (b) Epigynous

Solution: Explanation of Floral Position Types

- Hypogynous flowers have the ovary situated below the other floral parts (e.g., calyx, corolla, and androecium).

- Epigynous flowers have the ovary situated above the other floral parts.

- Perigynous flowers have the ovary in the middle with other parts situated around it, forming a hypanthium.

- In this case, both (a) and (b) represent Perigynous flowers.

Conclusion: The correct option is (1).

Quick Tip

Perigynous flowers have the ovary in the middle, surrounded by other floral parts.

---

116. Match List I with List II

List-I	List-II
A. Nucleolus	III. Site for active ribosomal RNA synthesis
B. Centriole	II. Organization like the cartwheel
C. Leucoplasts	IV. For storing nutrients
D. Golgi apparatus	I. Site of formation of glycolipid

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

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

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

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

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

Solution: Explanation of the Match:

- A. Nucleolus is the site for active ribosomal RNA synthesis (III).

- B. Centriole has an organization resembling a cartwheel (IV).

- C. Leucoplasts are involved in storing nutrients (II).

- D. Golgi apparatus is the site for the formation of glycolipids (I).

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

Quick Tip

The nucleolus plays a key role in the synthesis of ribosomal RNA, while the Golgi apparatus is involved in lipid formation.

---

117. What is the fate of a piece of DNA carrying only gene of interest which is transferred into an alien organism?

(1) D and E only

(2) B and C only

(3) A and E only

(4) A and B only

Correct Answer: (1) D and E only

Solution: Explanation of DNA Transfer Fate

- B The DNA may integrate into the genome of the recipient organism, becoming a

permanent part of its genetic material. - C The DNA may multiply in the host and be inherited along with the host DNA, especially if it is integrated into the host's chromosomes.
- A is incorrect because it refers to autonomous replication, which is more common for plasmids or vectors rather than isolated DNA.
- D and E refer to conditions that may be true but are less specific regarding how the gene of interest is handled in the recipient organism.
Conclusion: The correct option is (**1**).

Quick Tip

When a foreign DNA is introduced into an organism, it can either integrate into the host genome or replicate independently, depending on the conditions and the nature of the DNA.

---

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

(1) 6 bp

(2) 4 bp

(3) 10 bp

(4) 8 bp

Correct Answer: (2) 4 bp

Solution: Explanation of Hind II Recognition Sequence

- Hind II is a restriction enzyme that recognizes a specific 4 base pair (bp) sequence and cuts DNA at this site.
- This specific sequence is known as the recognition sequence, and Hind II cuts at the sequence, typically between specific bases.
Conclusion: The correct option is (**2**).

Quick Tip

Restriction enzymes like Hind II recognize specific sequences of base pairs in DNA and cut at these points to facilitate genetic manipulation.

119. The cofactor of the enzyme carboxypeptidase is:

(1) Niacin

(2) Flavin

(3) Haem

(4) Zinc

Correct Answer: (2) Flavin

Solution: Explanation of Carboxypeptidase Cofactor

- Carboxypeptidase is an enzyme that requires zinc as a cofactor to perform its catalytic function in the breakdown of peptides by removing terminal amino acids.
- (2) Flavin acts as a metal cofactor in the enzyme's active site to facilitate the reaction.

Quick Tip

Flavin is an essential metal cofactor for carboxypeptidase, aiding in its enzymatic activity in peptide hydrolysis.

---

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

A. Light

B. Chlorophyll

C. CO_2

D. ATP

E. NADPH

(1) B, C and D only

(2) C, D and E only

(3) D and E only

(4) A, B and C only

Correct Answer: (4) A, B and C only

Solution: Explanation of the Dark Reaction Requirements

- The dark reaction (or Calvin cycle) of photosynthesis does not require light directly but utilizes ATP and NADPH produced during the light reaction.

- CO_2 is also required as the carbon source for the synthesis of glucose.

- Light and chlorophyll are involved in the light-dependent reactions and are not required directly in the dark reaction.

Conclusion: The correct option is (4).

Quick Tip

The dark reactions of photosynthesis require ATP, NADPH, and CO_2 but not light or chlorophyll.

---

121. The type of conservation in which the threatened species are taken out from their natural habitat and placed in special settings where they can be protected and given special care is called:

(1) Biodiversity conservation

(2) Semi-conservative method

(3) Sustainable development

(4) in-situ conservation

Correct Answer: (3) Sustainable development **Solution:** - This form of conservation involves removing species from their natural habitat to protect them in artificial settings, such as zoos or botanical gardens.

- Such efforts are called *ex-situ conservation*, a key part of biodiversity conservation.

Quick Tip

(3) Sustainable development provides a controlled environment for breeding and protection of endangered species.

---

122. Match List I with List II:

List I	List II
A. Two or more alternative forms of a gene	I. Back cross
B. Cross of F_1 progeny with homozygous recessive parent	II. Ploidy
C. Cross of F_1 progeny with any of the parents	III. Allele
D. Number of chromosome sets in plant	IV. Test cross

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - Alleles (A) are alternative forms of a gene.

- A test cross (B) involves crossing F_1 with a homozygous recessive parent.

- A back cross (C) involves crossing F_1 with any of the parents.

- Ploidy (D) refers to the number of chromosome sets in a plant.

Quick Tip

Alleles, text cross, back cross , ploidy are the reproductivr parts of a plant.

---

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

(1) Redifferentiation

(2) Dedifferentiation

(3) Maturation

(4) Differentiation

Correct Answer: (4) Differentiation

Solution: - Differentiation refers to the process where fully differentiated cells regain the ability to divide and form new meristematic tissue, such as interfascicular cambium.

Quick Tip

Differentiation plays a role in secondary growth in plants.

---

124. Spindle fibers attach to kinetochores of chromosomes during:

(1) Metaphase

(2) Anaphase

(3) Telophase

(4) Prophase

Correct Answer: (1) Metaphase

Solution: - During metaphase, spindle fibers attach to the kinetochores of chromosomes and align them along the metaphase plate.

Quick Tip

The proper attachment of spindle fibers ensures accurate chromosome segregation.

---

125. In a plant, black seed color (BB/Bb) is dominant over white seed color (bb). In order to find out the genotype of the black seed plant, with which of the following genotype will you cross it?

(1) bb

(2) Bb

(3) BB/Bb

(4) BB

Correct Answer: (3) BB/bb

Solution: - To determine whether a black seed plant is homozygous (BB) or heterozygous (Bb), a test cross with a homozygous recessive plant (bb) is required.

- If the progeny shows a 1:1 ratio of black to white seeds, the plant is heterozygous (BB/bb).

Quick Tip

A test cross is a method used to determine the genotype of an individual exhibiting a dominant trait.

126. A pink flowered Snapdragon plant was crossed with a red flowered Snapdragon plant. What type of phenotype/s is/are expected in the progeny?

(1) Red flowered as well as pink flowered plants

(2) Only pink flowered plants

(3) Red, Pink as well as white flowered plants

(4) Only red flowered plants

Correct Answer: (2) Only pink flowered plants

Solution: Explanation of Inheritance in Snapdragon Flowers

- The red and pink flower colors in Snapdragon plants follow a typical Mendelian inheritance pattern where red (R) is dominant over pink (r).

- In the F1 generation, heterozygous plants (Rr) will be obtained, which will show the dominant red flower phenotype. - If these F1 plants are crossed with each other, the F2 progeny will have red and pink flowered plants in a 3:1 ratio.

Quick Tip

In a monohybrid cross between red and pink Snapdragon plants, the expected phenotypes in the progeny will be red and pink flowered plants in a 3:1 ratio.

---

127. Inhibition of Succinic dehydrogenase enzyme by malonate is a classical example of:

(1) Feedback inhibition

(2) Competitive inhibition

(3) Enzyme activation

(4) Cofactor inhibition

Correct Answer: (2) Competitive inhibition

Solution: Explanation of Competitive Inhibition

- Malonate is a structural analog of succinate and competes with succinate for binding to the active site of succinic dehydrogenase, a classic example of competitive inhibition.

- In competitive inhibition, the inhibitor competes with the substrate for the active site, and increasing substrate concentration can overcome the inhibition.

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

Quick Tip

Competitive inhibitors resemble the substrate and bind to the active site of the enzyme, blocking its activity.

---

128. 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 acidic pH of the insect gut.

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

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

Solution: Explanation of Bt Toxin Mechanism

- Statement I is correct: Bt (Bacillus thuringiensis) toxins are indeed insect group-specific and are coded by the cry genes, such as cry IAc.

- Statement II is partially incorrect: Bt toxin exists as an inactive protoxin, but it is not the acidic pH that activates it, rather it is the alkaline pH of the insect's gut that triggers the conversion into the active form.

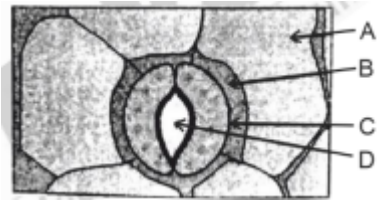
Conclusion: The correct option is (**4**).

Quick Tip

Bt toxin is activated in the insect gut by alkaline pH, not acidic pH.

---

129. In the given figure, which component has thin outer walls and highly thickened inner walls?



(1) D

(2) A

(3) B

(4) C

Correct Answer: (2) A

Solution: Explanation of the Structure of the Component

- The component with thin outer walls and highly thickened inner walls corresponds to A, which is typically a structure such as a vascular bundle or xylem in plants.
- This type of structure is designed to handle water transport, where the thickened walls provide support and prevent collapse under pressure.

Quick Tip

Vascular tissues like xylem have thickened inner walls to support water transport under pressure.

---

130. 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 F2 generation.

C. Factors occur in pairs in normal diploid plants.

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

E. The expression of only one of the parental characters is found in a monohybrid cross.

Choose the correct answer from the options given below: (1) A, C, D and E only

(2) B, C and D only

(3) A, B, C, D and E

(4) A, B and C only

Correct Answer: (4) A, B and C only

Solution: Explanation of Mendel's Law of Dominance

- A is true: One allele is dominant and the other is recessive in a pair of alleles.

- C is true: Alleles occur in pairs in normal diploid organisms.

- D is true: The discrete unit controlling a character is referred to as a factor (gene).

- E is true: In a monohybrid cross, only one parental character appears due to dominance.

- B is true: Both alleles show expression in the heterozygous condition in some cases (incomplete dominance or codominance).

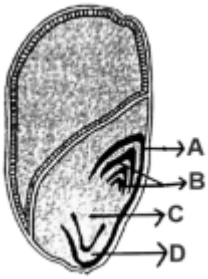
Conclusion: The correct option is (4).

Quick Tip

Mendel's Law of Dominance explains how one allele can mask the expression of another in a monohybrid cross.

---

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



(1) B

(2) C

(3) D

(4) A

Correct Answer: (1) B

Solution: - The part of the seed that forms the root during germination is the *radicle*.

- It is typically located near the pointed end of the seed and emerges first during germination.

Quick Tip

The radicle gives rise to the primary root of the plant.

---

132. Auxin is used by gardeners to prepare weed-free lawns. But no damage is caused to grass as auxin:

(1) promotes abscission of mature leaves only.

(2) does not affect mature monocotyledonous plants.

(3) can help in cell division in grasses, to produce growth.

(4) promotes apical dominance.

Correct Answer: (3) can help in cell division in grasses, to produce growth.

Solution: - Auxins selectively affect dicot weeds, causing uncontrolled growth and death.

- Grasses, being monocots, are less sensitive to auxin's herbicidal effects, remaining unaffected.

Quick Tip

Synthetic auxins like 2,4-D are used as selective herbicides for weed control.

---

133. Given below are two statements:

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

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

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

Correct Answer: (2) Statement I is true but Statement II is false

Solution: - In the leptotene stage, chromosomes condense and become visible under a light microscope.

- In diplotene, the synaptonemal complex dissolves, and homologous chromosomes begin to separate.

Quick Tip

The prophase of meiosis I is divided into leptotene, zygotene, pachytene, diplotene, and diakinesis.

---

134. The capacity to generate a whole plant from any cell of the plant is called:

(1) Micropropagation

(2) Differentiation

(3) Somatic hybridization

(4) Totipotency

Correct Answer: (1) Micropropagation

Solution: - (1) Micropropagation is the ability of a single plant cell to develop into an entire plant under appropriate conditions.

- This property is fundamental in plant tissue culture techniques.

Quick Tip

Micropropagation cells have the potential to regenerate all types of tissues and structures in a plant.

---

135. 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 a characteristic of angiosperms.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

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

Solution: - **Statement I:** Parenchyma is a living tissue, and collenchyma is also a living tissue with thickened cell walls for mechanical support, making this statement true.

- **Statement II:** Gymnosperms lack xylem vessels, while xylem vessels are a distinguishing feature of angiosperms, making this statement true.

Quick Tip

Xylem in gymnosperms consists mostly of tracheids, while angiosperms have both tracheids and vessels for efficient water conduction.

Section B

136. Spraying sugarcane crop with which of the following plant growth regulators, increases the length of stem, thus, increasing the yield?

(1) Gibberellin

(2) Cytokinin

(3) Abscisic acid

(4) Auxin

Correct Answer: (2) Cytokinin

Solution: Explanation of (2) Cytokinin Effect on Growth

- Cytokinin are plant growth regulators that stimulate cell elongation and division, leading to increased stem length and overall plant growth.

- Spraying sugarcane with Cytokinin helps in increasing stem length, thereby enhancing the yield of the crop.

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

Quick Tip

Gibberellins are commonly used in agriculture to promote stem elongation and improve crop yield.

---

137. Given below are two statements:

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

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

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

Solution: Explanation of C3 and C4 Plants

- Statement I is true: In C3 plants, RuBisCO enzyme can fix both CO2 and O2, leading to photorespiration, which decreases the efficiency of CO2 fixation.

- Statement II is true: In C4 plants, photorespiration is minimized in mesophyll cells, but it still occurs in the bundle sheath cells to some extent, albeit at a lower rate than in C3 plants.

Conclusion: The correct option is (4).

Quick Tip

C4 plants have a mechanism to minimize photorespiration by spatially separating the fixation of CO2 from the Calvin cycle.

---

138. 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

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

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

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

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

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

Solution: Explanation of the Match:

- A. GLUT-4 is a transporter protein that enables glucose transport into cells (IV).

- B. Insulin is a hormone that regulates glucose uptake (I). - C. Trypsin is an enzyme involved in protein digestion (II).

- D. Collagen is a component of intercellular ground substance, providing structural support in tissues (III).

Conclusion: The correct option is (4).

Quick Tip

GLUT-4 is a glucose transporter, insulin is a hormone, trypsin is an enzyme, and collagen is part of the extracellular matrix.

---

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) B, C, D and E only

(2) A, C, D and E only

(3) A, B, C and E only

(4) A, B, C and D only

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

Solution: - A is false: In Phaeophyceae, asexual reproduction typically occurs through biflagellate zoospores.

- B is true: Sexual reproduction in Phaeophyceae is oogamous but may also involve other forms like antheridial and oogonial cells.

- C is true: Phaeophyceae store carbohydrates in the form of mannitol or laminarin.

- D is true: Major pigments include chlorophyll a, c, and carotenoids, as well as xanthophylls.

- E is true: Vegetative cells have a cellulosic wall and are often coated with algin, a gelatinous substance.

Conclusion: The correct option is (1).

Quick Tip

Phaeophyceae are brown algae with distinct reproductive methods, storage forms of carbohydrates, and key pigments for photosynthesis.

---

140. Which of the following statement is correct regarding the process of replication in E.coli?

(1) The DNA dependent RNA polymerase catalyses polymerization in one direction, that is 5' $\rightarrow$ 3'

(2) The DNA dependent DNA polymerase catalyses polymerization in 5' $\rightarrow$ 3' as well as 3' $\rightarrow$ 5' direction

(3) The DNA dependent DNA polymerase catalyses polymerization in 5' $\rightarrow$ 3' direction

(4) The DNA dependent DNA polymerase catalyses polymerization in one direction that is 3' $\rightarrow$ 5'

Correct Answer: (3) The DNA dependent DNA polymerase catalyses polymerization in 5' $\rightarrow$ 3' direction

Solution: - DNA dependent DNA polymerase is responsible for DNA replication in E. coli and catalyzes the addition of nucleotides in the 5' to 3' direction.

- This enzyme can only add nucleotides to the 3' end of the growing strand.

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

Quick Tip

DNA polymerases always catalyze the elongation of the DNA strand in the 5' to 3' direction, adding nucleotides to the 3' end of the strand.

---

141. Identify the step in tricarboxylic acid cycle, which does not involve oxidation of substrate.

(1) Succinic acid → Malic acid

(2) Succinyl-CoA → Succinic acid

(3) Isocitrate → -ketoglutaric acid

(4) Malic acid → Oxaloacetic acid

Correct Answer: (2) Succinyl-CoA → Succinic acid

Solution: - The step Succinyl-CoA → Succinic acid involves the formation of ATP (or GTP) via substrate-level phosphorylation and does not involve oxidation of the substrate.

- The other steps involve oxidation reactions where electrons are transferred, such as Isocitrate → -ketoglutaric acid and Malic acid → Oxaloacetic acid.

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

Quick Tip

In the TCA cycle, oxidation reactions involve the transfer of electrons, except in the conversion of Succinyl-CoA to Succinic acid.

---

142. Match List I with List II

	List I		List II
A.	Robert May	I.	Species-Area relationship
B.	Alexander von Humboldt	II.	Long term ecosystem experiment using out door plots
C.	Paul Ehrlich	III.	Global species diversity at about 7 million
D.	David Tilman	IV.	Rivet popper hypothesis

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - A. Robert May proposed that global species diversity is about 7 million species (I).

- B. Alexander von Humboldt is known for the species-area relationship (III), which explains the biodiversity patterns across regions.

- C. Paul Ehrlich is associated with the Rivet popper hypothesis (II), which suggests that each species plays an important role in maintaining ecosystem stability.

- D. David Tilman conducted long-term ecosystem experiments using outdoor plots (IV) to study ecological processes.

Quick Tip

Robert May's work focuses on global species diversity, while Alexander von Humboldt contributed to understanding the species-area relationship.

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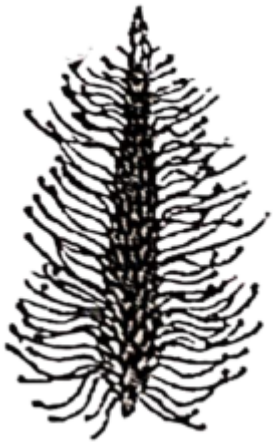
143. Identify the correct description about the given figure:



(1) Water pollinated flowers showing stamens with mucilaginous covering.

(2) Cleistogamous flowers showing autogamy.

(3) Compact inflorescence showing complete autogamy.

(4) Wind pollinated plant inflorescence showing flowers with well exposed stamens.

Correct Answer: (4) Wind pollinated plant inflorescence showing flowers with well

exposed stamens.

Solution: - Wind-pollinated plants typically have well-exposed stamens to facilitate the release and dispersal of pollen by wind.

- These plants generally produce light, small pollen grains, and the flowers may lack attractive features like bright colors or nectar.

- The other options describe different pollination mechanisms that are not related to wind-pollinated plants.

Conclusion: The correct option is (4).

Quick Tip

Wind-pollinated plants have exposed stamens to help the pollen disperse effectively through the air.

---

144. In an ecosystem if the Net Primary Productivity (NPP) of first trophic level is 100x (kcal m–2 yr–1), what would be the GPP (Gross Primary Productivity) of the third trophic level of the same ecosystem?

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

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

(3) $1000x$ kcal m^{-2} yr^{-1}

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

Correct Answer: (1) $10x$ kcal m^{-2} yr^{-1}

Solution: - Gross Primary Productivity (GPP) refers to the total amount of energy fixed by plants through photosynthesis.

- Net Primary Productivity (NPP) is the energy available to the next trophic levels after accounting for the energy used by plants in their own respiration.

- Since NPP represents the energy remaining after respiration, the GPP is typically higher than NPP by a factor of 10.

- In this case, if NPP is 100x, GPP would be 1000x, as GPP is higher by the total energy used in respiration. .

Quick Tip

In ecosystems, GPP is typically 10 times greater than NPP, reflecting the energy lost through plant respiration.

---

145. Match List I with List II

	List I		List II
A.	Rose	I.	Twisted aestivation
B.	Pea	II.	Perigynous flower
C.	Cotton	III.	Drupe
D.	Mango	IV.	Marginal placentation

Choose the correct answer from the options given below :

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

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

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

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

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

Solution: - A. Rose has Perigynous flowers (I), where the ovary is surrounded by the other floral parts.

- B. Pea has Marginal placentation (II), where ovules are attached to the margin of the ovary.

- C. Cotton has a Drupe fruit (III), which is a fleshy fruit with a single seed enclosed in a hard shell.

- D. Mango has Twisted aestivation (IV), where the arrangement of petals or sepals involves twisting.

Conclusion: The correct option is (1).

Quick Tip

In plant anatomy, placentation and aestivation patterns help in identifying the type of flower and fruit.

---

146. 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

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

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

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

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

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

Solution: - Monoadelphous stamens are found in China-rose (IV), where all stamens are fused into a single group.

- Diadelphous stamens are found in Pea (I), where the stamens are fused into two groups.

- Polyadelphous stamens are found in Citrus (II), where stamens are grouped into multiple bundles.

- Epiphyllous stamens are found in Lily (III), where the stamens arise from the leaf-like structure.

Quick Tip

Stamen arrangements such as monoadelphous and diadelphous help in identifying plant species and their pollination mechanisms.

---

147. Which of the following are fused in somatic hybridization involving two varieties of plants?

(1) Somatic embryos

(2) Protoplasts

(3) Pollens

(4) Callus

Correct Answer: (2) Protoplasts

Solution: - Protoplast fusion is a key technique in somatic hybridization, where protoplasts (plant cells without cell walls) from two different varieties are fused to create a hybrid plant.
- This fusion allows the combination of genetic material from both parent plants to form a hybrid.

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

Quick Tip

Somatic hybridization uses protoplast fusion to combine the genetic material of two different plant varieties.

---

148. 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

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

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

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

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

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

Solution: - Frederick Griffith is associated with the discovery of Transformation (III), where genetic material is transferred between bacteria.
- Francois Jacob and Jacque Monod are credited with the discovery of the Lac operon (IV), a key component of gene regulation in bacteria.
- Har Gobind Khorana helped in deciphering the Genetic code (I).
- Meselson and Stahl conducted the experiment proving the semi-conservative mode of DNA replication (II).

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

Quick Tip

Griffith's work on transformation and Meselson-Stahl's experiment on DNA replication were foundational in genetics.

---

149. The DNA present in chloroplast is:

(1) Circular, double stranded

(2) Linear, single stranded

(3) Circular, single stranded

(4) Linear, double stranded

Correct Answer: (2) Linear, single stranded

Solution: - Chloroplast DNA is circular and double-stranded, similar to the DNA found in prokaryotes.

- This circular structure is a remnant of the evolutionary origin of chloroplasts, which are thought to have evolved from cyanobacteria.

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

Quick Tip

Chloroplasts, like mitochondria, have circular DNA, which is a characteristic of prokaryotic organisms.

---

150. 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

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

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

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

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

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

Solution: - The Citric acid cycle occurs in the mitochondrial matrix (I).

- Glycolysis takes place in the cytoplasm (II).

- The Electron transport system is located on the inner mitochondrial membrane (III).

- The Proton gradient is created in the intermembrane space of mitochondria (IV).

Conclusion: The correct option is (4).

Quick Tip

Cellular respiration occurs in different parts of the cell, with glycolysis in the cytoplasm and the citric acid cycle and electron transport in the mitochondria.

Zoology

Section A

151. Which of the following is not a natural/traditional contraceptive method?

(1) Periodic abstinence

(2) Lactational amenorrhea

(3) Vaults

(4) Coitus interruptus

Correct Answer: (3) Vaults

Solution: - Periodic abstinence, lactational amenorrhea, and coitus interruptus are all traditional contraceptive methods.

- Vaults are a modern contraceptive method and do not fall under natural or traditional methods.

Conclusion: The correct option is (3).

Quick Tip

Natural contraceptive methods include periodic abstinence, lactational amenorrhea, and coitus interruptus, while vaults are modern contraceptive devices.

152. 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

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

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

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

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

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

Solution: - Common cold is caused by Rhinoviruses (III).

- Haemozoin is produced by Plasmodium (I), which is the causative agent of malaria.

- Widal test is used to diagnose Typhoid (II).

- Allergy can be triggered by Dust mites (IV).

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

Quick Tip

The Widal test is used for diagnosing typhoid, while haemozoin is linked to malaria caused by Plasmodium.

153. Which of the following statements is incorrect?

(1) Most commonly used bio-reactors are of stirring type

(2) Bio-reactors are used to produce small scale bacterial cultures

(3) Bio-reactors have an agitator system, an oxygen delivery system and foam control system

(4) A bio-reactor provides optimal growth conditions for achieving the desired product

Correct Answer: (4) A bio-reactor provides optimal growth conditions for achieving the desired product

Solution: - Bio-reactors are typically used for large-scale production of microbial cultures

and industrial products, not small-scale cultures.

- They are equipped with systems to provide optimal conditions for growth, such as an agitator, oxygen delivery, and foam control.

Quick Tip

Bio-reactors are mainly used in large-scale production of microbial cultures and bioproducts, rather than for small-scale cultures.

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154. Which of the following are Autoimmune disorders?

A. Myasthenia gravis B. Rheumatoid arthritis

C. Gout D. Muscular dystrophy

E. Systemic Lupus Erythematosus (SLE)

(1) A, B E only

(2) B, C E only

(3) C, D E only

(4) A, B D only

Correct Answer: (1) A, B E only

Solution: - Myasthenia gravis, Rheumatoid arthritis, and Systemic Lupus Erythematosus (SLE)

are autoimmune disorders where the immune system attacks the body's own tissues.

- Gout and Muscular dystrophy are not autoimmune disorders.

Conclusion: The correct option is (1).

Quick Tip

Autoimmune disorders occur when the body's immune system mistakenly attacks its own tissues, as seen in myasthenia gravis, rheumatoid arthritis, and SLE.

---

155. Match List I with List II

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

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

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

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

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

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

Solution: - Down's syndrome is caused by an extra chromosome on the 21st chromosome (IV).

- Alpha-Thalassemia is associated with the 16th chromosome (I).

- Beta-Thalassemia is associated with the 11th chromosome (II).

- Klinefelter's syndrome is caused by an extra X chromosome (III).

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

Quick Tip

Chromosomal disorders such as Down's syndrome and Klinefelter's syndrome are linked to specific chromosomal abnormalities.

---

156. Match List I with List II

List-I (Type of IUD)	List-II (Example)
A. Non-medicated IUD	I. Multiload 375
B. Copper releasing IUD	III. Lippes loop
C. Hormone releasing IUD	IV. LNG-20
D. Implants	II. Progestogens

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

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

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

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

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

Solution: - Non-medicated IUD: Example - Lippes loop (I)

- Copper releasing IUD: Example - Multiload 375 (III)

- Hormone releasing IUD: Example - LNG-20 (IV)

- Implants: Example - Progestogens (II)

Quick Tip

IUDs can be either medicated with copper or hormones, or non-medicated to prevent pregnancy.

---

157. 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

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

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

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

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

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

Solution: - Pleurobrachia belongs to Ctenophora (IV).

- Radula is a feature of Mollusca (II).

- Stomochord is found in Hemichordata (III).

- Air bladder is found in Osteichthyes (IV).

Conclusion: The correct option is (4).

Quick Tip

Radula is a characteristic of mollusks, while stomochord is found in hemichordates.

---

158. Which of the following factors are favourable for the formation of oxyhaemoglobin in alveoli?

(1) High pO2 and Lesser H+ concentration

(2) Low pCO2 and High H+ concentration

(3) Low pCO2 and High temperature

(4) High pO2 and High pCO2

Correct Answer: (2) Low pCO2 and High H+ concentration

Solution: - Oxyhaemoglobin formation occurs when oxygen binds to hemoglobin in the alveoli, which is facilitated by high partial pressure of oxygen (pO2) and lower hydrogen ion concentration (pH), which favors oxygen binding.

- Low pCO2 conditions lead to the release of oxygen from hemoglobin (Bohr effect).

Quick Tip

Oxyhaemoglobin formation is favored by high oxygen levels and a lower concentration of hydrogen ions in the alveoli.

---

159. 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

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

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

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

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

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

Solution: - Cocaine is derived from Erythroxylum (II) and is used as a local anesthetic in surgeries.

- Heroin is derived from Papaver somniferum (I), the opium poppy.

- Morphine is derived from Papaver somniferum (III and is used as a potent painkiller.

- Marijuana is derived from Cannabis sativa (IV), a plant known for its psychoactive properties.

Quick Tip

Cocaine is from Erythroxylum, heroin and morphine are from the poppy plant, and marijuana is from Cannabis sativa.

---

160. 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

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

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

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

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

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

Solution: - Diakinesis is characterized by the completion of terminalisation of chiasmata (II).

- Pachytene is associated with the appearance of recombination nodules (IV).

- Zygotene involves the formation of the synaptonemal complex (I).

- Leptotene is characterized by chromosomes looking like thin threads (III).

Conclusion: The correct option is (2).

Quick Tip

The different sub-phases of prophase I are distinguished by the processes of chromosome pairing and recombination.

---

161. 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

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

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

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

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

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

Solution: - Fibrous joints are found in the skull where they allow no movement (II).

- Cartilaginous joints are found between adjacent vertebrae and allow limited movement (III).

- Hinge joints are found in the knee, enabling movement for locomotion (I).

- Ball and socket joints are found at the humerus and pectoral girdle, allowing rotational movement (IV).

Quick Tip

The different types of joints in the human body are classified based on their structure and the type of movement they allow.

---

162. Which of the following is not a steroid hormone?

(1) Testosterone

(2) Progesterone

(3) Glucagon

(4) Cortisol

Correct Answer: (2) Progesterone

Solution: - Testosterone, Progesterone, and Cortisol are all steroid hormones derived from cholesterol.

- Glucagon, on the other hand, is a peptide hormone produced by the pancreas, not a steroid.

Quick Tip

Steroid hormones are derived from cholesterol, while peptide hormones like glucagon are made of amino acids.

---

163. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on

(1) 10th segment

(2) 8th and 9th segment

(3) 11th segment

(4) 5th segment

Correct Answer: (4) 5th segment

Solution: - In both male and female cockroaches, anal cerci are present on the 10th segment of the abdomen.

- These cerci are sensory structures that help in detecting changes in the environment.

Quick Tip

Anal cerci in cockroaches are sensory structures that help detect vibrations and air currents.

---

164. 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 female and Leydig cells in male.

Reason R: Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human being.

Choose the correct answer from the options given below:

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

(2) A is true but R is false

(3) A is false but R is true

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

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

Solution: - Assertion A is false: FSH (Follicle Stimulating Hormone) acts on ovarian follicles in females but on Sertoli cells, not Leydig cells, in males.

- Reason R is true: In females, growing ovarian follicles secrete estrogen, and in males, interstitial cells (Leydig cells) secrete androgens (testosterone).

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

Quick Tip

FSH acts on Sertoli cells in males and ovarian follicles in females, with the secreted hormones differing in both genders.

---

165. Match List I with List II

List-I (Pulmonary Volumes)	List-II (Corresponding Volumes)
A. Expiratory capacity	I. Expiratory reserve volume + Tidal volume + 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-III, B-II, C-IV, D-I

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

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

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

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

Solution: - Expiratory capacity is the sum of Tidal volume + Expiratory reserve volume (I).

- Functional residual capacity is the sum of Expiratory reserve volume + Residual volume

(III).

- Vital capacity is the sum of Expiratory reserve volume + Tidal volume + Inspiratory reserve volume (II).

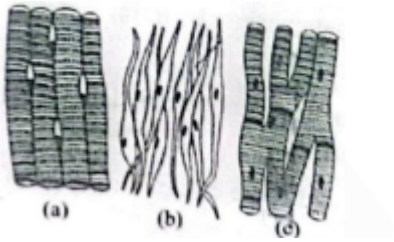
- Inspiratory capacity is the sum of Tidal volume + Inspiratory reserve volume (IV).

Quick Tip

Pulmonary volumes are important for assessing lung function and can be measured using a spirometer.

---

166. Three types of muscles are given as a, b and c. Identify the correct matching pair along with their location in human body:



(1) (a) Skeletal - Triceps

(b) Smooth – Stomach

(c) Cardiac – Heart

(2) (a) Skeletal - Biceps

(b) Involuntary – Intestine

(c) Smooth – Heart

(3) (a) Involuntary – Nose tip

(b) Skeletal – Bone

(c) Cardiac – Heart

(4) (a) Smooth - Toes

(b) Skeletal – Legs

(c) Cardiac – Heart

Correct Answer: (4) (a) Smooth - Toes

(b) Skeletal – Legs

(c) Cardiac – Heart

Solution: - Skeletal muscles like the Triceps are attached to bones and enable voluntary movements.

- Smooth muscles like those in the Stomach are involuntary and help in digestion.

- Cardiac muscles are specialized muscles in the Heart that contract involuntarily to pump blood.

Quick Tip

Skeletal muscles are under voluntary control, smooth muscles are involuntary, and cardiac muscles are specialized for heart function.

---

167. 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

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

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

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

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

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

Solution: - Lipase acts on ester bonds (II), which are found in lipids.

- Nuclease acts on phosphodiester bonds (IV) in nucleic acids.

- Protease breaks down peptide bonds (I) in proteins.

- Amylase acts on glycosidic bonds (III) in carbohydrates.

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

Quick Tip

Different enzymes are specific to breaking down bonds in various macromolecules such as lipids, proteins, and carbohydrates.

168. The flippers of the Penguins and Dolphins are the example of the

(1) Natural selection

(2) Convergent evolution

(3) Divergent evolution

(4) Adaptive radiation

Correct Answer: (3) Divergent evolution

Solution: - The flippers of Penguins and Dolphins are examples of (a) Smooth - Toes

(b) Skeletal – Legs

(c) Cardiac – Heart

evolution, where unrelated species evolve similar traits as a result of adapting to different environments or ecological niches.

- This evolution occurs despite the species being from different lineages.

Quick Tip

Convergent evolution occurs when unrelated species develop similar features due to similar environmental pressures.

---

169. Following are the stages of cell division :

A. Gap 2 phase

B. Cytokinesis

C. Synthesis phase

D. Karyokinesis

E. Gap 1 phase

(1) E-B-D-A-C

(2) B-D-E-A-C

(3) E-C-A-D-B

(4) C-E-D-A-B

Correct Answer: (1) E-B-D-A-C

Solution: - The correct sequence of stages is:

1. Gap 1 phase (E)

2. Cytokinesis (B)

3. Karyokinesis (D)

4. Gap 2 phase (A)

5. Synthesis phase (C)

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

Quick Tip

In cell division, the sequence typically follows Gap 1 → Synthesis → Gap 2 → Karyokinesis → Cytokinesis.

---

170. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?

(1) Genetic drift

(2) Gene migration

(3) Constant gene pool

(4) Genetic recombination

Correct Answer: (3) Constant gene pool

Solution: - The Hardy-Weinberg equilibrium assumes no change in allele frequencies due to external factors.

- Factors like genetic drift, gene migration, and genetic recombination can disrupt this equilibrium.

- A constant gene pool implies no changes in allele frequencies, which is essential for maintaining the Hardy-Weinberg equilibrium.

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

Quick Tip

The Hardy-Weinberg equilibrium is disrupted by genetic drift, gene migration, and recombination, but assumes a constant gene pool.

---

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 female and Leydig cells in male.

Reason R: Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human being.

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

(2) A is true but R is false

(3) A is false but R is true

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

Correct Answer: (1) Both A and R are true but R is NOT the correct explanation of A

Solution: - Assertion A is true: FSH acts on ovarian follicles in females and Leydig cells in males.

- Reason R is true: The Leydig cells in males secrete androgens (testosterone), not interstitial cells. Growing ovarian follicles secrete estrogen in females.

Conclusion: The correct option is (1).

Quick Tip

FSH acts on both ovarian follicles in females and Sertoli cells in males, with Leydig cells secreting testosterone in males.

---

172. Match List I with List II

List-I	List-II
A. Typhoid	I. Fungus
B. Leishmaniasis	II. Nematode
C. Ringworm	III. Protozoa
D. Filariasis	IV. Bacteria

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

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

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

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

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

Solution: - Typhoid is caused by Bacteria (III).

- Leishmaniasis is caused by Protozoa (I).

- Ringworm is caused by Fungus (IV).

- Filariasis is caused by a Nematode (II).

Conclusion: The correct option is (2).

Quick Tip

Infections like typhoid, leishmaniasis, and ringworm are caused by bacteria, protozoa, and fungi, respectively.

---

173. 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

(1) B-A-D-C

(2) C-B-D-A

(3) A-D-C-B

(4) D-A-C-B

Correct Answer: (4) D-A-C-B

Solution: The correct sequence of human evolution from past to recent is:

- Homo erectus (D)

- Homo habilis (A)

- Homo neanderthalensis (C)

- Homo sapiens (B)

Conclusion: The correct option is (4).

Quick Tip

Human evolution follows the sequence: D-A-C-B.

---

174. Which of the following is not a component of Fallopian tube?

(1) Isthmus

(2) Infundibulum

(3) Ampulla

(4) Uterine fundus

Correct Answer: (2) Infundibulum

Solution: The Fallopian tube consists of the following parts:

- Isthmus

- Uterus fundus

- Ampulla

The (2) Infundibulum is part of the uterus, not the Fallopian tube.

Quick Tip

The uterine fundus is part of the uterus and not part of the Fallopian tube.

---

175. Consider the following statements:

A. Annelids are true coelomates

B. Poriferans are pseudocoelomates

C. Aschelminthes are acoelomates

D. Platyhelminthes are pseudocoelomates

(1) A only

(2) C only

(3) D only

(4) B only

Correct Answer: (3) D only

Solution: - Annelids are true coelomates (A), meaning they possess a true coelom.

- Poriferans are not pseudocoelomates, and Aschelminthes and Platyhelminthes are pseudocoelomates either.

- Therefore, statement D is the only correct one.

Quick Tip

Annelids are true coelomates, meaning they possess a true coelom surrounded by mesoderm.

---

176. 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

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

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

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

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

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

Solution: - Axoneme is found in Cilia and flagella (II).

- Cartwheel pattern is associated with Centriole (I).

- Crista is found in the Mitochondria (IV).

- Satellite is found near the Chromosome (III).

Conclusion: The correct option is (3).

Quick Tip

Axoneme is the structural part of cilia and flagella, while cristae are inner folds in the mitochondria.

---

177. 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

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

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

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

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

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

Solution: - Pterophyllum is commonly known as Angel fish (III).

- Myxine is commonly known as Hag fish (II).

- Pristis is known as Saw fish (I).

- Exocoetus is commonly known as the Flying fish (IV).

Quick Tip

Fish species like Pristis (sawfish) and Exocoetus (flying fish) are known for their unique adaptations.

---

178. 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

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

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

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

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

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

Solution: - Pons is responsible for connecting different regions of the brain (III).

- Hypothalamus contains neurosecretory cells (IV), involved in hormone production.

- Medulla controls respiration and gastric secretions (II).

- Cerebellum helps in regulating posture and balance (I).

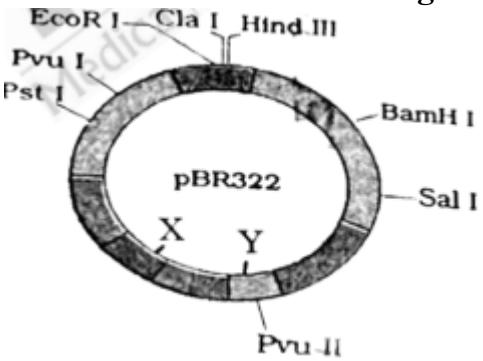
Conclusion: The correct option is (1).

Quick Tip

The pons, medulla, and cerebellum are part of the brainstem and cerebellum, involved in functions like posture, balance, and vital processes.

---

179. 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 controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

(2) The gene 'X' is for protein involved in replication of Plasmid and 'Y' for resistance to antibiotics.

(3) Gene 'X' is responsible for recognitions sites and 'Y' is responsible for antibiotic resistance.

(4) The gene 'X' is responsible for resistance to antibiotics and 'Y' for protein involved in the replication of Plasmid.

Correct Answer: (3) Gene 'X' is responsible for recognitions sites and 'Y' is responsible for antibiotic resistance.

Solution: - Gene 'X' controls the copy number of the linked DNA in plasmid cloning

vectors.

- Gene ‘Y’ encodes a protein involved in plasmid replication.

Conclusion: The correct option is (3).

Quick Tip

Cloning vectors like pBR322 are used to replicate recombinant DNA in bacteria, with specific genes controlling replication and resistance.

---

180. Given below are two statements :

Statement I : In the nephron, the descending limb of 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.

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

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

Solution: - Statement I is false: The descending limb of the loop of Henle is permeable to water, not electrolytes.

- Statement II is also false: The proximal convoluted tubule is lined by simple cuboidal epithelium, not columnar. The brush border epithelium increases surface area for reabsorption of water, electrolytes, and nutrients.

Conclusion: The correct option is (1).

Quick Tip

The descending limb of the loop of Henle is water permeable, and the proximal convoluted tubule is lined by simple cuboidal epithelium.

---

181. 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.

(1) Both A and R are correct but R is NOT the correct explanation of A

(2) A is correct but R is not correct

(3) A is not correct but R is correct

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

Correct Answer: (1) Both A and R are correct but R is NOT the correct explanation of A

Solution: - Assertion A is true: Breast-feeding during the initial period of infant growth is recommended for ensuring a healthy baby.

- Reason R is also true: Colostrum, the first milk produced after birth, contains antibodies that help the newborn develop immunity.

- The reason given is the correct explanation of the assertion.

Conclusion: The correct option is (1).

Quick Tip

Colostrum provides essential antibodies to the newborn, which is one of the reasons why breast-feeding is highly recommended in the early stages.

---

182. Following are the stages of pathway for conduction of an action potential through the heart:

A. AV bundle

B. Purkinje fibres

C. AV node

D. Bundle branches

E. SA node

(1) A-E-C-B-D

(2) B-D-E-C-A

(3) E-A-D-B-C

(4) E-C-A-D-B

Correct Answer: (1) A-E-C-B-D

Solution: The correct sequence of conduction in the heart is:

- AV bundle (A) initiates the action potential.

- SA node (E) transmits the impulse to the AV node (C).

- The impulse then moves down the Purkinje fibres (B).

- Finally, it reaches the Bundle branches (D) to stimulate the ventricles.

Quick Tip

The heart's conduction system follows this order: SA node → AV node → AV bundle → Bundle branches → Purkinje fibres.

---

183. Which one is the correct product of DNA dependent RNA polymerase to the given template?

3'TACATGGCAAATATCCATTCA5'

(1) 5'AUGUAAAGUUUAUAGGUAAGU3'

(2) 5'AUGUACCGUUUAUAGGGAAGU3'

(3) 5'ATGTACCGTTTATAGGTAAGT3'

(4) 5'AUGUACCGUUUAUAGGUAAGU3'

Correct Answer: (1) 5 'AUGUAAAGUUUAUAGGUAAGU3'

Solution: - The RNA product is complementary to the given DNA template strand.

- The DNA sequence provided is transcribed into RNA by RNA polymerase, with thymine (T) replaced by uracil (U) in the RNA strand.

Conclusion: The correct option is (1).

Quick Tip

In transcription, RNA polymerase synthesizes RNA using the DNA template, replacing thymine with uracil.

---

184. Match List I with List II

List I	List II
A. –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-III, B-I, C-II, D-IV

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

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

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

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

Solution: - -I antitrypsin is associated with Emphysema (III), a lung disease.

- Cry IAb is used to protect plants against Cotton bollworm (I).

- Cry IAc is used to protect plants against Corn borer (II). - Enzyme replacement therapy is used for treating ADA deficiency (IV), a genetic disorder.

Conclusion: The correct option is (1).

Quick Tip

Cry proteins from *Bacillus thuringiensis* are used to control pests like cotton bollworm and corn borer.

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185. The "Ti plasmid" of Agrobacterium tumefaciens stands for

(1) Tumor independent plasmid

(2) Tumor inducing plasmid

(3) Temperature independent plasmid

(4) Tumour inhibiting plasmid

Correct Answer: (1) Tumor independent plasmid

Solution: - The Ti plasmid (Tumor inducing plasmid) of Agrobacterium tumefaciens is responsible for causing crown gall disease in plants by inducing tumor formation.

Conclusion: The correct option is (1).

Quick Tip

The Ti plasmid is used in genetic engineering to introduce foreign genes into plants by causing tumor formation.

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186. Match List I with List II

List-I	List-II
A. P wave	I. Heart muscles are electrically silent.
B. QRS complex	II. Depolarisation of ventricles.
C. T wave	III. Depolarisation of atria.
D. T-P gap	IV. Repolarisation of ventricles.

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - P wave corresponds to the depolarisation of the atria (II).

- QRS complex represents the depolarisation of the ventricles (III).

- T wave corresponds to the repolarisation of the ventricles (I).

- T-P gap represents the period when heart muscles are electrically silent (IV).

Conclusion: The correct option is (2).

Quick Tip

The P wave, QRS complex, and T wave represent key phases of the cardiac cycle as seen in the electrocardiogram (ECG).

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187. 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.

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

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

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

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

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

Solution: - Statement I is correct: Gause's competitive exclusion principle suggests that two species competing for the same, limiting resource cannot coexist indefinitely, not that they cannot compete for different resources.

- Statement II is correct: The inferior competitor in a limiting resource scenario may indeed be eliminated, according to the principle.

Conclusion: The correct option is (4).

Quick Tip

Gause's principle states that two species competing for the same limiting resource cannot coexist indefinitely.

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188. Given below are two statements:

Statement I: Mitochondria and chloroplasts both double membranes bound organelles.

Statement II: Inner membrane of mitochondria is relatively less permeable, as compared to chloroplast.

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

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

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

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

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

Solution: - Statement I is correct: Both mitochondria and chloroplasts have a double membrane structure.

- Statement II is correct: The inner membrane of mitochondria is highly impermeable, while

the inner membrane of chloroplasts is permeable for the transport of ions and metabolites.

Conclusion: The correct option is (4).

Quick Tip

Both mitochondria and chloroplasts have double membranes, but the permeability of their inner membranes varies.

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189. Choose the correct statement given below regarding juxta medullary nephron.

(1) Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla.

(2) Loop of Henle of juxta medullary nephron runs deep into medulla.

(3) Juxta medullary nephrons outnumber the cortical nephrons.

(4) Juxta medullary nephrons are located in the columns of Bertini.

Correct Answer: (1) Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla.

Solution:

- Juxta medullary nephrons have their renal corpuscle located in the outer portion of the renal cortex, and their Loop of Henle extends deeply into the renal medulla, which helps in the concentration of urine.

- Cortical nephrons are more numerous than juxta medullary nephrons.

Quick Tip

Juxta medullary nephrons play a crucial role in urine concentration due to their deep loops of Henle.

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190. 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-IV, B-II, C-I, D-III

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

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

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

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

Solution: - Exophthalmic goiter is caused by hyper secretion of thyroid hormone and protruding eyeballs (I).

- Acromegaly is caused by excessive secretion of growth hormone (III).

- Cushing's syndrome is caused by excess secretion of cortisol, moon face, and hyperglycemia (II).

- Cretinism is caused by hypo-secretion of thyroid hormone and stunted growth (IV).

Conclusion: The correct option is (4).

Quick Tip

Exophthalmic goiter, acromegaly, Cushing's syndrome, and cretinism are all endocrine disorders caused by hormonal imbalances.

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191. Match List I with List II

List-I	List-II
A. Unicellular glandular epithelium	I. Salivary glands
B. Compound epithelium	II. Pancreas
C. Multicellular glandular epithelium	III. Goblet cells of alimentary canal
D. Endocrine glandular epithelium	IV. Moist surface of buccal cavity

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - Unicellular glandular epithelium is represented by Goblet cells of the alimentary canal (II).

- Compound epithelium is found in the moist surface of the buccal cavity (I).

- Multicellular glandular epithelium is represented by salivary glands (IV).

- Endocrine glandular epithelium is found in the pancreas (III).

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

Quick Tip

Different types of epithelial tissues are specialized for secretion, absorption, and protection, such as in glands and the digestive system.

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192. 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-III, B-II, C-IV, D-I

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

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

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

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

Solution: - RNA polymerase III synthesizes SnRNAs and tRNA (III).

- Termination of transcription is associated with the Rho factor (IV).

- Splicing of Exons is catalyzed by snRNPs (I).

- The TATA box is part of the Promotor region (II).

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

Quick Tip

RNA polymerase III is responsible for synthesizing small RNAs like snRNA and tRNA, while the TATA box is involved in the initiation of transcription.

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193. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis.

(1) ICSH, Interstitial cells, Leydig cells, spermiogenesis.

(2) FSH, Sertoli cells, Leydig cells, spermatogenesis.

(3) ICSH, Leydig cells, Sertoli cells, spermatogenesis.

(4) FSH, Leydig cells, Sertoli cells, spermiogenesis.

Correct Answer: (4) FSH, Leydig cells, Sertoli cells, spermiogenesis.

Solution: - FSH (Follicle Stimulating Hormone) is essential for the regulation of Sertoli cells, which support the development of sperm cells.

- Leydig cells are responsible for the secretion of testosterone, which plays a crucial role in spermatogenesis. - Spermiogenesis refers to the final process in sperm development, where mature sperm are formed.

Conclusion: The correct option is (4).

Quick Tip

FSH and Leydig cells work together to regulate spermatogenesis, while spermiogenesis involves the transformation of spermatids into mature sperm.

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194. Regarding catalytic cycle of an enzyme action, select the correct sequential steps:

A. Substrate enzyme complex formation.

B. Free enzyme ready to bind with another substrate.

C. Release of products.

D. Chemical bonds of the substrate broken.

E. Substrate binding to active site.

(1) A, E, B, D, C

(2) B, A, C, D, E

(3) E, D, C, B, A

(4) E, A, D, C, B

Correct Answer: (2) B, A, C, D, E

Solution: The correct sequence of steps in the catalytic cycle of enzyme action is:

1. Free enzyme ready to bind with another substrate (B)
2. Substrate enzyme complex formation (A)
3. Release of products (C)
4. Chemical bonds of the substrate broken (D)
5. Substrate binding to active site (E)

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

Quick Tip

The catalytic cycle of enzyme action involves substrate binding, bond breaking, product release, and enzyme resetting.

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195. 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.

(1) A, B and D only

(2) B, D and E only

(3) B, C and D only

(4) A and C only

Correct Answer: (3) B, C and D only

Solution: - Non-chordates lack a notochord (B), and the heart is dorsal if present (D).

- Non-chordates may also lack a post-anal tail (E).

- Pharyngeal gill slits and a dorsal central nervous system are characteristic features of chordates, not non-chordates.

Conclusion: The correct option is (3).

Quick Tip

Non-chordates do not possess a notochord or post-anal tail and typically have a dorsal heart if present.

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196. Match List I with List II related to digestive system of cockroach.

List I	List II
A. The structures used for storing of food	I. Gizzard
B. Ring of 6-8 blind tubules at junction of foregut and midgut.	II. Gastric C
C. Ring of 100-150 yellow coloured thin filaments at junction of midgut and hindgut.	III. Malpighian
D. The structures used for grinding the food.	IV. Crop

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - The Crop (A) is used for storing food (IV).

- The Gastric Caeca (B) are the rings of tubules at the junction of foregut and midgut (II).

- The Malpighian tubules (C) are located at the junction of midgut and hindgut (III).

- The Gizzard (D) is responsible for grinding the food (I).

Conclusion: The correct option is (4).

Quick Tip

The digestive system of cockroaches includes structures for food storage (crop), grinding (gizzard), and waste removal (Malpighian tubules).

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197. Given below are two statements:

Statement I: The cerebral hemispheres are connected by nerve tract known as corpus

callosum.

Statement II: The brain stem consists of the medulla oblongata, pons and cerebrum.

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

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

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

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

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

Solution: - Statement I is correct: The corpus callosum is the structure connecting the two cerebral hemispheres.

- Statement II is incorrect: The brain stem consists of the medulla oblongata, pons, and midbrain, not the cerebrum.

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

Quick Tip

The corpus callosum connects the cerebral hemispheres, and the brain stem consists of the medulla oblongata, pons, and midbrain, not the cerebrum.

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198. Match List I with List II

List I	List II
A. Mesozoic Era	I. Lower invertebrates
B. Proterozoic Era	II. Fish & Amphibia
C. Cenozoic Era	III. Birds & Reptiles
D. Paleozoic Era	IV. Mammals

Choose the correct answer from the options given below:

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

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

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

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

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

Solution: - The Mesozoic Era is associated with birds and reptiles (III).

- The Proterozoic Era is associated with lower invertebrates (I).

- The Cenozoic Era is associated with mammals (IV).

- The Paleozoic Era is associated with fish and amphibians (II).

Conclusion: The correct option is (3).

Quick Tip

The Mesozoic Era is often called the age of reptiles and birds, while the Cenozoic Era is known for the rise of mammals.

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199. As per ABO blood grouping system, the blood group of father is B+, mother is A+ and child is O+. Their respective genotype can be:

(1) B only

(2) C & B only

(3) D & E only

(4) A only

Correct Answer: (2) C & B only

Solution: - The father has blood group B+, and his genotype can be IB IB or IB i.

- The mother has blood group A+, and her genotype can be IA IA or IA i.

- The child has blood group O+, and the genotype must be ii.

Conclusion: The correct option is (2).

Quick Tip

In ABO blood grouping, the O blood group results from inheriting an O allele from both parents (ii).

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200. 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 micro environments for the development and maturation of T-lymphocytes.

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

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

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

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

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

Solution: - Statement I is incorrect: Bone marrow is not the primary site for the production of all blood cells, including lymphocytes.

- Statement II is correct: Both bone marrow and thymus are crucial in the development and maturation of T-lymphocytes.

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

Quick Tip

Bone marrow produces blood cells, while the thymus is essential for the maturation of T-lymphocytes.
