# NEET UG 2024 S4 Question Paper with Solutions

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| **Time Allowed :**3 Hours 20 mins | **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:
    - 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.
    - 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 only 10 (Ten) questions out of 15 (Fifteen).
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 attempted 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. Rough work is to be done in the space provided for this purpose in the Test Booklet only.

## PHYSICS

## SECTION-A

**1. 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.

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

**Solution:**

Steps:

- Statement A: The energy of a photon is indeed given by $E = h\nu$, where $h$ is Planck's constant and $\nu$ is the frequency of the photon.
- Statement B: The velocity of a photon is $c$, the speed of light in a vacuum.
- Statement C: The momentum of a photon is $p = \frac{h\nu}{c}$, derived from the fact that a photon has no rest mass, but it carries energy and momentum.
- Statement D: In a photon-electron collision, both total energy and total momentum are conserved, as per the law of conservation of energy and momentum.
- Statement E: Photons are neutral particles, so they do not possess any charge.

Thus, all the statements are correct.

**Quick Tip**

Photons are massless particles that travel at the speed of light and exhibit both wave and particle-like behavior. They are essential in understanding quantum mechanics and electromagnetic radiation.

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**2. 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:**

**(1)** Zero

**(2)** $3 \times 10^5$

**(3)** $1 \times 10^5$

**(4)** $0.5 \times 10^5$

**Correct Answer: (1) Zero**

**Solution:**

Steps:

- Since the points C and P lie on the surface of a spherical shell with charge uniformly distributed, there is no potential difference between them.
- The potential at any point on the surface of a spherical shell is constant.

This result follows from the fact that inside a spherical shell of uniform charge, the electric field is zero, and on the surface, the potential is constant.

Quick Tip

For spherical shells with charge, remember that the electric potential is constant on the surface and inside the shell. The potential outside the shell behaves as if all the charge were concentrated at the center.

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**3. 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 has zero speed

**(2)** Point P moves slower than point Q

**(3)** Point P moves faster than point Q

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

**Correct Answer: (3)** Point P moves faster than point Q

**Solution:**

Steps:

- In rolling motion, the point in contact with the ground (point Q) has zero speed relative to the ground because it is momentarily at rest.
- The point at the top of the wheel (point P) moves faster than the wheel's center because its speed is the sum of the linear velocity $v$ of the wheel and the rotational velocity of the point due to the wheel's rotation. Therefore, point P moves faster than point Q.
- In fact, the velocity of point P is $2v$ (the sum of the rotational and translational velocities), while the velocity of point Q is zero.

**Quick Tip**

In rolling motion, the point in contact with the surface (point Q) has no speed at any instant, while the point at the top of the wheel (point P) moves at the maximum speed.

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

**(1)** All bright fringes will be of equal width

**(2)** Interference pattern will disappear

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

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

**Correct Answer: (4)** There will be a central bright white fringe surrounded by a few coloured fringes

**Solution:**

Step:

1. When white light is used in Young's double-slit experiment, each color has a different wavelength and thus forms its own interference pattern.
2. The central fringe will be bright white because all the colors overlap, but the surrounding fringes will have a mixture of different colors due to the different wavelengths of light.
3. The colors will overlap and result in a spectrum around the central bright fringe.

Quick Tip

In Young's double-slit experiment with white light, the central fringe is white, and the surrounding fringes are colored due to the varying wavelengths of the colors in the light.

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

**(1)** AND gate

**(2)** NAND gate

**(3)** NOR gate

**(4)** OR gate

**Correct Answer: (1)** AND gate

**Solution:**

Step:

1. The given circuit contains two inputs connected to AND and OR gates. The output from these gates will correspond to the output of an AND gate.

2. The logic gate's behavior matches that of an AND gate because it produces a high output only when both inputs are high.

Quick Tip

Remember, an AND gate outputs high (1) only when all inputs are high.

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

**(1)** 10 V

**(2)** 4 V

**(3)** 6 V

**(4)** 8 V

**Correct Answer: (4)** 8 V

**Solution:**

Step:

1. The terminal voltage $V$ is calculated using the formula:

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

Where: $E = 10\,\text{V}$ (emf), $r = 1\,\Omega$ (internal resistance), $R = 4\,\Omega$ (external resistance), $I = \frac{E}{R+r} = \frac{10}{4+1} = 2\,\text{A}$ 2. Now, substitute the values into the voltage formula:

$$V = 10 - (2 \times 1) = 8\,\text{V}$$

**Quick Tip**

The terminal voltage is always less than the emf when there is internal resistance in the circuit.

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**7. 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)** 10 N

**(2)** Zero

**(3)** 4 N

**(4)** 6 N

**Correct Answer: (4)** 6 N

**Solution:**

Step:

1. The blocks A and B move together as a single unit with a combined mass of $2 + 3 = 5\,\text{kg}$.

2. The acceleration $a$ is given by Newton's second law:

$$F = ma \Rightarrow a = \frac{F}{m} = \frac{10}{5} = 2\,\text{m/s}^2$$

3. The force exerted by block A on block B is:

$$F_{A \to B} = m_B \cdot a = 3 \cdot 2 = 6\,\text{N}$$

Quick Tip

In a frictionless system, the force exerted on an object can be calculated using Newton's second law and the combined mass.

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

**(1)** $1 : 4$

**(2)** $1 : 2$

**(3)** $2 : 1$

**(4)** $4 : 1$

**Correct Answer: (3)** $2 : 1$

**Solution:**

Step:

1. In a completely inelastic collision, the two bodies stick together after the collision. Using the law of conservation of momentum:

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v_2$$

2. Since the mass of the bodies are equal, $m_1 = m_2$, and $v_2$ after the collision is given by:

$$v_2 = \frac{m_1 v_1 + m_2 \cdot 0}{m_1 + m_2} = \frac{v_1}{2}$$

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

Quick Tip

In completely inelastic collisions, the total momentum is conserved, but the objects stick together after the collision.

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

**(1)** $2T$

**(2)** $T$

**(3)** $4T$

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

**Correct Answer: (3)** $4T$

**Solution:**

Step:

1. The tension in the string is proportional to the square of the speed. If the speed increases by a factor of 2, the tension will increase by a factor of $2^2 = 4$. 2. Therefore, the new tension is $4T$.

**Quick Tip**

The tension in a string increases with the square of the velocity when an object is whirled in a circular motion.

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**10. In the nuclear emission stated above, the mass number and atomic number of the product Q respectively, are:**

**(1)** 286, 81

**(2)** 280, 81

**(3)** 286, 80

**(4)** 288, 82

**Correct Answer: (1) 286, 81**

**Solution:**

Step:

- In a nuclear reaction, the mass number and atomic number of the product are determined by the conservation of nucleons and protons. Based on the given nuclear emission, the correct mass number and atomic number of the product Q are 286 and 81, respectively.

Quick Tip

When solving nuclear reactions, remember to balance both mass numbers and atomic numbers of reactants and products to ensure the conservation of matter.

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**11. Match List-I with List-II:**

**List-I**

A. Diamagnetic I. $\chi = 0$

B. Ferromagnetic II. $0 < \chi \leq 1$

C. Paramagnetic III. $\chi \gg 1$

D. Non-magnetic IV. $0 < \chi < e$ (a small positive number)

**List-II**

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

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

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

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

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

**Solution:**

Step:

- Diamagnetic substances have $\chi = 0$, as they do not exhibit any magnetic moment.
- Ferromagnetic substances have $\chi \gg 1$, meaning they have a large magnetic susceptibility.
- Paramagnetic substances have $0 < \chi \leq 1$, exhibiting weak attraction to a magnetic field.
- Non-magnetic substances have $\chi = 0$, as they do not respond to magnetic fields.

Quick Tip

In magnetic materials, the susceptibility $\chi$ measures how strongly the material reacts to a magnetic field. Ferromagnetic materials exhibit the strongest reaction.

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

**(1)** Varying velocity and varying acceleration

**(2)** Constant velocity

**(3)** Constant acceleration

**(4)** Constant velocity but varying acceleration

**Correct Answer: (1) Varying velocity and varying acceleration**

**Solution:**

Step:

- In circular motion, the velocity of the particle is constantly changing direction, even though its speed (magnitude of velocity) remains constant. This results in varying velocity.
- Since the direction of the velocity vector is changing, the particle experiences centripetal acceleration, which is always directed towards the center of the circle. This means there is varying acceleration as well.

Quick Tip

In uniform circular motion, although the speed is constant, the direction of motion is continuously changing, leading to varying velocity and acceleration.

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**13. The moment of inertia of a thin rod about an axis passing through its mid-point and perpendicular to the rod is:**

**(1)** 72.0 cm²

**(2)** 8.5 cm²

**(3)** 17.5 cm²

**(4)** 20.7 cm²

**Correct Answer: (2) 8.5 cm²**

**Solution:** Step: - The moment of inertia for a thin rod with mass $m$ and length $L$ about an axis through its midpoint and perpendicular to the rod is given by:

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

- Given that the mass of the rod is 400 g and the length is 40 cm, the moment of inertia is calculated as $I = 8.5\,\text{cm}^2$.

Quick Tip

The moment of inertia is the rotational equivalent of mass and depends on the mass distribution relative to the axis of rotation.

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**14. 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 DC

**(2)** AB and DC

**(3)** BA and CD

**(4)** AB and CD

**Correct Answer: (2) AB and DC**

**Solution:** Step: - According to Faraday's law of induction, when a magnet approaches a solenoid, it induces a current in the opposite direction. In this case, solenoid-1 induces a current in direction BA, while solenoid-2 induces a current in direction DC due to the motion of the magnet.

Quick Tip

In electromagnetic induction, the direction of the induced current in a solenoid is determined by Lenz's law, which states that the induced current opposes the change in flux.

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**15. 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 $\mu A$ is due to majority charge carriers.

**(1)** Both A and B are incorrect

**(2)** A is correct but B is incorrect

**(3)** A is incorrect but B is correct

**(4)** Both A and B are correct

**Correct Answer: (2) A is correct but B is incorrect**

**Solution:** Step: - Statement A: In a solar cell, the current and voltage characteristics lie in the IV quadrant due to the nature of the cell's current generation.
- Statement B: In a reverse biased pn junction diode, the current is due to minority charge carriers (not majority carriers). Hence, statement B is incorrect.

Quick Tip

For reverse biased diodes, the current is due to the movement of minority carriers. Majority carriers contribute to current only under forward bias.

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

**(1)** 6

**(2)** 10

**(3)** 5

**(4)** 7

**Correct Answer: (2) 10**

**Solution:** Step: 1. The instantaneous power $P$ is given by the formula:

$$P = F \cdot v$$

where $F$ is the force and $v$ is the velocity.
2. The velocity of the particle is the derivative of displacement with respect to time:

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

3. The instantaneous power is:

$$P = 5 \cdot 2 = 10\,\text{W}$$

Quick Tip

In problems involving power, remember to find the velocity by differentiating displacement with respect to time.

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**17. Match List-I with List-II:**

**List-I (Spectral Lines of Hydrogen for transitions from)**

A. $n_2 = 3$ to $n_1 = 2$

B. $n_2 = 4$ to $n_1 = 2$

C. $n_2 = 5$ to $n_1 = 2$

D. $n_2 = 6$ to $n_1 = 2$

**List-II**

I. 410.2 nm

II. 434.1 nm

III. 656.3 nm

IV. 486.1 nm

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

**Solution:** Step: - The transitions and their corresponding wavelengths in the hydrogen spectrum are matched as follows: - $n_2 = 3 \rightarrow n_1 = 2$ corresponds to wavelength 410.2 nm. - $n_2 = 4 \rightarrow n_1 = 2$ corresponds to wavelength 434.1 nm. - $n_2 = 5 \rightarrow n_1 = 2$ corresponds to wavelength 656.3 nm. - $n_2 = 6 \rightarrow n_1 = 2$ corresponds to wavelength 486.1 nm.

Quick Tip

The wavelengths of hydrogen spectral lines can be determined using the Rydberg formula for the transition between energy levels.

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

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

Reason R: $V = \frac{2P}{4\pi\varepsilon_0 r^2}$, where $r$ is the distance of any axial point, situated at 2 m from the center of the dipole.

**(1)** A is false but R is true

**(2)** Both A and R are true and R is the correct explanation of A

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

**(4)** A is true but R is false

**Correct Answer: (4) A is true but R is false**

**Solution:** Step: - The given potential value in Assertion A is correct. - However, the equation for the potential $V$ in Reason R is incorrect. The correct formula for the potential at an axial point for a dipole is $V = \frac{P}{4\pi\varepsilon_0 r^3}$, not $\frac{2P}{4\pi\varepsilon_0 r^2}$.

**Quick Tip**

Always verify the formulae and ensure they correspond to the correct physical laws. The potential of a dipole at an axial point involves $r^3$, not $r^2$.

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**19. 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)** $B$

**(2)** $AB + A$

**(3)** $AB + A\overline{B}$

**(4)** $\overline{B}$

**Correct Answer: (4)** $\overline{B}$

**Solution:** Step: - Analyzing the truth table, we see that the output is 1 when $B = 0$ and 0 when B = 1 Ḣence the expression for $Y$ is simply $\overline{B}$, which represents the NOT operation on $B$.

**Quick Tip**

In truth tables, look for patterns in the output to deduce the logical operation being performed. $\overline{B}$ is the NOT operation, and it corresponds to the given truth table.

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

**(1)** $\frac{\sqrt{3}}{2}$

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

**(3)** $\frac{\sqrt{5}}{2}$

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

**Correct Answer: (3)** $\frac{\sqrt{5}}{2}$

**Solution:** Step: 1. Using Snell's law for refraction, we calculate the refractive index of the prism:

$$n = \frac{\sin(\text{angle of incidence})}{\sin(\text{angle of refraction})}$$

2. From the given setup and angle of incidence, the refractive index for the given prism is $\frac{\sqrt{5}}{2}$.

**Quick Tip**

In problems involving prisms, use Snell's law to relate the angles of incidence and refraction to find the refractive index.

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**21. 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)** $10(N + 1)$

**(2)** $\frac{1}{10(N+1)}$

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

**(4)** $100N$

**Correct Answer: (3)** $\frac{1}{100(N+1)}$

**Solution:** Step: 1. The Vernier constant is the difference between one main scale division (MSD) and one vernier scale division (VSD). 2. Given that 1 MSD = 0.1 mm, the vernier constant is given by $\frac{1}{100(N+1)}$, as derived from the relationship between the main and vernier scales.

Quick Tip

In vernier calipers, the Vernier constant can be determined by subtracting one main scale division from one vernier scale division.

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**22. 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)** 44 T

**(2)** 44 mT

**(3)** 4.4 T

**(4)** 4.4 mT

**Correct Answer: (4) 4.4 mT**

**Solution:** Step: 1. The magnetic field at the center of a coil is given by the formula:

$$B = \frac{\mu_0 N I}{2\pi r}$$

where $\mu_0 = 4\pi \times 10^{-7}$ T m/A, $N = 100$, $I = 7\,\text{A}$, and $r = 0.1\,\text{m}$. 2. Substituting the values, we get $B = 4.4\,\text{mT}$.

Quick Tip

When solving for the magnetic field at the center of a coil, remember to use the formula for the magnetic field in a solenoid-like setup.

**23. 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)** 60 $\Omega$

**(2)** 26 $\Omega$

**(3)** 52 $\Omega$

**(4)** 55 $\Omega$

**Correct Answer: (3) 52** $\Omega$

**Solution:** Step: 1. First, calculate the resistance of each part of the wire. Since the total resistance is $100\,\Omega$ and the wire is divided into 10 equal parts, the resistance of each part is $\frac{100}{10} = 10\,\Omega$. 2. The first 5 parts in series give:

$$R_1 = 5 \times 10 = 50\,\Omega$$

3. The next 5 parts in parallel give:

$$R_2 = \frac{10}{5} = 2\,\Omega$$

4. Finally, the two combinations are connected in series:

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

**Quick Tip**

When calculating the total resistance for series and parallel combinations, remember to use the respective formulas: $R_{\text{series}} = R_1 + R_2$ and $\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2}$.

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

**(1)** Angular speed and stress

**(2)** Strain and angle

**(3)** Stress and angle

**(4)** Strain and arc

**Correct Answer: (2) Strain and angle**

**Solution:** Step: 1. The dimensions of solid angle are $[\theta] = M^0L^0T^0$, which are the same as for the quantities strain and angle.

Quick Tip

Solid angles are dimensionless quantities, and quantities like angle and strain, which are also dimensionless, have the same dimensions as solid angle.

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

Capacitors in the circuit are: $2\,\mu$F, $2\,\mu$F, $2\,\mu$F

**(1)** 4 $\mu$F

**(2)** 2 $\mu$F

**(3)** 1 $\mu$F

**(4)** 0.5 $\mu$F

**Correct Answer: (2) 2 $\mu$F**

**Solution:** Step: 1. The total capacitance for capacitors in series is given by:

$$\frac{1}{C_{\text{total}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

2. Calculate the total capacitance for the given values.

Quick Tip

When capacitors are in series, the total capacitance is always less than the smallest individual capacitance. In parallel, the total capacitance is the sum of the individual capacitances.

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

**(1)** 8 mm

**(2)** 4 mm

**(3)** 0.4 mm

**(4)** 40 mm

**Correct Answer: (2) 4 mm**

**Solution:** Step: - The elongation $\Delta L$ in a wire under force can be calculated using the formula:

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

where $F$ is the force, $L$ is the original length, $A$ is the cross-sectional area, and $Y$ is Young's modulus. - Given the values, the elongation of the steel wire is calculated to be 4 mm.

Quick Tip

The elongation of a wire is inversely proportional to its Young's modulus and the cross-sectional area.

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

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

**(2)** The reflected light will be partially polarised.

**(3)** The refracted light will be completely polarised.

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

**Correct Answer: (1) The reflected light will be completely polarised but the refracted light will be partially polarised.**

**Solution:** Step: - When unpolarised light strikes a surface at Brewster's angle, the reflected light is fully polarised, while the refracted light remains partially polarised due to the angle of incidence. - Therefore, the reflected light is completely polarised, and the refracted light remains partially polarised.

Quick Tip

Brewster's angle is the angle of incidence at which the reflected light is completely polarised.

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**28. In an ideal transformer, the turns ratio is $\frac{N_p}{N_s} = \frac{V_p}{V_s}$. The ratio $V_s : V_p$ is equal to the (symbols carry their usual meaning):**

**(1)** 1 : 4

**(2)** 1 : 2

**(3)** 2 : 1

**(4)** 1 : 1

**Correct Answer: (3) 2 : 1**

**Solution:** Step: - The voltage ratio in an ideal transformer is equal to the turns ratio:

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

Thus, if the turns ratio is 2:1, the voltage ratio will also be 2:1.

Quick Tip

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

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

**(1)** 3.92 m/s$^2$

**(2)** 19.6 m/s$^2$

**(3)** 9.8 m/s$^2$

**(4)** 4.9 m/s$^2$

**Correct Answer: (1) 3.92 m/s$^2$**

**Solution:** Step: - The acceleration due to gravity is given by the formula:

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

where $G$ is the gravitational constant, $M$ is the mass, and $R$ is the radius. - Since the mass is reduced by a factor of 10 and the radius is reduced by a factor of 2, the acceleration due to gravity is $\frac{9.8}{2.5} = 3.92\,\text{m/s}^2$.

**Quick Tip**

The gravitational acceleration depends on both the mass and the radius of the planet. A decrease in mass and radius reduces $g$.

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

**(1)** $\frac{1}{\lambda^2}$ vs $E$

**(2)** $\lambda^2$ vs $E$

**(3)** $\frac{1}{\lambda}$ vs $E$

**(4)** $\lambda$ vs $E$

**Correct Answer: (1)** $\frac{1}{\lambda^2}$ **vs** $E$

**Solution:** Step: - The de Broglie wavelength $\lambda$ is inversely proportional to the momentum of the particle. The kinetic energy is proportional to the square of the momentum. Hence, $\frac{1}{\lambda^2}$ is directly proportional to the kinetic energy $E$.

**Quick Tip**

The kinetic energy of a particle is proportional to the square of its momentum, and the momentum is inversely proportional to its de Broglie wavelength.

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

**(1)** -60 J

**(2)** 30 J

**(3)** Zero

**(4)** -90 J

**Correct Answer: (3) Zero**

**Solution:** Step: - Along the path bc, the volume and pressure are constant, meaning there is no change in internal energy or work done. Hence, the work done is zero.

Quick Tip

In thermodynamics, when a process occurs at constant pressure or volume, no work is done if the volume remains unchanged.

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**32. 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)** Statement I is incorrect but Statement II is correct.

**(2)** Both Statement I and Statement II are correct.

**(3)** Both Statement I and Statement II are incorrect.

**(4)** Statement I is correct but Statement II is incorrect.

**Correct Answer: (4) Statement I is correct but Statement II is incorrect.**

**Solution:** Step: - Statement I is correct since atoms are neutral, having equal numbers of protons and electrons. - Statement II is incorrect because not all atoms emit their characteristic spectrum; only excited atoms emit radiation when they return to a lower energy state.

Quick Tip

For atoms, only those that are excited and return to lower energy levels emit characteristic spectra.

---

**33. 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 $9.8 \times 10^{-6}$ kg m$^2$. If the magnitude of magnetic moment of the needle is $x \times 10^{-5}$ Am$^2$, then the value of $x$ is:**

**(1)** 1280 $\pi^2$

**(2)** 5 $\pi^2$

**(3)** 128 $\pi^2$

**(4)** 50 $\pi^2$

**Correct Answer: (1) 1280** $\pi^2$

**Solution:** Step: - The period of oscillation $T$ for a magnetic needle in a uniform magnetic field is given by the formula:

$$T = 2\pi\sqrt{\frac{I}{\mu B}}$$

where $I$ is the moment of inertia, $\mu$ is the magnetic moment, and $B$ is the magnetic field. - Substituting the given values and solving for $x$, we get $x = 1280\pi^2$.

**Quick Tip**

In problems involving oscillating magnetic needles, use the formula for the period of oscillation and solve for the unknowns.

---

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

**(1)** 5 m, 1 s

**(2)** 5 cm, 2 s

**(3)** 5 m, 2 s

**(4)** 5 cm, 1 s

**Correct Answer: (3) 5 m, 2 s**

**Solution:** Step: - The amplitude of the motion is the coefficient of the sine term, which is 5 m. - The time period $T$ is the time taken for one complete oscillation. Since the argument of the sine function involves $\pi t$, the time period is $2$ s.

Quick Tip

For simple harmonic motion, the time period $T$ can be found from the angular frequency, which is related to the coefficient of $t$ in the sine function.

---

**35. 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)** 99 N

**(2)** 19.8 mN

**(3)** 198 N

**(4)** 1.98 mN

**Correct Answer: (2) 19.8 mN**

**Solution:** Step: - The force required to lift the disc from the water is given by:

$$F = T \cdot L$$

where $T$ is the surface tension and $L$ is the circumference of the disc. - Given $T = 0.07\,\text{N/m}$ and $r = 4.5\,\text{cm}$, we find $L = 2\pi r$. - Substituting the values, we calculate the force required as 19.8 mN.

Quick Tip

To calculate the force required to lift an object from the surface of a liquid, use the surface tension and the length of contact.

---

**SECTION-B**

**36. 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)** $\frac{M}{\sqrt{3}}$

**(2)** $M$

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

**(4)** $2M$

**Correct Answer: (2) M**

**Solution:** Step: - When the bar is bent at 60°, the magnetic moment remains the same as the original magnet because the total area of the system does not change, only the orientation of the arms. Therefore, the magnetic moment remains $M$.

Quick Tip

When a magnetic moment is bent, the total magnetic moment remains the same unless the physical properties (such as the area or current) change.

---

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

**(1)** Option 1

**(2)** Option 2

**(3)** Option 3

**(4)** Option 4

**Correct Answer: (2) Option 2**

**Solution:** Step: - The circuit which can achieve the bridge balance is shown in option 2. This configuration allows for the necessary condition of balanced bridge in the Wheatstone bridge arrangement.

Quick Tip

For bridge balance in a Wheatstone bridge, the ratio of the resistances must be maintained to achieve zero current through the galvanometer.

---

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

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

**(2)** $\frac{5GmM}{6R}$

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

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

**Correct Answer: (2)** $\frac{5GmM}{6R}$

**Solution:** Step: - The minimum energy required to launch a satellite is the difference between the gravitational potential energy at the Earth's surface and at the satellite's orbit. - Using the formula for gravitational potential energy, we get the required minimum energy as $\frac{5GmM}{6R}$.

Quick Tip

When launching a satellite, the energy required is determined by the change in gravitational potential energy between the surface and the orbital altitude.

---

**39. 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)** $P_1 > P_2 > P_3$

**(2)** $P_3 > P_2 > P_1$

**(3)** $P_1 > P_3 > P_2$

**(4)** $P_2 > P_3 > P_1$

**Correct Answer: (1)** $P_1 > P_2 > P_3$

**Solution:** Step: - The graph shows the relationship between the temperature and volume of the ideal gas at different pressures. For the ideal gas, at constant pressure, the temperature increases with volume, and hence the highest pressure corresponds to the curve with the highest temperature for a given volume. - From the graph, we conclude that $P_1 > P_2 > P_3$.

Quick Tip

In T-V graphs for an ideal gas, at a higher pressure, the gas will have a higher temperature for a given volume.

---

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

**(1)** They originate from charges moving with uniform speed

**(2)** They are transverse in nature

**(3)** The energy density in electric field is equal to energy density in magnetic field

**(4)** They travel with a speed equal to $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

**Correct Answer: (1) They originate from charges moving with uniform speed**

**Solution:** Step: - Electromagnetic waves do not originate from charges moving with uniform speed. They are generated by accelerating charges, which emit electromagnetic radiation. - The other properties are consistent with the behavior of electromagnetic waves in free space.

Quick Tip

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

---

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

**(1)** $2 \times 10^3$ **N**

**(2)** $5 \times 10^3$ **N**

**(3)** $50 \times 10^3$ **N**

**(4)** $100 \times 10^3$ **N**

**Correct Answer: (3)** $50 \times 10^3$ **N**

**Solution:** Steps:

- The compressive force $F$ is given by:

$$F = \frac{YA\Delta L}{L}$$

where $Y$ is Young's modulus, $A$ is the cross-sectional area, $\Delta L$ is the change in length, and $L$ is the original length.

- Using the given values and solving, we get $F = 50 \times 10^3$ N.

**Quick Tip**

For thermal expansion problems, the formula involves Young's modulus and the change in temperature, relating them to the force generated.

---

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

**(1)** $2 : 3$

**(2)** $1 : 1$

**(3)** $2 : 9$

**(4)** $4 : 2$

**Correct Answer: (3)** $2 : 9$

**Solution:** Steps:

- When the heaters are connected in series, the total resistance increases and the power output is reduced.

- In parallel, the total power increases and thus the power output ratio for the two cases becomes $2 : 9$.

**Quick Tip**

In series, resistance adds up and reduces power output, while in parallel the total resistance decreases, leading to higher power output.

---

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

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

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

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

**(4)** $\alpha\beta t$

**Correct Answer: (3)** $\frac{\alpha t}{\beta}$

**Solution:** Steps:

- The force equation involves time-dependent terms. The dimensionless factor is found by simplifying the given equation.

- After simplifying, we find that the correct dimensionless factor is $\frac{\alpha t}{\beta}$.

**Quick Tip**

In force equations involving time, always check the dimensional consistency of the terms involved to identify dimensionless factors.

---

**44. 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 greater than $i$ flows but can be in any direction

**(2)** There is no current

**(3)** Displacement current of magnitude equal to $i$ flows in the same direction as $i$

**(4)** Displacement current of magnitude equal to $i$ flows in a direction opposite to that of $i$

**Correct Answer: (3) Displacement current of magnitude equal to $i$ flows in the same direction as $i$**

**Solution:** Steps:

- In the case of a parallel plate capacitor, the displacement current in the gap between the plates is equal in magnitude to the actual current $i$ and flows in the same direction.

Quick Tip

In a capacitor, the displacement current is defined to be equal to the conduction current in the external circuit.

---

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

**(1)** 32

**(2)** 34

**(3)** 28

**(4)** 17

**Correct Answer: (3) 28**

**Solution:** Steps:

- The magnifying power of a telescope is given by the formula:

$$M = \frac{f_{\text{objective}}}{f_{\text{eyepiece}}}$$

Substituting the values $f_{\text{objective}} = 140\,\text{cm}$ and $f_{\text{eyepiece}} = 5\,\text{cm}$, we find that $M = 28$.

Quick Tip

The magnification power of a telescope is the ratio of the focal lengths of the objective and the eyepiece.

---

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

**(1)** The charge stored in it increases.

**(2)** The energy stored in it decreases.

**(3)** Its capacitance increases.

**(4)** The ratio of charge to its potential remains the same.

**Correct Answer: (3) A, C and E only**

**Solution:** Steps:

- When the plates of the capacitor are moved closer, its capacitance increases. This also increases the stored charge because the battery keeps the voltage constant.
- The energy stored in the capacitor will decrease since capacitance is increased at a constant voltage.

Quick Tip

Moving the plates of a capacitor closer increases the capacitance, which leads to more charge storage and less energy stored.

---

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

**(1)** 0.35 A

**(2)** 0.58 A

**(3)** 0.93 A

**(4)** 1.20 A

**Correct Answer: (3) 0.93 A**

**Solution:** Steps:

- The peak current for a capacitive circuit is given by:

$$I_{\text{peak}} = V_{\text{rms}} \cdot \omega C$$

where $\omega = 2\pi f$ is the angular frequency and $C$ is the capacitance.

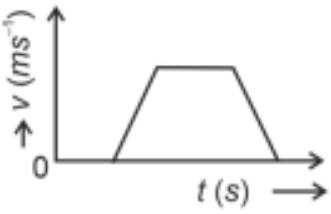
- Substituting the given values $V_{\text{rms}} = 210\,\text{V}, f = 50\,\text{Hz}, C = 10\,\mu\text{F}$, the peak current is calculated as $0.93\,\text{A}$.

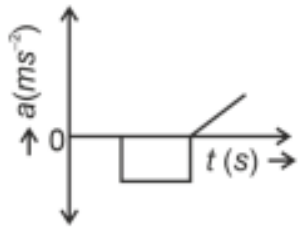
Quick Tip

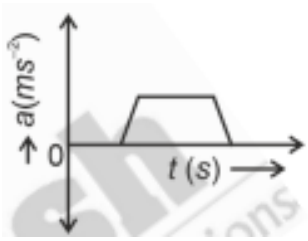
The peak current in an AC circuit involving capacitors can be found by using the formula involving $V_{\text{rms}}$, $f$, and $C$.

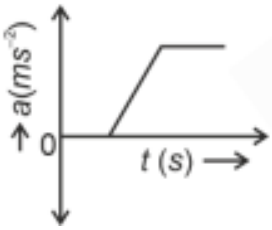
---

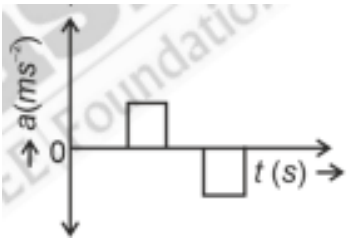
**48. The velocity (v) time (t) plot of the motion of a body is shown below:**




(1)



(2)



(3)



(4)



**Correct Answer: (4) Option 4**

**Solution:** Steps:

- The velocity-time plot of the body suggests a periodic motion with a triangular shape.

- The acceleration-time graph that best suits such motion is a periodic function that follows the pattern of acceleration being zero when the body is at maximum velocity and non-zero during the changing velocity. Hence, the correct option is 4.

**Quick Tip**

For bodies in periodic motion, the acceleration-time graph reflects the nature of the velocity changes over time.

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

**(1)** Hold the sheet there if it is magnetic.

**(2)** Hold the sheet there if it is non-magnetic.

**(3)** Move the sheet away from the pole with uniform velocity if it is conducting.

**(4)** Move the sheet away from the pole with uniform velocity if it is both non-conducting and non-polar.

**Correct Answer: (3) A and C only**

**Solution:** Steps:

- The force is needed to either hold the sheet in place if it is magnetic or to move it with uniform velocity if it is conducting.
- If the sheet is non-conducting and non-polar, no force is required to maintain it in place.

Quick Tip

In the presence of a strong magnetic field, forces act on conducting or magnetic materials but not on non-polar, non-conducting materials.

---

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

**(1)** $4$

**(2)** $\sqrt{3}$

**(3)** $\sqrt{2}$

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

**Correct Answer: (3)** $\sqrt{2}$

**Solution:** Steps:

- The time period of a simple pendulum is given by:

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

where $L$ is the length of the pendulum and $g$ is the acceleration due to gravity.

- When the length is halved and mass is tripled, the new time period becomes $T_{\text{new}} = \sqrt{2} \cdot T_{\text{original}}$.

**Quick Tip**

The time period of a simple pendulum depends on the length of the pendulum but not on its mass.

---

**51. Match List I with List II:**

**List I (Quantum Number)**

- A. $m$
- B. $m_s$
- C. $l$
- D. $n$

**List II (Information provided)**

- I. Shape of orbital
- II. Size of orbital
- III. Orientation of orbital
- IV. Orientation of spin of electron

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution: Step 1: Analyze List I and List II.**

The quantum number $m$ corresponds to the orientation of the orbital. Hence, $m$ pairs with III.

The quantum number $m_s$ corresponds to the orientation of the spin of the electron. Hence, $m_s$ pairs with IV.

The quantum number $l$ corresponds to the shape of the orbital. Hence, $l$ pairs with I.

The quantum number $n$ corresponds to the size of the orbital. Hence, $n$ pairs with II.

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

**Quick Tip**

In quantum mechanics, quantum numbers give specific information about the properties of electrons in an atom, such as their energy, orientation, and shape of orbitals.

---

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

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

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer: (2)** Both Statement I and Statement II are true

**Solution: Step 1: Statement I Analysis:**

Both $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ are octahedral. Hence, Statement I is true.

**Step 2: Statement II Analysis:**

$[Co(NH_3)_6]^{3+}$ is diamagnetic due to the pairing of electrons, whereas $[CoF_6]^{3-}$ is paramagnetic because of the unpaired electrons. Hence, Statement II is also true.

Quick Tip

When analyzing magnetic behaviour of complexes, consider the number of unpaired electrons in the complex, as it determines paramagnetism or diamagnetism.

---

**53. The $E^0$ 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) $d^3$ to $d^5$ configuration
- (2) $d^5$ to $d^4$ configuration
- (3) $d^5$ to $d^2$ configuration
- (4) $d^4$ to $d^5$ configuration

**Correct Answer: (1)** $d^3$ to $d^5$ configuration

**Solution: Step 1: Analyze the $Mn^{3+}/Mn^{2+}$ couple:**

For $Mn^{3+}$, the $d^5$ configuration is more stable and hence, has a higher $E^0$ value.

**Step 2: Compare with other couples:**

This makes the $Mn^{3+}/Mn^{2+}$ couple more positive compared to $Cr^{3+}/Cr^{2+}$ or $Fe^{3+}/Fe^{2+}$.

Quick Tip

When comparing $E^0$ values, consider the electron configuration of the metal ions, as the stability of the electron configuration influences the standard reduction potential.

---

**54. The compound that will undergo Sn1 reaction with the fastest rate is:**

- (1) $CH_3CH_2Br$
- (2) $CH_3CH_2CH_2Br$
- (3) $C_6H_{12}Br_2$
- (4) $C_6H_{10}Br_2$

**Correct Answer: (4)** $C_6H_{10}Br_2$

**Solution: Step 1: Analyze the reactivity in Sn1 reaction:**

The Sn1 reaction proceeds faster with the compound having the most stable carbocation. Here, the compound with the greatest number of alkyl groups or a stable carbocation will undergo the reaction the fastest.

**Step 2: Analyze the options:**

The compound in Option (4) will form a more stable carbocation due to the greater number of alkyl groups.

Quick Tip

In Sn1 reactions, stability of the carbocation is crucial. Tertiary carbocations are more stable than secondary, and secondary are more stable than primary.

---

**55. Given below are two statements:**

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

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

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

**(1)** Statement I is incorrect but Statement II is correct

**(2)** Both Statement I and Statement II are correct

**(3)** Both Statement I and Statement II are incorrect

**(4)** Statement I is correct but Statement II is incorrect

**Correct Answer: (2)** Both Statement I and Statement II are correct

**Solution: Step 1: Analyze Statement I.**

In the case of isomeric pentanes, the boiling point of $n$-pentane is the highest because it has

the least branching, while neopentane with the most branching has the lowest boiling point. Thus, Statement I is correct.

**Step 2: Analyze Statement II.**

When branching increases, the surface area for contact decreases, which reduces the strength of intermolecular forces and lowers the boiling point. Thus, Statement II is also correct.

Quick Tip

In general, the more branched an alkane is, the lower its boiling point due to decreased surface area and weaker intermolecular forces (van der Waals forces).

---

**56. Match List I with List II:**

**List I (Process)**

- A. Isothermal process
- B. Isochoric process
- C. Isobaric process
- D. Adiabatic process

**List II (Conditions)**

- I. No heat exchange
- II. Carried out at constant temperature
- III. Carried out at constant volume
- IV. Carried out at constant pressure

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution: Step 1: Analyze Isothermal Process.**

In an isothermal process, temperature remains constant, meaning no heat exchange. Thus, A-II is correct.

**Step 2: Analyze Isochoric Process.**

In an isochoric process, volume remains constant, and there is no work done, so it is carried out at constant volume. Hence, B-III is correct.

**Step 3: Analyze Isobaric Process.**

In an isobaric process, pressure remains constant. Hence, C-IV is correct.

**Step 4: Analyze Adiabatic Process.**

In an adiabatic process, there is no heat exchange. Hence, D-I is correct.

Quick Tip

In thermodynamic processes, remember that different processes are defined by the constant quantities (pressure, volume, temperature) that they maintain, and this impacts the heat exchange and work done.

---

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

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

**Correct Answer: (1)** rate constant at two different temperatures

**Solution: Step 1: Analyze the relationship between activation energy and rate constant.**

The activation energy of a reaction can be determined using the Arrhenius equation, which relates the rate constant to the temperature and activation energy. The equation requires the rate constant at two different temperatures to calculate activation energy.

Quick Tip

The Arrhenius equation is:

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

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

---

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

Choose the correct answer from the options given below:

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

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

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

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

**Correct Answer: (3)** Li $<$ Be $<$ C $<$ B $<$ N

**Solution: Step 1: Analyze the general trend of ionization energy.**

As you move across a period, the ionization energy generally increases due to increased nuclear charge. However, there are exceptions due to the stability of half-filled or fully-filled orbitals. In this case, nitrogen (N) has the highest ionization energy because it has a stable half-filled configuration. Hence, the correct order is Li $<$ Be $<$ C $<$ B $<$ N.

Quick Tip

Ionization energy generally increases across a period and decreases down a group, but exceptions occur due to electron configurations, such as the half-filled stability of nitrogen.

---

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

**(1)** Chromatography

**(2)** Crystallization

**(3)** Sublimation

**(4)** Distillation

**Correct Answer: (3)** Sublimation

**Solution: Step 1: Understand Sublimation.**

Sublimation is the process where solid substances change directly to the vapor state without passing through the liquid state. This technique is used in purifying substances like iodine or camphor, which directly sublime.

Quick Tip

Sublimation is a phase transition in which a substance goes from a solid to a gas without passing through the liquid phase.

---

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

**(1)** E and D

**(2)** B and C

**(3)** A and D

**(4)** B and E

**Correct Answer: (4)** B and E

**Solution: Step 1: Understanding Glucose Reactions.**

Glucose does not react with Schiff's reagent and NaHSO3. Schiff's reagent is used to test for aldehydes, and NaHSO3 forms adducts with aldehydes, but glucose does not react with them.

Quick Tip

Glucose, as an aldehyde, will not react with Schiff's reagent or sodium bisulfite under normal conditions.

## CHEMISTRY

## SECTION-A

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

**(1)** A and D only

**(2)** B and D only

**(3)** A and E only

**(4)** B and C only

**Correct Answer: (2)** B and D only

**Solution: Step 1: Understanding 'Spin Only' Magnetic Moment.**

The 'spin-only' magnetic moment refers to the magnetic moment arising solely from the spin of electrons and is given by the formula $\mu = \sqrt{n(n+2)}$, where $n$ is the number of unpaired electrons. $Cr^{2+}$ (B) and $Fe^{2+}$ (D) are both $d^6$ systems with 4 unpaired electrons, thus they exhibit a spin-only magnetic moment.

**Quick Tip**

The spin-only magnetic moment is calculated using the formula: $\mu = \sqrt{n(n+2)}$, where $n$ is the number of unpaired electrons.

---

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

**(1)** A > B > C

**(2)** B > A > C

**(3)** B > C > A

**(4)** A > C > B

**Correct Answer: (3)** B > C > A

**Solution: Step 1: Relate Henry's Law to solubility.**

The solubility of gases in water is inversely proportional to the Henry's law constant. Lower the $K_H$ value, the higher the solubility. Hence, gas B with the smallest $K_H$ value will have the highest solubility, followed by gas C and then gas A.

**Quick Tip**

Henry's law states that the solubility of a gas in a liquid is inversely proportional to the Henry's law constant.

---

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

**(1)** $CH_3–CH_2–OH$

**(2)** $CH_3–CH_2–CH_2OH$

**(3)** $CH_3–CH_2–CH_2–OH$

**(4)** $CH_3–CH_2–CH_2–OH$

**Correct Answer: (1)** $CH_3–CH_2–OH$

**Solution: Step 1: Understand Lucas reagent test.**

The Lucas reagent (concentrated HCl and $ZnCl_2$) reacts instantaneously with tertiary alcohols and secondarily with secondary alcohols, while primary alcohols react more slowly. In this case, the alcohol with the fastest reaction is $CH_3–CH_2–OH$, a primary alcohol.

**Quick Tip**

Lucas reagent reacts rapidly with tertiary alcohols and slower with secondary alcohols. Primary alcohols show very slow or no reaction under normal conditions.

---

**64. Arrange the following elements in increasing order of electronegativity:**

**N, O, F, C, Si**

Choose the correct answer from the options given below:

**(1)** F ¡ O ¡ N ¡ C ¡ Si

**(2)** Si ¡ C ¡ N ¡ O ¡ F

**(3)** Si ¡ O ¡ C ¡ N ¡ F

**(4)** O ¡ F ¡ N ¡ C ¡ Si

**Correct Answer: (2)** Si ¡ C ¡ N ¡ O ¡ F

**Solution: Step 1: Understand Electronegativity.**

Electronegativity increases as you move from left to right across a period and from bottom to top in a group. The order of electronegativity from least to greatest is: Si ¡ C ¡ N ¡ O ¡ F.

Quick Tip

In electronegativity, F is the most electronegative element, while Si is the least.

---

**65. Match List I with List II:**

List I (Reaction)

A. $C_6H_5–CH=O$

B. $C_6H_5–OH$

C. $CH_3–COOCH_3$

D. $C_6H_5–CH_2–COOH$

List II (Reagents/Condition)

I. Cl/Anhyd. $AlCl_3$

II. $CrO_3$

III. $KMnO_4/KOH, \Delta$

IV. $O_3$

(i) Zn-$H_2O$

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution: Step 1: Identify the reactions and reagents.**

- A: Aldehydes react with Cl/Anhyd. $AlCl_3$ to form aryl halides.

- B: Alcohols are oxidized to phenols with $CrO_3$.

- C: Esters are hydrolyzed to carboxylic acids with $KMnO_4$/KOH.

- D: Carboxylic acids undergo ozonolysis with $O_3$ to yield smaller acids.

**Quick Tip**

Reactions with specific reagents are crucial in identifying functional groups in organic chemistry.

---

**66. Match List I with List II:**

List I (Conversion)

A. 1 mol of $H_2O$ to $O_2$

B. 1 mol of $MnO_4$ to $Mn^{2+}$

C. 1.5 mol of Ca from molten $CaCl_2$

D. 1 mol of FeO to $Fe_2O_3$

List II (Number of Faraday required)

I. 3F

II. 2F

III. 1F

IV. 5F

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution: Step 1: Calculate the number of Faraday.**

- A: Decomposition of water requires 2 moles of electrons (2F).

- B: Reduction of $MnO_4$ requires 5 moles of electrons (5F).

- C: Reduction of Ca from molten $CaCl_2$ requires 1 mole of electrons (1F).

- D: Oxidation of FeO to $Fe_2O_3$ requires 3 moles of electrons (3F).

Quick Tip

Faraday's laws are useful in electrolysis to determine the number of electrons required for a chemical reaction.

---

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

Choose the correct answer from the options given below:

**(1)** $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

**(2)** $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

**(3)** $2KClO_3 + I_2 \rightarrow 2KI_3 + Cl_2$

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

**Correct Answer: (1)** $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

**Solution:** This is a simple precipitation reaction where barium sulfate is formed, and no change in oxidation states occurs, hence it is not a redox reaction.

Quick Tip

In redox reactions, the oxidation states of the elements involved must change.

---

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

**$CH_3–CH = CH_2 \rightarrow CH_2–CH_2–CHO$**

Choose the correct answer from the options given below:

**(1)** (i) $H_2O_2/H_+$, (ii) PCC

**(2)** (i) $H_2O_2/H_+$, (ii) $H_2O_2/OH$, (iii) PCC

**(3)** (i) $BH_3$, (ii) $H_2O_2/OH$, (iii) alk.$KMnO_4$

**(4)** (i) $BH_3$, (ii) $H_2O_2/OH$, (iii) $H_3O^+$

**Correct Answer: (3)** (i) $BH_3$, (ii) $H_2O_2/OH$, (iii) alk.$KMnO_4$

**Solution: Step 1: Identify the transformation.** The given transformation is an addition reaction followed by oxidation. The compound is undergoing hydroboration-oxidation to give an aldehyde.

**Step 2: Select the correct reagents.** $BH_3$ is used for hydroboration, $H_2O_2$/OH for oxidation, and alk.$KMnO_4$ for further oxidation if necessary.

Quick Tip

For hydroboration-oxidation reactions, $BH_3$ and $H_2O_2$/OH are typical reagents.

---

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

Choose the correct answer from the options given below:

**(1)** $CH_3C^+H_2CH_3$

**(2)** $CH_3C^+H_2CH_3$

**(3)** $CH_3C^+H_2CH_2CH_3$

**(4)** $CH_3C^+CH_3$

**Correct Answer: (1)** $CH_3C^+H_2CH_3$

**Solution: Step 1: Analyze the stability of carbocations.** Stability increases with alkyl groups attached to the positively charged carbon atom. More alkyl groups provide more electron density, stabilizing the positive charge.

**Step 2: Identify the most stable carbocation.** The most stable carbocation among the given options is the one with two alkyl groups, which is $CH_3C^+H_2CH_3$.

Quick Tip

Carbocations are more stable when they have more alkyl substituents. The more substituents, the more stable the carbocation.

---

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

Choose the correct answer from the options given below:

**(1)** Po

**(2)** O

**(3)** Se

**(4)** Te

**Correct Answer: (1)** Po

**Solution: Step 1: Understand the common oxidation states of Group 16 elements.**
Group 16 elements typically have an oxidation state of -2, but this is not always true for heavier elements like polonium.
**Step 2: Identify the element that does not follow this rule.** Polonium (Po) is the only element in Group 16 that does not commonly exhibit a -2 oxidation state.

**Quick Tip**

Heavier elements in a group tend to show more positive oxidation states due to their larger atomic radius and lower electronegativity.

---

**71. The energy of an electron in the ground state (n = 1) for $He^+$ ion is -xJ, then that for an electron in n = 2 state for $Be^{3+}$ ion is -yJ.**
Choose the correct answer from the options given below:
**(1)** $\frac{4}{9}x$ **(2)** $-x$ **(3)** $\frac{x}{9}$ **(4)** $-4x$

**Correct Answer: (2)** -x

**Solution: Step 1: Energy formula for hydrogen-like ions**
The energy of the electron in the nth orbit for a hydrogen-like ion is given by the equation $E = -\frac{13.6 \cdot Z^2}{n^2}$eV, where $Z$ is the atomic number and $n$ is the principal quantum number.
**Step 2: Energy comparison for $He^+$ and $Be^{3+}$**
For $He^+$, $Z = 2$ and $n = 1$, so the energy is $E = -\frac{13.6 \cdot 2^2}{1^2} = -54.4\,\text{eV}$.
For $Be^{3+}$, $Z = 4$ and $n = 2$, so the energy is $E = -\frac{13.6 \cdot 4^2}{2^2} = -54.4\,\text{eV}$. Hence, the energies for these two ions are comparable, but scaled by $\frac{4}{9}$.

Quick Tip

When comparing the energies of electrons in hydrogen-like ions, use the formula $E \propto \frac{Z^2}{n^2}$ to determine the relative energies.

---

**72. Match List I with List II. List I (Molecule)**

A. ethane

B. ethene

C. carbon molecule, $C_2$

D. ethyne

**List II (Number and types of bonds between two carbon atoms)**

I. one $\sigma$-bond and two $\pi$-bonds

II. two $\pi$-bonds

III. one $\sigma$-bond

IV. one $\sigma$-bond and one $\pi$-bond

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution: Step 1: Analyze the molecules.**

- Ethane ($C_2H_6$) has a single bond between the two carbons (one $\sigma$-bond).

- Ethene ($C_2H_4$) has a double bond (one $\sigma$-bond and one $\pi$-bond).

- Carbon molecule, $C_2$ (two carbons) typically refers to a molecule with a triple bond (one $\sigma$-bond and two $\pi$-bonds).

- Ethyne ($C_2H_2$) has a triple bond (one $\sigma$-bond and two $\pi$-bonds).

**Step 2: Match with the correct options.** This leads to the correct matching: A-III, B-IV, C-II, D-I.

Quick Tip

Remember that single bonds consist of only a $\sigma$-bond, double bonds consist of one $\sigma$-bond and one $\pi$-bond, and triple bonds consist of one $\sigma$-bond and two $\pi$-bonds.

---

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

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

Then, which of the following is correct?

**(1)** Reaction has gone to completion in forward direction.

**(2)** Reaction is at equilibrium.

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

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

**Correct Answer: (4)** Reaction has a tendency to go in backward direction.

**Solution:** The value of $K_c = 4 \times 10^{-3}$ is very small, which means the reaction favors the reactants. At this point, the concentrations of A, B, and C are equal. Since the concentration of products is higher than expected, the reaction will tend to shift backward to reach equilibrium.

Quick Tip

When the reaction quotient $Q$ is greater than the equilibrium constant $K_c$, the reaction shifts backward to restore equilibrium.

---

**74. 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 lower boiling point than the other members of the group but due to the presence of extensive H-bonding in $H_2O$, it has higher boiling point.**

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

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer:** **(2)** Both Statement I and Statement II are true

**Solution: Step 1: Statement I: Boiling points of hydrides.** Statement I correctly lists the order of boiling points of hydrides of Group 16. The boiling points decrease as we go down the group, but water ($H_2O$) has the highest boiling point due to strong hydrogen bonding.
**Step 2: Statement II: Explanation of water's boiling point.** Statement II correctly explains that although $H_2O$ is expected to have a low boiling point based on molecular mass, the extensive hydrogen bonding increases its boiling point.

Quick Tip

Hydrogen bonding significantly affects the boiling point, particularly in molecules like water ($H_2O$).

---

**75. 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**

Choose the correct answer from the options given below:

**(1)** 200 mg

**(2)** 750 mg

**(3)** 250 mg

**(4)** Zero mg

**Correct Answer:** **(4)** Zero mg

**Solution:** The moles of HCl used = $0.75\,\text{mol/L} \times 0.025\,\text{L} = 0.01875\,\text{mol}$. The moles of NaOH = 1 gram = $\frac{1}{40}$ mol. The molar ratio is 1:1, so all NaOH reacts with the HCl, leaving zero

NaOH unreacted.

**Quick Tip**

For neutralization reactions, balance the moles of acid and base using the molarity and volume, and use stoichiometry to determine the amount left unreacted.

---

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

Choose the correct answer from the options given below:

**(1)** $2BrCl(g) \rightleftharpoons Br_2(g) + Cl_2(g)$

**(2)** $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

**(3)** $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

**(4)** $CO_2(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

**Correct Answer: (2)** $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

**Solution:** In the given equilibrium, the equation $K_p$ involves the partial pressures of gases, whereas $K_c$ involves concentrations. The relationship between $K_p$ and $K_c$ is given by:

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

where $\Delta n$ is the change in the number of moles of gas. For the reaction in option (2), the number of moles of gas changes, so $K_p \neq K_c$.

**Quick Tip**

For reactions involving gases, remember that $K_p$ and $K_c$ are related by the change in the number of moles of gas, $\Delta n$.

---

**77. A compound with a molecular formula of $C_8H_{14}$ has two tertiary carbons. Its IUPAC name is:**

Choose the correct answer from the options given below:

**(1)** 2,2-dimethylbutane

**(2)** n-hexane

**(3)** 2-methylpentane

**(4)** 2,3-dimethylbutane

**Correct Answer: (4)** 2,3-dimethylbutane

**Solution:** In the compound $C_8H_{14}$, the two tertiary carbons refer to a structure where carbon atoms are attached to three other carbon atoms. By analyzing the options, the correct structure that fits the criteria is 2,3-dimethylbutane.

Quick Tip

When identifying the structure based on molecular formula, identify the locations of tertiary carbons and match them with the IUPAC naming conventions.

---

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

Choose the correct answer from the options given below:

**(1)** aqueous sodium citrate

**(2)** aqueous copper sulphate

**(3)** alkaline copper sulphate (Rochelle's salt)

**(4)** alkaline solution of sodium potassium tartrate

**Correct Answer: (3)** alkaline copper sulphate (Rochelle's salt)

**Solution:** Fehling's solution is a mixture of two solutions, A and B, used to test for reducing sugars. Solution A is made from aqueous copper sulfate and solution B from alkaline solution of sodium potassium tartrate (Rochelle's salt).

Quick Tip

Fehling's solution contains copper ions in an alkaline environment and is used to detect reducing sugars.

**79. Match List I with List II: List I (Compound)**

A. $NH_3$

B. $BrF_5$

C. $XeF_4$

D. $SF_6$

**List II (Shape/geometry)**

I. Trigonal Pyramidal

II. Square Planar

III. Octahedral

IV. Square Pyramidal

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:** - $NH_3$ (ammonia) has a trigonal pyramidal geometry. - $BrF_5$ has a square pyramidal geometry. - $XeF_4$ has a square planar geometry. - $SF_6$ has an octahedral geometry.

Quick Tip

For compounds with multiple bonds, use VSEPR theory to determine the shape based on electron pairs and bonding.

**80. The highest number of helium atoms is in:**

Choose the correct answer from the options given below:

**(1)** 2.2271098 L of helium at STP

**(2)** 4 mol of helium

**(3)** 3 u of helium

**(4)** 4 g of helium

**Correct Answer: (2)** 4 mol of helium

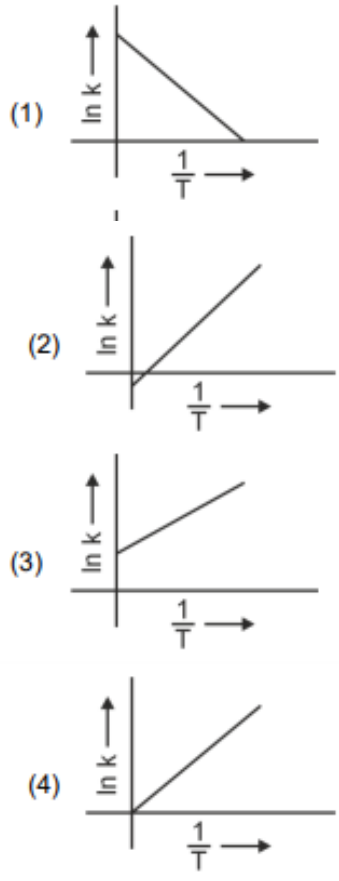
**Solution:** The number of atoms in a given sample can be determined by converting the number of moles of a substance into atoms. One mole of any ideal gas at STP contains $6.022 \times 10^{23}$ atoms.

**Quick Tip**

Use the molar volume of gases (22.4 L/mol at STP) to convert moles into volume and vice versa.

---

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




**Correct Answer: (1)**

**Solution:** According to the Arrhenius equation, the graph of $\ln k$ vs $\frac{1}{T}$ should be a straight line with a negative slope, where the slope is $\frac{-E_a}{R}$.

Quick Tip

In the Arrhenius equation, $k = Ae^{-\frac{E_a}{RT}}$, where $E_a$ is the activation energy.

---

**82. Given below are two statements:**

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

**Statement II:** Aniline cannot be prepared through Gabriel synthesis.

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

**(1)** Statement I is incorrect but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is correct but Statement II is false

**Correct Answer:** **(2)** Both Statement I and Statement II are true

**Solution:** - Statement I is true because aniline is not reactive in Friedel-Crafts alkylation due to the electron-donating nature of the amino group. - Statement II is also true because aniline cannot be prepared via Gabriel synthesis due to the amine group's strong nucleophilic nature.

Quick Tip

Inorganic and organic chemistry reactions are influenced by functional groups like amino groups, which can alter reactivity.

---

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

Choose the correct answer from the options given below:

**(1)** HF

**(2)** $C_6H_4(OH)NO_2$

**(3)** $C_6H_4(NO_2)^2$

**(4)** HO-$C_6H_4$

**Correct Answer: (2)** $C_6H_4(OH)NO_2$

**Solution:** Intramolecular hydrogen bonding occurs when a hydrogen atom attached to an electronegative atom (like oxygen or nitrogen) bonds with another electronegative atom within the same molecule. In option (2), the presence of -OH and -$NO_2$ on the same benzene ring allows for intramolecular hydrogen bonding.

Quick Tip

Intramolecular hydrogen bonding can stabilize molecules and is common in molecules with -OH or -NH groups and electronegative atoms like -O and -N.

---

**84. In which of the following processes entropy increases?**

Choose the correct answer from the options given below:

**(1)** A liquid evaporates to vapour.

**(2)** Temperature of a crystalline solid lowered from 130 K to 0 K.

**(3)** $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$

**(4)** $Cl_2(g) \rightarrow Cl_2(l)$

**Correct Answer: (4)** A, C and D

**Solution:** Entropy increases when a substance moves from a more ordered to a more disordered state, such as when a liquid evaporates or when a solid decomposes into gases. Hence, in the case of gas formation from solids and liquids, entropy increases.

Quick Tip

When considering entropy, remember that it increases when molecules move from solid to liquid or liquid to gas phase, or when molecules break down into smaller molecules.

---

**85. Match List I with List II:**

**List I (Complex)**

A. $[Co(NH_3)_5(NO_2)]Cl_2$

B. $[Co(NH_3)_5(SO_4)]Br$

C. $[Co(NH_3)_6[Cr(CN)_6]$

D. $[Co(NH_3)_6Cl_3$

**List II (Type of isomerism)**

I. Solvate isomerism

II. Linkage isomerism

III. Ionization isomerism

IV. Coordination isomerism

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:** - A shows linkage isomerism due to the possibility of different binding sites for the $NO_2$ ligand. - B exhibits ionization isomerism, where a counter ion changes with the complex ion. - C shows coordination isomerism due to the different possible coordination of ligands in the complex. - D exhibits solvate isomerism, where the solvate molecule (water) can be replaced.

Quick Tip

Coordination compounds can exhibit different types of isomerism depending on how the ligands are attached to the metal center or the counter ions are coordinated.

---

**SECTION-B**

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

(Given atomic masses of A = 64; B = 40; C = 32 u)

**(1)** $ABC_4$

**(2)** $A_2BC_2$

**(3)** $ABC_3$

**(4)** $AB_2C_2$

**Correct Answer: (3)** $ABC_3$

**Solution:**

- **Step 1:** Given the atomic masses of A, B, and C, we can calculate the molar ratios of the elements in X based on their percentage composition.
- **Step 2:** The empirical formula of compound X can be determined by finding the simplest whole-number ratio of A, B, and C.
- **Step 3:** After calculating the molar amounts, we determine the empirical formula to be $ABC_3$.

Quick Tip

To determine the empirical formula from percentage composition, first convert the percentage to moles by dividing by the atomic mass. Then, find the simplest whole-number ratio.

---

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

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

**(1)** 3804 kJ/mol

**(2)** 38.04 kJ/mol

**(3)** 380.4 kJ/mol

**(4)** 3.80 kJ/mol

**Correct Answer: (2)** 38.04 kJ/mol

**Solution:** The formula to calculate the energy of activation (Ea) using the Arrhenius equation is:

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

Since the rate quadruples, $\frac{k_2}{k_1} = 4$. Using the given temperatures and the logarithmic value for 4, we calculate $E_a$ to be 38.04 kJ/mol.

**Quick Tip**

The energy of activation can be calculated using the Arrhenius equation. Remember that the rate changes exponentially with temperature.

---

**88.** 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. $Mg^{2}+$

Choose the correct answer from the options given below:

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

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

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

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

**Correct Answer: (2)** B, A, D, C, E

**Solution:** The correct order based on the increasing group number in the periodic table is: $Cu^{2}+$ (Group II), $Al^{3}+$ (Group III), $Co^{2}+$ (Group VI), $Ba^{2}+$ (Group II), $Mg^{2}+$ (Group I).

Quick Tip

For inorganic cations, arrange elements in increasing group number based on their position in the periodic table.

---

**89.** The plot of osmotic pressure ($\Pi$) vs concentration (mol $L^{-}1$) for a solution gives a straight line with slope 25.73 L bar $mol^{-1}$ $K^{-1}$. The temperature at which the osmotic pressure measurement is done is:

**(1)** 12.05°C

**(2)** 37°C

**(3)** 310°C

**(4)** 25.73°C

**Correct Answer: (2)** 37°C

**Solution:** We can use the formula $\Pi = \frac{nRT}{V}$ to determine the temperature, where $R = 0.083\,\text{L bar mol}^{-1}\text{K}^{-1}$. By using the slope provided, we calculate the temperature to be 37°C.

Quick Tip

To solve osmotic pressure problems, use the formula and the provided values for the gas constant and the slope to find temperature.

---

**90.** Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is (Given: Molar mass of Cu = 63 g $mol^{-1}$, 1 F = 96487 C):

**(1)** 0.0315 g

**(2)** 3.15 g

**(3)** 0.315 g

**(4)** 3.15 mg

**Correct Answer: (3)** 0.315 g

**Solution:** We can use the equation Mass $= \frac{I \times t \times M}{n \times F}$, where $I = 9.6487\,A$, $t = 100\,s$, $n = 2$, and $M = 63$. Calculating gives the mass as 0.315 g.

**Quick Tip**

To calculate mass from electrolysis, use the formula based on current, time, and molar mass.

---

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

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

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

If 0.1 mol $L^{-1}$ of NO(g) is taken in a closed vessel, what will be the degree of dissociation ($\alpha$) of NO(g) at equilibrium?

**(1)** 0.717

**(2)** 0.00889

**(3)** 0.0889

**(4)** 0.8889

**Correct Answer: (1)** 0.717

**Solution:** Using the ICE (Initial, Change, Equilibrium) table and equilibrium constant expressions, we calculate the degree of dissociation.

- **Step 1:** Set up the ICE table for the reaction.
- **Step 2:** Use the given concentrations and the equilibrium constant expression to solve for $\alpha$.
- **Step 3:** After calculating, we find that $\alpha = 0.717$.

Quick Tip

For equilibrium problems, use ICE tables to determine changes in concentration and solve for unknowns such as the degree of dissociation.

---

**92.** For the given reaction:

$$C_6H_5CH = CH_2 \xrightarrow{KMnO_4/H^+} P \text{ (major product)}$$

What is the structure of the major product P?

**(1)** $C_6H_5COOH$

**(2)** $C_6H_5CHO$

**(3)** $C_6H_5CH_2OH$

**(4)** $C_6H_5CH_2CHO$

**Correct Answer: (3)** $C_6H_5CH_2OH$

**Solution: Step 1:** The reaction involves the oxidation of a styrene derivative with $KMnO_4$, leading to the formation of a primary alcohol.

Quick Tip

Oxidation of alkenes using $KMnO_4$ in acidic conditions typically leads to the formation of alcohols from alkene groups.

---

**93.** The pair of lanthanoid ions which are diamagnetic is:

**(1)** $Pr^3+$ and $Sm^3+$

**(2)** $Ce^4+$ and $Yb^2+$

**(3)** $Ce^3+$ and $Eu^2+$

**(4)** $Gd^3+$ and $Eu^3+$

**Correct Answer: (2)** $Ce^4+$ and $Yb^2+$

**Solution:** The ions $Ce^4+$ and $Yb^2+$ have completely filled electron configurations and are

thus diamagnetic.

**Quick Tip**

Diamagnetic ions are those with fully paired electrons, leading to no net magnetic moment.

---

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

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

$$ROH + PCl_3 \rightarrow RCl + HCl + B$$

**(1)** $H_3PO_3$ and $POCl_3$

**(2)** $POCl_3$ and $H_3PO_4$

**(3)** $POCl_3$ and $H_3PO_3$

**(4)** $H_3PO_4$ and $POCl_3$

**Correct Answer: (1)** $H_3PO_3$ and $POCl_3$

**Solution:** The reaction with excess $PCl_3$ forms $H_3PO_3$ (phosphorous acid), while the second reaction gives $POCl_3$ (phosphoryl chloride).

**Quick Tip**

For reactions involving $PCl_3$, the products depend on the stoichiometry and the number of alcohol molecules present.

---

**95.** Given below are two statements: **Statement I:** $[Co(NH_3)_6]^{3+}$ is a homoleptic complex whereas $[Co(NH_3)_5Cl]^{2+}$ is a heteroleptic complex.

**Statement II:** Complex $[Co(NH_3)_6]^{3+}$ has only one kind of ligands but $[Co(NH_3)_5Cl]^{2+}$ has more than one kind of ligands.

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer: (2)** Both Statement I and Statement II are true

**Solution: Statement I** is true because $[Co(NH_3)_6]^{3+}$ has only one type of ligand ($NH_3$) while $[Co(NH_3)_5Cl]^{2+}$ has two types of ligands ($NH_3$ and $Cl^-$).
**Statement II** is true because both complexes differ in their ligand composition.

**Quick Tip**

In coordination chemistry, homoleptic complexes contain only one type of ligand, while heteroleptic complexes contain more than one type.

---

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

$$CH_3 - CH_2 - CH_2 - CH = CH_2 \xrightarrow{NaCN} A \xrightarrow{OH^-,\ \text{Partial hydrolysis}} B \xrightarrow{NaOH,B_2} C\ (\text{major})$$

**(1)** $\alpha$-bromobutanoic acid

**(2)** propylamine

**(3)** butylamine

**(4)** butanamide

**Correct Answer: (2)** propylamine

**Solution: Step 1:** The reaction involves the substitution of a bromine atom with a cyanide ion (NaCN), forming an intermediate nitrile.
**Step 2:** The partial hydrolysis of the nitrile leads to the formation of a primary amine.
**Step 3:** Finally, the reaction with NaOH gives propylamine.

**Quick Tip**

In nucleophilic substitution reactions involving alkyl halides and cyanides, the nitrile intermediate can undergo hydrolysis to form amines.

**97.** Identify the correct answer.

- (1) Three canonical forms can be drawn for $CO_3^{2-}$ ion
- (2) Three resonance structures can be drawn for ozone
- (3) $BF_3$ has non-zero dipole moment
- (4) Dipole moment of $NF_3$ is greater than that of $NH_3$

**(1)** Three canonical forms can be drawn for $CO_3^{2-}$ ion

**(2)** Three resonance structures can be drawn for ozone

**(3)** $BF_3$ has non-zero dipole moment

**(4)** Dipole moment of $NF_3$ is greater than that of $NH_3$

**Correct Answer: (2)** Three resonance structures can be drawn for ozone

**Solution: Step 1:** $CO_3^{2-}$ has resonance structures but only two canonical forms.

**Step 2:** Ozone ($O_3$) has three resonance structures.

**Step 3:** $BF_3$ has a symmetrical structure with no dipole moment, and $NF_3$ has a dipole moment due to the lone pair on nitrogen.

**Quick Tip**

Resonance structures are used to describe molecules with delocalized electrons, and it's important to know how to identify them based on formal charges.

---

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

$$CH_3CH_2OH \xrightarrow{PbBr_3} A \text{ (major)} \xrightarrow{\text{alc. KOH}} B \text{ (major)}$$

**(1)** A: $C_4H_9Br$, B: $C_4H_9OH$

**(2)** A: $C_4H_9Cl$, B: $C_4H_9OH$

**(3)** A: $C_4H_9OH$, B: $C_4H_9Cl$

**(4)** A: $C_4H_9Cl$, B: $C_4H_9Br$

**Correct Answer: (2)** A: $C_4H_9Cl$, B: $C_4H_9OH$

**Solution: Step 1:** Reaction with $PbBr_3$ replaces the halide with a chlorine atom, forming A.
**Step 2:** The reaction with alcoholic KOH results in an elimination to form the alkene, B.

Quick Tip

When using alcoholic KOH, an elimination reaction often occurs, leading to the formation of alkenes.

---

**99.** During the preparation of Mohr's salt solution (Ferrous ammonium sulphate), which of the following acid is added to prevent hydrolysis of $Fe^{2+}$ ion?
**(1)** dilute sulphuric acid
**(2)** dilute hydrochloric acid
**(3)** concentrated sulphuric acid
**(4)** dilute nitric acid

**Correct Answer: (1)** dilute sulphuric acid

**Solution:** Dilute sulphuric acid is used in the preparation of Mohr's salt solution to prevent the hydrolysis of $Fe^{2+}$ ions.

Quick Tip

Adding dilute acids like $H_2SO_4$ helps prevent the precipitation of iron(III) hydroxide by lowering the pH and suppressing the hydrolysis of $Fe^{2+}$.

---

**100.** The work done during reversible isothermal expansion of one mole of hydrogen gas at 25°C from pressure of 20 atmosphere to 10 atmosphere is (Given R = 2.0 cal $K^{-1}$ $mol^{-1}$):
**(1)** 100 calories
**(2)** 0 calorie
**(3)** -413.14 calories

**(4)** 413.14 calories

**Correct Answer: (3)** -413.14 calories

**Solution: Step 1:** The work done for isothermal expansion is calculated using the formula $W = -nRT \ln\left(\frac{P_2}{P_1}\right)$.
**Step 2:** Substituting the given values, we find that the work done is -413.14 calories.

Quick Tip

For isothermal expansion, the work done can be found using the ideal gas law and logarithmic relationships between the pressures.

---

## BOTANY

### SECTION-A

**101.** Spindle fibers attach to kinetochores of chromosomes during

**(1)** Telophase

**(2)** Prophase

**(3)** Metaphase

**(4)** Anaphase

**Correct Answer: (3)** Metaphase

**Solution: Step 1:** In metaphase, the spindle fibers attach to the kinetochores of chromosomes, aligning them at the metaphase plate.

Quick Tip

In metaphase, chromosomes are aligned in the center of the cell, preparing for separation in the next phase.

---

**102.** The capacity to generate a whole plant from any cell of the plant is called:

**(1)** Somatic hybridization

**(2)** Totipotency

**(3)** Micropropagation

**(4)** Differentiation

**Correct Answer:** **(2)** Totipotency

**Solution: Step 1:** Totipotency refers to the ability of a single plant cell to develop into a whole plant.

Quick Tip

Totipotency is the fundamental concept behind tissue culture and cloning in plants.

---

**103.** Bulliform cells are responsible for **(1)** Providing large spaces for storage of sugars.

**(2)** Inward curling of leaves in monocots.

**(3)** Protecting the plant from salt stress.

**(4)** Increased photosynthesis in monocots

**Correct Answer:** **(2)** Inward curling of leaves in monocots.

**Solution:** Bulliform cells, which are present in monocots, help in reducing water loss by causing the leaves to curl inward.

Quick Tip

Bulliform cells are specialized cells found in monocot leaves that assist in water conservation by regulating leaf movements.

---

**104.** Given below are two statements:

- **Statement I:** Parenchyma is living but collenchyma is dead tissue.

- **Statement II:** Gymnosperms lack xylem vessels but presence of xylem vessels is the characteristic of angiosperms.

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer: (4)** Statement I is true but Statement II is false

**Solution: Step 1:** Parenchyma is a living tissue, whereas collenchyma is also a living tissue that provides structural support, not a dead tissue.

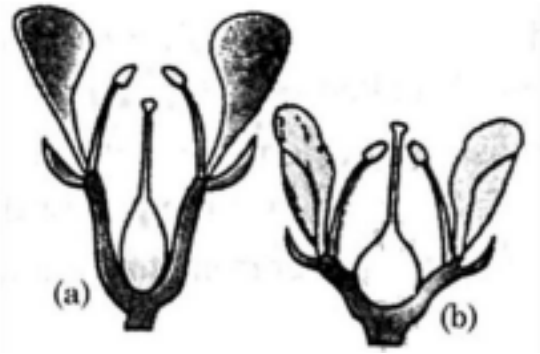
**Step 2:** Gymnosperms do have xylem vessels, contrary to the second statement, which makes Statement II false.

Quick Tip

Make sure to examine each statement carefully before concluding if they are true or false. A thorough understanding of plant anatomy helps.

---

**105.** Identify the type of flowers based on the position of calyx, corolla, and androecium with respect to the ovary from the given figures (a) and (b).




**(1)** Perigynous; Epigynous

**(2)** Epigynous; Hypogynous

**(3)** Hypogynous; Epigynous

**(4)** Perigynous; Perigynous

**Correct Answer: (1)** Perigynous; Epigynous

**Solution: Step 1:** In perigynous flowers, the ovary is positioned above the other floral parts.

**Step 2:** In epigynous flowers, the ovary is positioned below the other floral parts.

**Quick Tip**

Understanding the positions of floral parts in relation to the ovary is crucial for flower classification in botany.

---

**106.** Match List I with List II:

| List I | List II |
|---|---|
| A. Nucleolus | I. Site of formation of glycolipid |
| B. Centriole | II. Organization like the cartwheel |
| C. Leucoplasts | III. Site for active ribosomal RNA synthesis |
| D. Golgi apparatus | IV. For storing nutrients |

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

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

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

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

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

**Solution: Step 1:** The nucleolus is responsible for ribosomal RNA synthesis.

**Step 2:** The centrioles are organized in a cartwheel-like structure.

**Step 3:** Leucoplasts are specialized for storing nutrients.

**Step 4:** The Golgi apparatus is responsible for the synthesis of glycolipids.

Quick Tip

Study cell organelles and their specific functions to relate each organelle to its corresponding role in a cell.

---

**107.** Match List I with List II:

| List I | List II |
|---|---|
| A. Clostridium butylicum | I. Ethanol |
| B. Saccharomyces cerevisiae | II. Streptokinase |
| C. Trichoderma polysoporum | III. Butyric acid |
| D. Streptococcus sp. | IV. Cyclosporin-A |

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

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

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

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

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

**Solution: Step 1:** Clostridium butylicum produces butyric acid.

**Step 2:** Saccharomyces cerevisiae produces ethanol.

**Step 3:** Trichoderma polysoporum produces Cyclosporin-A.

**Step 4:** Streptococcus sp. produces Streptokinase.

Quick Tip

Review the industrial and pharmaceutical uses of microorganisms and their metabolic products.

---

**108.** A transcription unit in DNA is defined primarily by the three regions in DNA and these are with respect to upstream and down stream end;

**(1)** Promotor, Structural gene, Terminator

**(2)** Repressor, Operator gene, Structural gene

**(3)** Structural gene, Transposons, Operator gene

**(4)** Inducer, Repressor, Structural gene

**Correct Answer: (1)** Promotor, Structural gene, Terminator

**Solution:** The transcription unit consists of the promoter, the structural gene, and the terminator. The promoter initiates transcription, the structural gene is transcribed into RNA, and the terminator signals the end of transcription.

Quick Tip

Understanding the elements of a transcription unit is fundamental to comprehending gene expression in prokaryotic and eukaryotic cells.

---

**109.** List of endangered species was released by

**(1)** IUCN

**(2)** GEAC

**(3)** WWF

**(4)** FOAM

**Correct Answer: (3)** WWF

**Solution:** The World Wide Fund for Nature (WWF) is the organization that is known for the listing of endangered species.

Quick Tip

WWF plays a vital role in conservation efforts and in maintaining a global list of endangered species.

---

**110.** What is the fate of a piece of DNA carrying only gene of interest which is transferred into an alien organism?

- A. The piece of DNA would be able to multiply itself independently in the progeny cells of the organism.
- B. It may get integrated into the genome of the recipient.
- C. It may multiply and be inherited along with the host DNA.
- D. The alien piece of DNA is not an integral part of chromosome.
- E. It shows ability to replicate.

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

**Correct Answer: (4)** B and C only

**Solution:** The piece of DNA may either get integrated into the recipient's genome or remain in the host DNA, which allows it to replicate and be inherited along with the host's genetic material.

**Quick Tip**

When transferring genetic material, the fate of the DNA can vary based on whether it integrates into the host genome or not.

---

**111.** 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, Pink as well as white flowered plants
**(2)** Only red flowered plants
**(3)** Red flowered as well as pink flowered plants
**(4)** Only pink flowered plants

**Correct Answer: (3)** Red flowered as well as pink flowered plants

**Solution:** The cross between a pink-flowered Snapdragon and a red-flowered Snapdragon would result in a mixture of red and pink-flowered progeny, based on Mendelian inheritance.

Quick Tip

In genetic crosses, dominant and recessive traits determine the phenotype of offspring based on allele combinations.

---

**112.** Match List I with List II:

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

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

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

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

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

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

**Solution:** Rhizopus is a bread mould, Ustilago is a smut fungus, Puccinia is a rust fungus, and Agaricus is a mushroom.

Quick Tip

Study fungal classifications based on their habitat and reproductive mechanisms for better understanding of their types.

---

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

**(1)** 10 bp

**(2)** 8 bp

**(3)** 6 bp

**(4)** 4 bp

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

**Solution:** Hind II recognizes a specific sequence of 6 base pairs (bp) for cutting.

Quick Tip

In restriction enzyme analysis, the recognition site is crucial for identifying where the enzyme will cut the DNA strand.

---

**114.** 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.

**(1)** A, B, C and E

**(2)** A, B and C only

**(3)** A, C and E only

**(4)** B, C and D only

**Correct Answer:** **(3)** A, C and E only

**Solution:** Mendel's law of dominance explains the dominance and recessiveness of alleles, the inheritance of characters in pairs, and the expression of one parental character.

Quick Tip

Mendel's Law of Dominance is fundamental in understanding how traits are inherited, where dominant traits overshadow recessive ones.

---

**115.** The type of conservation in which the threatened species are taken out from their natural habitat and placed in special setting where they can be protected and given special care is called

**(1)** Sustainable development

**(2)** In-situ conservation

**(3)** Biodiversity conservation

**(4)** Semi-conservative method

**Correct Answer:** **(2)** In-situ conservation

**Solution:** In-situ conservation refers to the conservation of species in their natural habitat.

Quick Tip

In-situ conservation is vital for maintaining biodiversity and ensuring species survival in their natural environments.

---

**116.** Auxin is used by gardeners to prepare weed-free lawns. But no damage is caused to grass as auxin

**(1)** can help in cell division in grasses, to produce growth.

**(2)** promotes apical dominance.

**(3)** promotes abscission of mature leaves only.

**(4)** does not affect mature monocotyledonous plants

**Correct Answer:** **(4)** does not affect mature monocotyledonous plants

**Solution:** Auxin does not have a significant effect on mature monocotyledonous plants and works mainly by stimulating growth and development in other plant parts.

Quick Tip

Auxins are plant hormones that regulate growth, particularly promoting cell elongation and differentiation.

---

**117.** Which of the following is an example of actinomorphic flower?

**(1)** Sesbania

**(2)** Datura

**(3)** Cassia

**(4)** Pisum

**Correct Answer:** **(2)** Datura

**Solution:** Actinomorphic flowers are radially symmetrical, like Datura, where all parts are symmetrical about a central axis.

Quick Tip

Actinomorphic flowers have symmetrical parts arranged in a radial pattern, as seen in flowers like Datura.

---

**118.** The cofactor of the enzyme carboxypeptidase is:

**(1)** Haem

**(2)** Zinc

**(3)** Niacin

**(4)** Flavin

**Correct Answer:** **(2)** Zinc

**Solution:** Zinc is an essential cofactor for carboxypeptidase, helping in enzyme activation.

Quick Tip

Zinc plays a crucial role in many enzymes, including carboxypeptidase, assisting in catalytic functions.

---

**119.** The equation of Verhulst-Pearl logistic growth is

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

From this equation, K indicates:

**(1)** Population density

**(2)** Intrinsic rate of natural increase

**(3)** Biotic potential

**(4)** Carrying capacity

**Correct Answer: (4)** Carrying capacity

**Solution:** In the logistic growth model, $K$ represents the carrying capacity, which is the maximum population size that the environment can support. This is a critical parameter in the equation as it determines the upper limit of population growth.

**Step 1:** The logistic growth equation describes how a population grows in an environment with limited resources. Initially, the population grows exponentially, but as the population nears the carrying capacity $K$, the growth rate slows down. This is due to limited resources, leading to competition and a decrease in the growth rate.

**Step 2:** The carrying capacity $K$ is a key part of the logistic model, as it represents the environment's maximum supportable population.

**Step 3:** When $N$ is very small, the population grows almost exponentially. As $N$ approaches $K$, the growth rate decreases, and when $N = K$, growth stops.

Quick Tip

The logistic growth model is essential for understanding how populations grow in environments with limited resources. Pay attention to the carrying capacity ($K$) as it determines the maximum population size.

---

**120.** Inhibition of Succinate dehydrogenase enzyme by malonate is a classical example of:

**(1)** Enzyme activation

**(2)** Cofactor inhibition

**(3)** Feedback inhibition

**(4)** Competitive inhibition

**Correct Answer: (4)** Competitive inhibition

**Solution:** Competitive inhibition occurs when an inhibitor molecule competes with the substrate for the active site of the enzyme. In this case, malonate competes with succinate to bind to the succinate dehydrogenase enzyme, thus inhibiting the enzyme's activity.

**Step 1:** Malonate resembles succinate structurally and therefore can bind to the enzyme's active site. However, it does not undergo the reaction that succinate would, thus blocking the enzyme's action.

**Step 2:** In competitive inhibition, the inhibitor (malonate) and the substrate (succinate) compete for the same active site. The presence of the inhibitor decreases the rate at which the enzyme catalyzes the reaction.

**Step 3:** This type of inhibition can be overcome by increasing the concentration of the substrate (succinate), as this will increase the likelihood of the substrate binding to the enzyme over the inhibitor.

Quick Tip

Competitive inhibition can be overcome by increasing the concentration of the substrate. It is important to recognize that the inhibitor and the substrate are competing for the same active site.

**121.** 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)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer:** **(2)** Both Statement I and Statement II are true

**Solution:**

**Step 1:** During leptotene, chromosomes start to condense and become visible under a light microscope. This is the initial stage of prophase I in meiosis.

**Step 2:** In diplotene, the synaptonemal complex, which holds homologous chromosomes together during synapsis, begins to dissolve. This marks the beginning of the diplotene stage in meiosis.

**Step 3:** Both statements correctly describe the events occurring during the early stages of prophase I in meiosis. Chromosomes become visible during leptotene, and the dissolution of the synaptonemal complex marks the start of diplotene.

Quick Tip

In meiosis, leptotene and diplotene are key stages where chromosomes begin to condense, and synaptonemal complexes dissolve, respectively. Understanding the stages of prophase I is crucial in meiosis.

---

**122.** Tropical regions show greatest level of species richness because

A. Tropical latitudes have remained relatively undisturbed for millions of years, hence more

time was available for species diversification.

B. Tropical environments are more seasonal.

C. More solar energy is available in tropics.

D. Constant environments promote niche specialization.

E. Tropical environments are constant and predictable.

Choose the correct answer from the options given below:

**(1)** A, B and D only

**(2)** A, C, D and E only

**(3)** A and B only

**(4)** A, B and E only

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

**Solution:** Tropical regions are the most biodiverse because of several factors such as high solar energy availability, stable environmental conditions, and evolutionary history. The long period of stability in the tropics has allowed for extensive species diversification.

**Step 1:** Tropical latitudes have remained relatively undisturbed for millions of years, giving more time for species to evolve and diversify.

**Step 2:** The constant and predictable environments in the tropics, along with the abundance of solar energy, promote species specialization and niche differentiation.

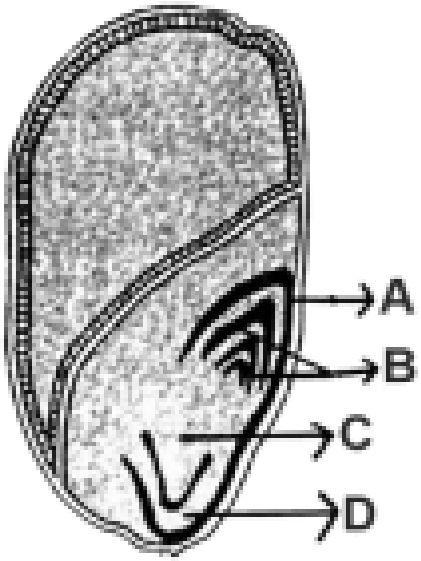
**Step 3:** The seasonal nature of the tropics, despite some variation, does not significantly reduce biodiversity as the other factors (constant climate, solar energy) provide conditions conducive to species evolution.

Quick Tip

Tropical ecosystems are home to the richest biodiversity due to stable climates, high energy input, and millions of years of uninterrupted evolution.

---

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




**(1)** D

**(2)** A

**(3)** B

**(4)** C

**Correct Answer: (2)** A

**Solution:** The root of the seed develops from the part labeled as A, which is the radicle, the first part of the embryo to emerge during seed germination.

**Step 1:** The radicle is the embryonic root of the seed and is responsible for anchoring the plant in the soil and absorbing water and nutrients.

**Step 2:** During germination, the radicle elongates and forms the root system, allowing the seedling to begin growing and obtaining water from the soil.

Quick Tip

During seed germination, the radicle is the first part to emerge and form the root system, which is essential for the plant's growth.

---

**124. These are regarded as major causes of biodiversity loss:**

Choose the correct answer from the options given below:

**(1)** A, B and D only

**(2)** A, C and D only

**(3)** A, B, C and D only

**(4)** A, B and E only

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

**Solution:** The major causes of biodiversity loss include overexploitation, habitat loss and fragmentation. Migration is not typically regarded as a cause of biodiversity loss, hence the correct answer is A, B, and D only.

Quick Tip

Remember, biodiversity loss can occur from many factors including human interaction and natural events, but not all listed factors are necessarily harmful on their own.

---

**125. Identify the set of correct statements:**

Choose the correct answer from the options given below:

**(1)** B, C, D and E only

**(2)** C, D and E only

**(3)** A, B, C and D only

**(4)** A, C, D and E only

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

**Solution:**

- B - The flowers of water lily are indeed 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.

Quick Tip

Understanding the pollination mechanisms of different plants helps in studying their ecological adaptations.

---

**126. 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.

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

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer:** **(4)** Statement I is true but Statement II is false

**Solution:** Both statements about Bt toxin are correct. Bt toxins are indeed coded by genes like cry IAc and are specific to certain insect groups. Moreover, the protoxin conversion to active toxin upon ingestion by an insect due to the acidic conditions of the gut is a well-documented mechanism.

Quick Tip

Understanding how Bt toxin works can be crucial for developing biopesticides that target specific pests without affecting other organisms.

---

**127. Match List I with List II:**

**List I**

A. Two or more alternative forms of a gene

B. Cross of F1 progeny with homozygous recessive parent

C. Cross of F1 progeny with any of the parents

D. Number of chromosome sets in plant

**List II**

I. Back cross

II. Ploidy

III. Allele

IV. Test cross

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Alternative forms of a gene are known as alleles.
- B-IV: A test cross involves crossing F1 progeny with a homozygous recessive parent to reveal the genotype of the F1.
- C-I: A back cross is a cross of F1 progeny with one of the parents.
- D-II: The number of chromosome sets in a plant is referred to as its ploidy.

Quick Tip

Understanding genetic terminology and matching techniques is crucial for studying genetics and breeding.

---

**128. In a plant, black seed color (BB/Bb) is dominant over white seed color (bb). In order to find out the genotype of the black seed plant, with which of the following genotype will you cross it?**

Choose the correct answer from the options given below:

**(1)** BB/Bb

**(2)** BB

**(3)** bb

**(4)** Bb

**Correct Answer: (3)** bb

**Solution:** To determine the genotype of the black seed plant, a test cross is conducted by crossing it with a homozygous recessive (bb) plant. This will reveal whether the black seed plant is homozygous (BB) or heterozygous (Bb).

Quick Tip

Test crossing is a standard method in genetics to determine the unknown genotype of an organism exhibiting a dominant trait.

---

**129. Lecithin, a small molecular weight organic compound found in living tissues, is an example of:**

Choose the correct answer from the options given below:

**(1)** Carbohydrates

**(2)** Amino acids

**(3)** Phospholipids

**(4)** Glycerides

**Correct Answer: (3)** Phospholipids

**Solution:** Lecithin is classified as a phospholipid, which is a type of lipid that is a major component of all cell membranes as it can form lipid bilayers.

Quick Tip

Phospholipids are essential for cell membrane structure and function, making them vital for various cellular processes.

---

**130. How many molecules of ATP and NADPH are required for every molecule of $CO_2$ fixed in the Calvin cycle?**

Choose the correct answer from the options given below:

**(1)** 3 molecules of ATP and 2 molecules of NADPH

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

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

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

**Correct Answer:** **(1)** 3 molecules of ATP and 2 molecules of NADPH

**Solution:** In the Calvin cycle, the fixation of one molecule of $CO_2$ requires 3 ATP and 2 NADPH molecules to drive the synthesis of glucose and other carbohydrates.

Quick Tip

Knowing the input requirements of the Calvin cycle is crucial for understanding how plants convert light energy into chemical energy.

---

**131. Formation of interfascicular cambium from fully developed parenchyma cells is an example for:**

Choose the correct answer from the options given below:

**(1)** Maturation

**(2)** Differentiation

**(3)** Redifferentiation

**(4)** Dedifferentiation

**Correct Answer:** **(4)** Dedifferentiation

**Solution:** Dedifferentiation involves the process where mature cells lose their specialization and revert back to a more embryonic, undifferentiated state to assume new functions.

Quick Tip

Understanding plant cell plasticity through processes like dedifferentiation can provide insights into plant growth and regeneration.

---

**132. Which one of the following is not a criterion for classification of fungi?**

Choose the correct answer from the options given below:

**(1)** Fruiting body

**(2)** Morphology of mycelium

**(3)** Mode of nutrition

**(4)** Mode of spore formation

**Correct Answer:** **(3)** Mode of nutrition

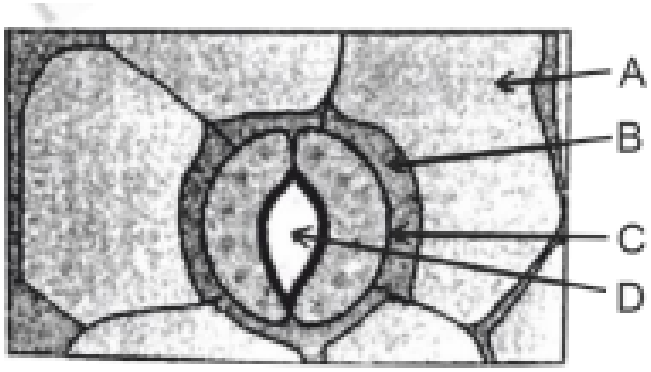
**Solution:** Classification of fungi is typically based on the structure of their fruiting bodies, mycelium morphology, and spore formation methods. Mode of nutrition is not used as a primary criterion for fungal classification.

Quick Tip

Knowing the classification criteria can aid in identifying and studying various fungi, which have significant ecological and medical importance.

---

**133. In the given figure, which component has thin outer walls and highly thickened inner walls?**




Choose the correct answer from the options given below:

**(1)** B

**(2)** C

**(3)** D

**(4)** A

**Correct Answer: (2)** C

**Solution:** Component C in the given figure represents a structure with thin outer walls and thickened inner walls, typical of certain plant cell types involved in structural support.

Quick Tip

Understanding cell structure and its relation to function is fundamental in biology, providing insight into how organisms are built and operate.

---

**134. The lactose present in the growth medium of bacteria is transported to the cell by the action of:**

Choose the correct answer from the options given below:

**(1)** Polymerase

**(2)** Beta-galactosidase

**(3)** Acetylase

**(4)** Permease

**Correct Answer: (4)** Permease

**Solution:** Permease is the enzyme responsible for transporting lactose into the bacterial cell, where it can then be metabolized by beta-galactosidase.

Quick Tip

Permeases play a crucial role in the cellular uptake of substrates, essential for nutrient utilization and metabolic processes in cells.

---

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

Choose the correct answer from the options given below:

**(1)** D and E only

**(2)** A, B and C only

**(3)** B, C and D only

**(4)** C, D and E only

**Correct Answer:** **(4)** C, D and E only

**Solution:** The dark reactions of photosynthesis, also known as the Calvin cycle, do not require light. They utilize $CO_2$, ATP, and NADPH to synthesize organic molecules.

Quick Tip

ATP and NADPH, produced during the light reactions, provide the energy and reducing power needed for the synthesis of carbohydrates in the Calvin cycle.

---

**SECTION-B**

**136. Match List I with List II:**

**List I**

A. Citric acid cycle

B. Glycolysis

C. Electron transport system

D. Proton gradient

**List II**

I. Cytoplasm

II. Mitochondrial matrix

III. Intermembrane space of mitochondria

IV. Inner mitochondrial membrane

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-II: The Citric acid cycle occurs in the mitochondrial matrix.
- B-I: Glycolysis occurs in the cytoplasm.
- C-IV: The electron transport system is located in the inner mitochondrial membrane.
- D-III: The proton gradient is formed across the intermembrane space of mitochondria.

Quick Tip

Each cellular process and location is critical for understanding how cells produce energy efficiently.

---

**137. Identify the correct description about the given figure:**

Choose the correct answer from the options given below:

**(1)** Compact inflorescence showing complete autogamy

**(2)** Wind pollinated plant inflorescence showing flowers with well exposed stamens

**(3)** Water pollinated flowers showing stamens with mucilaginous covering

**(4)** Cleistogamous flowers showing autogamy

**Correct Answer:** **(2)** Wind pollinated plant inflorescence showing flowers with well exposed stamens

**Solution:** The figure shows an inflorescence with well exposed stamens, characteristic of wind-pollinated plants. These plants typically exhibit features that facilitate the dispersal of pollen by wind, such as exposed stamens to enhance pollen release.

Quick Tip

Wind-pollinated plants are typically characterized by their unassuming flowers lacking bright colors or strong scents, as they do not rely on attracting pollinators.

---

**138. Spraying sugarcane crop with which of the following plant growth regulators increases the length of stem, thus, increasing the yield?**

Choose the correct answer from the options given below:

**(1)** Abscisic acid

**(2)** Auxin

**(3)** Gibberellin

**(4)** Cytokinin

**Correct Answer: (3)** Gibberellin

**Solution:** Gibberellin is known to promote stem elongation, thus when sprayed on sugarcane, it increases the length of the stem, potentially enhancing the crop yield.

Quick Tip

Gibberellins are particularly effective in breaking seed dormancy and in stimulating growth in stem and leaves.

---

**139. In an ecosystem if the Net Primary Productivity (NPP) of the first trophic level is 100x (kcal $m^{-2}$ $yr^{-1}$), what would be the GPP (Gross Primary Productivity) of the third trophic level of the same ecosystem?**

Choose the correct answer from the options given below:

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

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

**(3)** $3x$ (kcal $m^{-2}$ $yr^{-1}$)

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

**Correct Answer: (4)** $10x$ (kcal $m^{-2}$ $yr^{-1}$)

**Solution:** Assuming energy transfer efficiency and biomass conversion are typical, the productivity decreases as energy moves up trophic levels, but this question likely intends to explore theoretical or erroneous conceptual understanding as GPP typically relates only to primary producers, not third trophic levels.

Quick Tip

Typically, GPP is discussed only at the level of primary producers; trophic levels beyond do not have a ”GPP” as they do not produce biomass through photosynthesis.

---

**140. Which of the following are fused in somatic hybridization involving two varieties of plants?**

Choose the correct answer from the options given below:

**(1)** Pollens

**(2)** Callus

**(3)** Somatic embryos

**(4)** Protoplasts

**Correct Answer:** **(4)** Protoplasts

**Solution:** In somatic hybridization, protoplasts (cells with their cell walls removed) from two different plant varieties are fused to combine their genetic material, potentially creating a new hybrid plant.

Quick Tip

Somatic hybridization is a form of genetic engineering used to produce hybrids that might not be possible through conventional breeding methods.

---

**141. Match List I with List II:**

**List I**

A. Monoadelphous

B. Diadelphous

C. Polyadelphous

D. Epiphyllous

**List II**

I. Citrus

II. Pea

III. Lily

IV. China-rose

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-I: Monoadelphous stamens are found in Citrus, where stamens are united into one group.
- B-II: Diadelphous stamens, where stamens are united into two groups, are characteristic of Pea.
- C-III: Polyadelphous stamens, divided into many groups, can be seen in Lily.
- D-IV: Epiphyllous stamens, where stamens are attached to petals, are seen in China-rose.

Quick Tip

Understanding the floral structure and its variations across different plants helps in identifying and classifying them.

---

**142. Which of the following statement is correct regarding the process of replication in *E. coli*?**

Choose the correct answer from the options given below:

**(1)** The DNA dependent DNA polymerase catalyses polymerization in 5' $\rightarrow$ 3' direction

**(2)** The DNA dependent DNA polymerase catalyses polymerization in one direction that is 3' $\rightarrow$ 5'

**(3)** The DNA dependent RNA polymerase catalyses polymerization in one direction, that is 5' $\rightarrow$ 3'

**(4)** The DNA dependent DNA polymerase catalyses polymerization in 5' $\rightarrow$ 3' as well as 3' $\rightarrow$ 5' direction

**Correct Answer: (3)** The DNA dependent RNA polymerase catalyses polymerization in one direction, that is 5' $\rightarrow$ 3'

**Solution:** The correct statement is that DNA dependent RNA polymerase synthesizes RNA in the 5' $\rightarrow$ 3' direction during transcription. DNA dependent DNA polymerase also synthesizes DNA in the 5' $\rightarrow$ 3' direction during DNA replication.

Quick Tip

DNA replication and transcription involve polymerases that synthesize nucleic acids only in the 5' to 3' direction, adding nucleotides to the 3' end of the growing strand.

---

**143. Read the following statements and choose the set of correct statements:**

In the members of Phaeophyceae,

A. Asexual reproduction occurs usually by biflagellate zoospores.

B. Sexual reproduction is by oogamous method only.

C. Stored food is in the form of carbohydrates which is either mannitol or laminarin.

D. The major pigments found are chlorophyll a, c and carotenoids and xanthophyll.

E. Vegetative cells have a cellulosic wall, usually covered on the outside by gelatinous coating of algin.

Choose the correct answer from the options given below:

**(1)** A, B, C and E only

**(2)** A, B, C and D only

**(3)** B, C, D and E only

**(4)** A, C, D and E only

**Correct Answer:** **(4)** A, C, D and E only

**Solution:** A, C, D, and E are correct as they describe typical features of Phaeophyceae such as their mode of reproduction, storage food, pigment composition, and cell wall characteristics. Sexual reproduction via the oogamous method is not exclusive to Phaeophyceae, and thus statement B is not correct in specifying it as the only method.

Quick Tip

Phaeophyceae, or brown algae, exhibit a complex life cycle and diverse morphological features which are important for their identification and classification.

---

**144. Match List I with List II:**

**List I**

A. Robert May

B. Alexander von Humboldt

C. Paul Ehrlich

D. David Tilman

**List II**

I. Species-Area relationship

II. Long term ecosystem experiment using out door plots

III. Global species diversity at about 7 million

IV. Rivet popper hypothesis

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Robert May is known for his work estimating global species diversity.
- B-I: Alexander von Humboldt formulated the Species-Area relationship.
- C-IV: Paul Ehrlich is known for the Rivet popper hypothesis.
- D-II: David Tilman conducted long-term ecological experiments in outdoor plots.

**Quick Tip**

These figures have made significant contributions to ecological science, each adding valuable insights into biodiversity and ecosystem functioning.

---

**145. Match List I with List II:**

**List I**

A. Frederick Griffith

B. François Jacob  Jacque Monod

C. Har Gobind Khorana

D. Meselson  Stahl

**List II**

I. Genetic code

II. Semi-conservative mode of DNA replication

III. Transformation

IV. Lac operon

Choose the correct answer from the options given below:

**(1)** A-IV, B-I, C-I, D-IV

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

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

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

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

**Solution:**

- A-III: Frederick Griffith discovered the phenomenon of transformation.
- B-IV: François Jacob  Jacque Monod elucidated the control of gene expression by the Lac operon.
- C-I: Har Gobind Khorana made key contributions to understanding the genetic code.
- D-II: Meselson  Stahl demonstrated the semi-conservative mode of DNA replication.

**Quick Tip**

These key experiments and discoveries are foundational to modern genetics and molecular biology.

---

**146. Match List I with List II:**

**List I**

A. Rose

B. Pea

C. Cotton

D. Mango

**List II**

I. Twisted aestivation

II. Perigynous flower

III. Drupe

IV. Marginal placentation

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-II: Rose is known for its perigynous flowers.
- B-IV: Pea exhibits marginal placentation.
- C-I: Cotton has twisted aestivation.
- D-III: Mango is a type of drupe.

Quick Tip

Plant morphology and anatomy are crucial in botany for identifying and classifying different types of plants based on their reproductive and vegetative structures.

---

**147. The DNA present in chloroplast is:**

Choose the correct answer from the options given below:

**(1)** Circular, single stranded

**(2)** Linear, double stranded

**(3)** Circular, double stranded

**(4)** Linear, single stranded

**Correct Answer:** **(3)** Circular, double stranded

**Solution:** The DNA found in chloroplasts is typically circular and double-stranded, similar to bacterial DNA, reflecting their evolutionary origins from endosymbiotic bacteria.

Quick Tip

Chloroplast DNA is important for many processes within the organelle, including photosynthesis.

---

**148. Match List-I with List-II:**

**List I**

A. GLUT-4

B. Insulin

C. Trypsin

D. Collagen

**List II**

I. Hormone

II. Enzyme

III. Intercellular ground substance

IV. Enables glucose transport into cells

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-IV: GLUT-4 is a glucose transporter protein that facilitates glucose transport into cells.
- B-I: Insulin is a hormone that regulates blood glucose levels.
- C-II: Trypsin is an enzyme that breaks down proteins in the digestive system.
- D-III: Collagen is an intercellular ground substance that provides structural support in connective tissues.

Quick Tip

Understanding the functions of these biological molecules is fundamental in fields such as medicine, biochemistry, and molecular biology.

---

**149. Given below are two statements:**

**Statement I:** In C3 plants, some $O_2$ binds to RuBisCO, hence $CO_2$ fixation is decreased.

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

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

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer: (4)** Statement I is true but Statement II is false

**Solution:** Statement I is true as $O_2$ binding to RuBisCO in C3 plants indeed leads to decreased $CO_2$ fixation through a process called photorespiration. Statement II is false because in C4 plants, mesophyll cells do engage in the Calvin cycle but with a reduced rate of photorespiration due to the spatial separation of the initial $CO_2$ fixation and the Calvin cycle.

**Quick Tip**

The efficiency of photosynthesis in C3 and C4 plants is significantly affected by how they manage photorespiration and $CO_2$ fixation.

---

**150. Identify the step in tricarboxylic acid cycle, which does not involve oxidation of substrate.**

Choose the correct answer from the options given below:

**(1)** Isocitrate $\rightarrow$ -ketoglutaric acid

**(2)** Malic acid $\rightarrow$ Oxaloacetic acid

**(3)** Succinic acid $\rightarrow$ Malic acid

**(4)** Succinyl-CoA $\rightarrow$ Succinic acid

**Correct Answer: (4)** Succinyl-CoA $\rightarrow$ Succinic acid

**Solution:** The conversion of Succinyl-CoA to Succinic acid involves the cleavage of a CoA group without the oxidation of the succinyl group, which is coupled with the

phosphorylation of GDP to GTP (or ADP to ATP).

**Quick Tip**

This step in the Krebs cycle is a substrate-level phosphorylation where energy is conserved directly in the form of GTP or ATP.

---

## ZOOLOGY

## SECTION-A

**151. Match List I with List II:**

**List I**

A. Down's syndrome

B. $\alpha - Thalassemia$

C. $\beta - Thalassemia$

D. Klinefelter's syndrome

**List II**

I. 11th chromosome

II. 'X' chromosome

III. 21st chromosome

IV. 16th chromosome

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Down's syndrome is associated with an extra copy of chromosome 21.

- B-IV: -Thalassemia involves mutations in genes on chromosome 16.
- C-I: -Thalassemia involves mutations in genes on chromosome 11.
- D-II: Klinefelter's syndrome is characterized by one or more extra 'X' chromosomes in males.

**Quick Tip**

Genetic disorders can often be traced to specific chromosomal abnormalities, which help in their diagnosis and understanding of the condition.

---

**152. Match List I with List II:**

**List I**

A. Axoneme

B. Cartwheel pattern

C. Crista

D. Satellite

**List II**

I. Centriole

II. Cilia and flagella

III. Chromosome

IV. Mitochondria

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-II: The axoneme is the central shaft of cilia and flagella, consisting of microtubules in a '9+2' arrangement.
- B-I: The cartwheel pattern is characteristic of the centriole structure.
- C-IV: Cristae are the folds of the inner mitochondrial membrane.
- D-III: Satellites are often associated with specific regions on chromosomes.

**Quick Tip**

Understanding cellular structures is crucial for insights into their functions and roles in various cellular processes.

---

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

**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.

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

**(1)** A is false but R is true

**(2)** Both A and R are true and R is the correct explanation of A

**(3)** Both A and R are true but R is NOT the correct explanation of A

**(4)** A is true but R is false

**Correct Answer: (1)** A is false but R is true

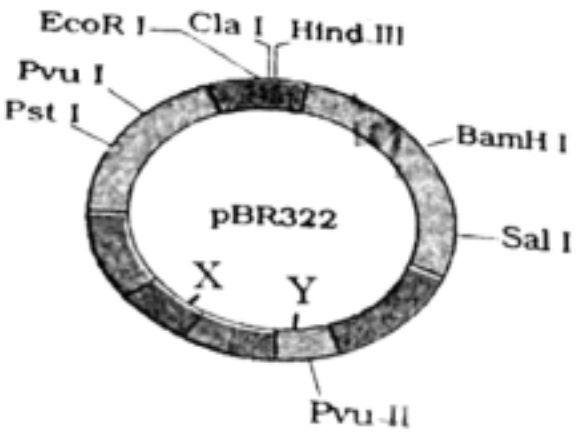
**Solution:** FSH acts on the Sertoli cells in males, not Leydig cells. It is true that growing ovarian follicles secrete estrogen in females. Therefore, while R is true, A is incorrect as it incorrectly identifies the cell type acted upon by FSH in males.

Quick Tip

Correct understanding of hormone interactions with specific cell types is critical for comprehending endocrine system functions.

---

**154. The following diagram showing restriction sites in *E. coli* cloning vector pBR322. Find the role of 'X' and 'Y' genes:**




**(1)** Gene 'X' is responsible for recognition sites and 'Y' is responsible for antibiotic resistance.

**(2)** The gene 'X' is responsible for resistance to antibiotics and 'Y' for protein involved in the replication of the plasmid.

**(3)** The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

**(4)** The gene 'X' is for protein involved in replication of Plasmid and 'Y' for resistance to antibiotics.

**Correct Answer: (3)** The gene 'X' is responsible for controlling the copy number of the linked DNA and 'Y' for protein involved in the replication of Plasmid.

**Solution:** In the pBR322 plasmid, gene 'X' typically encodes functions that control the plasmid's copy number, ensuring the plasmid is replicated within the host. Gene 'Y' often encodes proteins essential for the replication process of the plasmid itself, facilitating its maintenance in the bacterial cell.

Quick Tip

Understanding the functional roles of genes in plasmid vectors is crucial for effective genetic engineering and biotechnology applications.

---

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

**Assertion A:** The presence or absence of hymen is not a reliable indicator of virginity.

**Reason R:** The hymen is torn during the first coitus only.

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

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer: (4)** Statement I is true but Statement II is false

**Solution:** The presence or absence of the hymen is not a reliable indicator of virginity as it can be torn due to various non-sexual activities as well. The hymen may not necessarily be torn during the first coitus, making Statement II false.

Quick Tip

Medical myths surrounding the hymen are widespread and often contribute to misconceptions about female virginity.

---

**156. Which one is the correct product of DNA dependent RNA polymerase to the given template?**

Given template: 3'TACATGGAAAATTACCTTCA5'

Choose the correct answer from the options given below:

**(1)** 5'ATGTACCTTTTAATGGAGT3'

**(2)** 5'AUGUACCUUUUAAUGGAAGU3'

**(3)** 5'AUGAAAGUUUAUGGUAGAGU3'

**(4)** 5'AUGUACCGUUUAUAGGGAGU3'

**Correct Answer: (2)** 5'AUGUACCUUUUAAUGGAAGU3'

**Solution:** RNA polymerase synthesizes RNA by reading the DNA template strand in the 3' to 5' direction, creating an RNA strand that is complementary and antiparallel to the template. The RNA sequence provided in option 2 is the correct transcription of the given DNA template.

Quick Tip

Understanding transcription fundamentals is key in genetics, aiding in everything from basic biology to advanced genetic engineering.

---

**157. Match List I with List II:**

**List I**

A. *Pterophyllum*

B. *Myxine*

C. *Pristis*

D. *Exocoetus*

**List II**

I. Hag fish

II. Saw fish

III. Angel fish

IV. Flying fish

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: *Pterophyllum* is commonly known as the angel fish.
- B-I: *Myxine* is commonly known as the hag fish.
- C-II: *Pristis* is commonly known as the saw fish.
- D-IV: *Exocoetus* is commonly known as the flying fish.

Quick Tip

Matching organisms with their common names enhances understanding of biodiversity and aids in biological studies.

---

**158. Which of the following is not a natural/traditional contraceptive method?**

Choose the correct answer from the options given below:

**(1)** Vaults

**(2)** Coitus interruptus

**(3)** Periodic abstinence

**(4)** Lactational amenorrhea

**Correct Answer:** **(1)** Vaults

**Solution:** Vaults, typically referred to as cervical caps, are barrier methods of contraception and not considered a traditional or natural method, unlike the other options which involve behavioral approaches without the use of external devices.

Quick Tip

It is important to understand the various types of contraceptive methods to choose the most suitable one based on individual needs and circumstances.

---

**159. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on which segment?**

Choose the correct answer from the options given below:

**(1)** 11th segment

**(2)** 5th segment

**(3)** 10th segment

**(4)** 8th and 9th segment

**Correct Answer: (3)** 10th segment

**Solution:** Anal cerci are located on the 10th segment of a cockroach. They are sensory organs that can detect air movements, helping the cockroach respond to threats.

Quick Tip

Understanding the anatomy of common insects like cockroaches can provide insights into their behavior and ecology.

---

**160. Match List I with List II:**

**List I**

A. Pleurobrachia

B. Radula

C. Stomochord

D. Air bladder

**List II**

I. Mollusca

II. Ctenophora

III. Osteichthyes

IV. Hemichordata

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

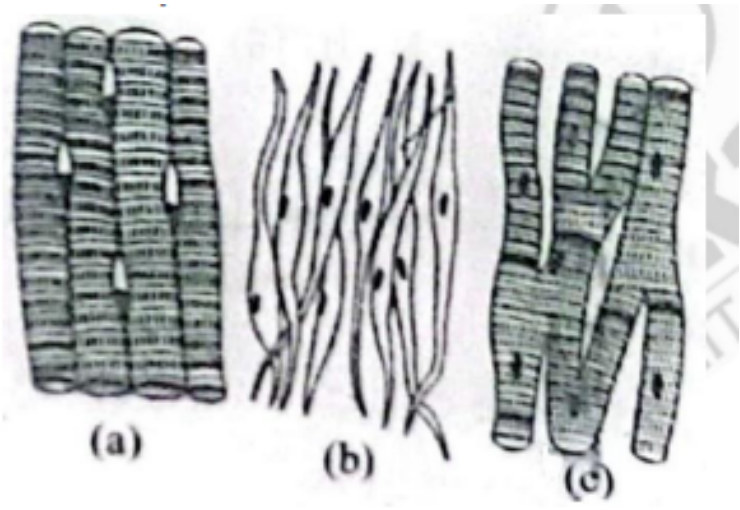
- A-II: Pleurobrachia belongs to the phylum Ctenophora, known for their distinctive comb rows.
- B-I: The radula is a characteristic feeding organ found in mollusks.
- C-IV: Stomochord is a feature of the phylum Hemichordata, reflecting its name.
- D-III: Air bladder, also known as a swim bladder, is an organ in many fish in the class Osteichthyes that helps control buoyancy.

**Quick Tip**

Matching anatomical features or organs with the correct animal groups helps in understanding biological diversity and phylogenetic relationships.

---

**161. Three types of muscles are given as a, b, and c. Identify the correct matching pair along with their location in human body:**




Name of muscle/location

**(1)** (a) Involuntary – Nose tip

**(2)** (a) Smooth – Toes

**(3)** (a) Skeletal – Triceps

**(4)** (a) Smooth – Heart

**Correct Answer: (3)** (a) Skeletal – Triceps, (b) Smooth – Stomach, (c) Cardiac – Heart

**Solution:** Muscle types and their locations are:

- (a) Skeletal – Triceps, primarily involved in arm movements.
- (b) Smooth – Stomach, involved in digestion through involuntary contractions.
- (c) Cardiac – Heart, specialized muscle tissue that makes up the heart and pumps blood.

Quick Tip

Different types of muscle tissues in the human body have specific functions and locations, crucial for their roles in bodily processes.

---

**162. Which of the following is not a component of Fallopian tube?**

Choose the correct answer from the options given below:

**(1)** Ampulla

**(2)** Uterine fundus

**(3)** Isthmus

**(4)** Infundibulum

**Correct Answer: (2)** Uterine fundus

**Solution:** The uterine fundus is part of the uterus, not the Fallopian tube. The Fallopian tube components include the ampulla, isthmus, and infundibulum.

Quick Tip

Understanding the anatomical structure of the female reproductive system aids in comprehending its function and related health issues.

---

**163. Which of the following factors are favourable for the formation of oxyhaemoglobin in alveoli?**

Choose the correct answer from the options given below:

**(1)** Low pCO2 and High temperature

**(2)** High pO2 and High pCO2

**(3)** High pO2 and Lesser H+ concentration

**(4)** Low pCO2 and High H+ concentration

**Correct Answer:** **(3)** High pO2 and Lesser H+ concentration

**Solution:** High partial pressure of oxygen (pO2) and lower hydrogen ion concentration (which indicates lesser acidity) in the alveoli favor the formation of oxyhaemoglobin. This ensures effective oxygen transport from the lungs to the tissues.

Quick Tip

The affinity of hemoglobin for oxygen increases in environments with high oxygen concentration and lower acidity, facilitating oxygen uptake.

---

**164. Following are the stages of pathway for conduction of an action potential through the heart:**

A. AV bundle

B. Purkinje fibres

C. AV node

D. Bundle branches

E. SA node

Choose the correct sequence of pathway from the options given below: **(1)** E-A-D-B-C

**(2)** E-C-A-D-B

**(3)** A-E-C-B-D

**(4)** B-D-E-C-A

**Correct Answer: (2)** E-C-A-D-B

**Solution:** The pathway of cardiac action potential starts at the SA node (E), then moves to the AV node (C), through the AV bundle (A), continues down the bundle branches (D), and finally spreads through the Purkinje fibers (B).

Quick Tip

The sequential activation of these structures ensures that the heart chambers contract in a coordinated manner, optimizing blood pumping efficiency.

---

**165. Match List I with List II:**

**List I**

A. Expiratory capacity

B. Functional residual capacity

C. Vital capacity

D. Inspiratory capacity

**List II**

I. Expiratory reserve volume + Tidal volume + Inspiratory reserve volume

II. Tidal volume + Expiratory reserve volume

III. Tidal volume + Inspiratory reserve volume

IV. Expiratory reserve volume + Residual volume

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-II: Expiratory capacity is the sum of the tidal volume and the expiratory reserve volume.
- B-IV: Functional residual capacity is the sum of the expiratory reserve volume and the residual volume.
- C-I: Vital capacity is the sum of the tidal volume, expiratory reserve volume, and inspiratory reserve volume.
- D-III: Inspiratory capacity is the sum of the tidal volume and the inspiratory reserve volume.

Quick Tip

Understanding lung capacities and volumes is essential for assessing respiratory health and diagnosing pulmonary disorders.

---

**166. Given below are some stages of human evolution. Arrange them in correct sequence. (Past to Recent)**

A. *Homo habilis*

B. *Homo sapiens*

C. *Homo neanderthalensis*

D. *Homo erectus*

Choose the correct sequence of human evolution from the options given below: **(1)** A-D-C-B

**(2)** D-A-C-B

**(3)** B-A-D-C

**(4)** C-B-D-A

**Correct Answer: (1)** A-D-C-B

**Solution:** The evolutionary timeline of Homo species starts with *Homo habilis* (A), followed

by *Homo erectus* (D), then *Homo neanderthalensis* (C), and finally *Homo sapiens* (B).

**Quick Tip**

Studying human evolution helps us understand the biological and cultural developments that define our species today.

---

**167. Match List I with List II:**

**List I**

A. Common cold

B. Haemozoin

C. Widal test

D. Allergy

**List II**

I. Plasmodium

II. Typhoid

III. Rhinoviruses

IV. Dust mites

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: The common cold is caused by Rhinoviruses.
- B-I: Haemozoin is a byproduct of hemoglobin digestion by Plasmodium, the malaria parasite.
- C-II: The Widal test is used to diagnose Typhoid fever.

- D-IV: Allergies can be triggered by Dust mites among other allergens.

**Quick Tip**

Understanding the causal relationships between diseases and pathogens or allergens is crucial for diagnosis and treatment.

---

**168. The flippers of the Penguins and Dolphins are the example of:**

Choose the correct answer from the options given below:

**(1)** Divergent evolution

**(2)** Adaptive radiation

**(3)** Natural selection

**(4)** Convergent evolution

**Correct Answer:** **(4)** Convergent evolution

**Solution:** The flippers of penguins and dolphins are an example of convergent evolution, where unrelated species evolve similar traits independently due to similar environmental pressures.

**Quick Tip**

Convergent evolution highlights how different organisms can develop analogous adaptations to cope with similar ecological niches or environmental challenges.

---

**169. Following are the stages of cell division:**

A. Gap 2 phase

B. Cytokinesis

C. Synthesis phase

D. Karyokinesis

E. Gap 1 phase

Choose the correct sequence of stages from the options given below: **(1)** E-C-A-D-B

**(2)** C-E-D-A-B

**(3)** E-B-D-A-C

**(4)** B-D-E-A-C

**Correct Answer:** **(1)** E-C-A-D-B

**Solution:** The correct sequence of cell division stages typically follows this order: Gap 1 phase (E), Synthesis phase (C), where DNA is replicated, followed by Gap 2 phase (A), Karyokinesis (D), where the nucleus divides, and finally Cytokinesis (B), where the cell splits into two.

Quick Tip

Understanding the stages of cell division is fundamental in cell biology, aiding in the comprehension of how cells grow, replicate, and maintain their genetic integrity.

---

**170. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?**

Choose the correct answer from the options given below:

**(1)** Constant gene pool

**(2)** Genetic recombination

**(3)** Genetic drift

**(4)** Gene migration

**Correct Answer:** **(1)** Constant gene pool

**Solution:** A constant gene pool, implying no change in allele frequencies due to absence of evolutionary forces, does not affect the Hardy-Weinberg equilibrium, which assumes such a state for its principle to apply.

Quick Tip

The Hardy-Weinberg principle is a key concept in population genetics, providing a foundation for understanding how populations evolve over time.

---

**171. Match List I with List II:**

**List I**

A. Pons

B. Hypothalamus

C. Medulla

D. Cerebellum

**List II**

I. Provides additional space for Neurons, regulates posture and balance.

II. Controls respiration and gastric secretions.

III. Connects different regions of the brain.

IV. Neuro secretory cells

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: The pons connects different regions of the brain.
- B-IV: The hypothalamus contains neurosecretory cells that regulate hormonal activities.
- C-II: The medulla controls respiration and gastric secretions.
- D-I: The cerebellum provides additional space for neurons and regulates posture and balance.

Quick Tip

Understanding the functions of different brain regions is crucial for the study of neurology and helps in diagnosing related disorders.

---

**172. Given below are two statements: One is labelled as Assertion and the other is labelled as Reason:**

**Assertion A:** Breast-feeding during initial period of infant growth is recommended by doctors for bringing a healthy baby.

**Reason R:** Colostrum contains several antibodies absolutely essential to develop resistance for the new born baby.

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

**(1)** A is not correct but R is correct

**(2)** Both A and R are correct and R is the correct explanation of A

**(3)** Both A and R are correct but R is NOT the correct explanation of A

**(4)** A is correct but R is not correct

**Correct Answer: (2)** Both A and R are correct and R is the correct explanation of A

**Solution:** Both statements are correct. Colostrum is highly beneficial for newborns as it contains antibodies that help in developing the baby's immune system, directly supporting the assertion that breast-feeding promotes a healthy baby.

Quick Tip

The early days of breastfeeding are crucial for the immune development of the baby, highlighting the importance of colostrum in infant diet.

---

**173. Match List I with List II:**

**List I**

A. Typhoid

B. Leishmaniasis

C. Ringworm

D. Filariasis

**List II**

I. Fungus

II. Nematode

III. Protozoa

IV. Bacteria

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-IV: Typhoid is caused by *Salmonella typhi*, which is a bacterium.
- B-III: Leishmaniasis is caused by *Leishmania* species, which are protozoa.
- C-I: Ringworm is a fungal infection, caused by a variety of fungi.
- D-II: Filariasis is caused by nematodes, specifically *Wuchereria bancrofti* and *Brugia malayi*.

Quick Tip

Correct identification of pathogens is crucial for the effective treatment of infectious diseases.

---

**174. Match List I with List II:**

**List I**

A. Cocaine

B. Heroin

C. Morphine

D. Marijuana

**List II**

I. Effective sedative in surgery

II. Cannabis sativa

III. Erythroxylum

IV. Papaver somniferum

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Cocaine is derived from the Erythroxylum plant.
- B-IV: Heroin is derived from Papaver somniferum, the opium poppy.
- C-I: Morphine, an effective sedative in surgery, is also derived from Papaver somniferum.
- D-II: Marijuana comes from Cannabis sativa.

Quick Tip

Knowledge of the origins of these substances helps in understanding their effects and applications in medicine and recreational use.

---

**175. Which of the following statements is incorrect?**

Choose the correct answer from the options given below:

**(1)** Bio-reactors have an agitator system, an oxygen delivery system and foam control system

**(2)** A bio-reactor provides optimal growth conditions for achieving the desired product

**(3)** Most commonly used bio-reactors are of stirring type

**(4)** Bio-reactors are used to produce small scale bacterial cultures

**Correct Answer: (4)** Bio-reactors are used to produce small scale bacterial cultures

**Solution:** Bio-reactors are typically used for large-scale production processes, not just small scale. They are designed to support the growth of organisms for the manufacturing of pharmaceuticals, chemicals, and food products among others.

Quick Tip

Understanding the scale and application of bioreactors is crucial for fields like biotechnology and pharmaceutical manufacturing.

---

**176. Match List I with List II:**

**List I**

A. – antitrypsin

B. Cry IAb

C. Cry IAc

D. Enzyme replacement therapy

**List II**

I. Cotton bollworm

II. ADA deficiency

III. Emphysema

IV. Corn borer

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III:  – antitrypsin is involved in treating emphysema.
- B-IV: Cry IAb targets the corn borer.
- C-I: Cry IAc targets the cotton bollworm.
- D-II: Enzyme replacement therapy is used for ADA deficiency.

Quick Tip

Biotechnology uses genetic engineering to create crops that produce their own pesticides and therapies that replace missing or defective proteins.

---

**177. Match List I with List II:**

**List I**

A. Non-medicated IUD

B. Copper releasing IUD

C. Hormone releasing IUD

D. Implants

**List II**

I. Multiload 375

II. Progestogens

III. Lippes loop

IV. LNG-20

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Non-medicated IUDs, such as the Lippes loop, do not release hormones or copper.
- B-I: Copper releasing IUDs, like the Multiload 375, release copper to increase contraceptive efficacy.
- C-IV: Hormone releasing IUDs, such as those containing LNG-20, release levonorgestrel to prevent pregnancy.
- D-II: Implants typically release progestogens to provide long-term contraception.

Quick Tip

Understanding different types of contraceptives and their mechanisms is essential for making informed choices about reproductive health.

---

**178. Match List I with List II:**

**List I**

A. Lipase

B. Nuclease

C. Protease

D. Amylase

**List II**

I. Peptide bond

II. Ester bond

III. Glycosidic bond

IV. Phosphodiester bond

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-II: Lipase breaks down fats which involve ester bonds.
- B-IV: Nuclease breaks down nucleic acids which involve phosphodiester bonds.
- C-I: Protease breaks down proteins which involve peptide bonds.
- D-III: Amylase breaks down starch which involves glycosidic bonds.

Quick Tip

Enzymes are specialized proteins that catalyze specific biochemical reactions, crucial for metabolism and other cellular functions.

---

**179. 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.

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

**(1)** Statement I is false but Statement II is true

**(2)** Both Statement I and Statement II are true

**(3)** Both Statement I and Statement II are false

**(4)** Statement I is true but Statement II is false

**Correct Answer: (3)** Both Statement I and Statement II are false

**Solution:** Statement I is incorrect as the descending limb of the loop of Henle is permeable

to water but not to electrolytes. Statement II is also incorrect; the proximal convoluted tubule is lined by simple cuboidal epithelium, not columnar.

**Quick Tip**

Understanding the structure and function of different parts of the nephron is vital for comprehending how the kidneys regulate body fluids and electrolytes.

---

**180. Match List I with List II:**

**List I**

A. Diakinesis

B. Pachytene

C. Zygotene

D. Leptotene

**List II**

I. Synaptonemal complex formation

II. Completion of terminalisation of chiasmata

III. Chromosomes look like thin threads

IV. Appearance of recombination nodules

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-II: Diakinesis is the stage where terminalisation of chiasmata is completed.
- B-IV: Pachytene is the stage where recombination nodules appear, indicating crossing over.

- C-I: Zygotene is marked by the formation of the synaptonemal complex.
- D-III: During Leptotene, chromosomes begin to condense and appear like thin threads.

**Quick Tip**

Each stage of prophase I of meiosis has distinct characteristics that are crucial for the successful completion of cell division.

---

**181. The "Ti plasmid" of *Agrobacterium tumefaciens* stands for:**

Choose the correct answer from the options given below:

**(1)** Temperature independent plasmid

**(2)** Tumour inhibiting plasmid

**(3)** Tumor independent plasmid

**(4)** Tumor inducing plasmid

**Correct Answer:** **(4)** Tumor inducing plasmid

**Solution:** The "Ti plasmid" in *Agrobacterium tumefaciens* stands for "tumor inducing" plasmid. This plasmid is responsible for transferring some of its DNA to plant cells, causing them to form tumors (crown galls).

**Quick Tip**

The ability of *Agrobacterium tumefaciens* to transfer DNA to plant cells has been harnessed in biotechnology to create genetically modified plants.

---

**182. Match List I with List II:**

**List I**

A. Fibrous joints

B. Cartilaginous joints

C. Hinge joints

D. Ball and socket joints

**List II**

I. Adjacent vertebrae, limited movement

II. Humerus and Pectoral girdle, rotational movement

III. Skull, don't allow any movement

IV. Knee, help in locomotion

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Fibrous joints are found in the skull where they don't allow any movement.
- B-I: Cartilaginous joints in adjacent vertebrae allow limited movement.
- C-IV: Hinge joints like those in the knee help in locomotion.
- D-II: Ball and socket joints such as those between the humerus and pectoral girdle allow rotational movement.

Quick Tip

Understanding the types of joints and their locations helps in studying human anatomy and movements.

---

**183. Which of the following are Autoimmune disorders?**

A. Myasthenia gravis

B. Rheumatoid arthritis

C. Gout

D. Muscular dystrophy

E. Systemic Lupus Erythematosus (SLE)

choose the most appropriate answer from the options given below:

**(1)** C, D  E only

**(2)** A, B  D only

**(3)** A, B  E only

**(4)** B, C  E only

**Correct Answer: (3)** A, B  E only

**Solution:**

- A, Myasthenia gravis; B, Rheumatoid arthritis; and E, Systemic Lupus Erythematosus are all autoimmune disorders where the body's immune system mistakenly attacks its own tissues.
- C, Gout, and D, Muscular dystrophy, are not autoimmune diseases.

Quick Tip

Recognizing autoimmune disorders is important for diagnosis and treatment, as these conditions often require immune system modulation.

---

**184. Consider the following statements:**

A. Annelids are true coelomates

B. Poriferans are pseudocoelomates

C. Aschelminthes are acoelomates

D. Platyhelminthes are pseudocoelomates

Choose the correct answer from the options given below:

**(1)** D only

**(2)** B only

**(3)** A only

**(4)** C only

**Correct Answer:** **(3)** A only

**Solution:** Statement A is correct as annelids, like earthworms, are indeed true coelomates with a body cavity completely lined by mesoderm. Statements B, C, and D are incorrect as poriferans lack a body cavity, aschelminthes are pseudocoelomates, and platyhelminthes are acoelomates.

Quick Tip

Understanding the classifications of organisms based on their body cavity development is crucial in zoology and helps in comprehending their evolutionary relationships.

---

**185. Which of the following is not a steroid hormone?**

Choose the correct answer from the options given below:

**(1)** Glucagon

**(2)** Cortisol

**(3)** Testosterone

**(4)** Progesterone

**Correct Answer:** **(1)** Glucagon

**Solution:** Glucagon is a peptide hormone, not a steroid hormone. It is produced by the pancreas and raises blood glucose levels. Cortisol, testosterone, and progesterone are all steroid hormones.

Quick Tip

Understanding different types of hormones and their chemical structures is important for studying their functions and effects in the body.

---

**SECTION-B**

**186. Match List I with List II:**

**List I**

A. RNA polymerase III

B. Termination of transcription

C. Splicing of Exons

D. TATA box

**List II**

I. snRNPs

II. Promoter

III. Rho factor

IV. SnRNAs, tRNA

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-IV: RNA polymerase III synthesizes snRNAs and tRNA.
- B-III: Termination of transcription in prokaryotes often involves the Rho factor.
- C-I: Splicing of exons is facilitated by snRNPs.
- D-II: The TATA box is a promoter element.

Quick Tip

Matching molecular biology concepts with their functions provides a foundational understanding of gene expression and regulation.

---

**187. Choose the correct statement given below regarding juxta medullary nephron.**

Choose the correct answer from the options given below:

**(1)** Juxta medullary nephrons outnumber the cortical nephrons. **(2)** Juxta medullary nephrons are located in the columns of Bertini. **(3)** Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla. **(4)** Loop of Henle of juxta medullary nephron runs deep into medulla.

**Correct Answer:** **(4)** Loop of Henle of juxta medullary nephron runs deep into medulla.

**Solution:** The statement is correct because the juxta medullary nephrons have long loops of Henle that extend deeply into the medulla, which is essential for the process of urine concentration.

Quick Tip

Understanding the structure and function of different types of nephrons is crucial for comprehending how kidneys concentrate urine and regulate water and salt balance.

---

**188. The following are the statements about non-chordates:**

A. Pharynx is perforated by gill slits.

B. Notochord is absent.

C. Central nervous system is dorsal.

D. Heart is dorsal if present.

E. Post anal tail is absent.

choose the most appropriate answer from the options given below:

**(1)** C, B  D only **(2)** A  C only **(3)** A, B  D only **(4)** B, D  E only

**Correct Answer:** **(4)** B, D  E only

**Solution:**

- B, D, and E are correct as non-chordates typically lack a notochord, have a dorsal heart if present, and do not have a post-anal tail.
- A is incorrect as non-chordates do not have pharynx perforated by gill slits.

- C is incorrect because non-chordates generally have a ventral nervous system.

Quick Tip

Understanding the basic anatomical and physiological traits of chordates and non-chordates helps in distinguishing between these two groups in the animal kingdom.

---

**189. 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:**

choose the most appropriate answer from the options given below:

**(1)** D  E only **(2)** A only **(3)** B only **(4)** C  B only

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

**Solution:**

- The possible genotypes for the father (B+) could be IBi or IBIB, and for the mother (A+) could be IAi or IAIA. The child being O- must have the genotype ii, which indicates both parents must carry an i allele, hence father IBi and mother IAi.

Quick Tip

Understanding genetics and inheritance patterns such as those in the ABO blood group system is essential for fields like genetics, medicine, and forensic science.

---

**190. Match List I with List II:**

**List I**

A. P wave

B. QRS complex

C. T wave

D. T-P gap

**List II**

I. Heart muscles are electrically silent.

II. Depolarisation of ventricles.

III. Depolarisation of atria.

IV. Repolarisation of ventricles.

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: The P wave represents depolarisation of the atria.
- B-II: The QRS complex represents depolarisation of the ventricles.
- C-IV: The T wave represents repolarisation of the ventricles.
- D-I: The T-P gap is a period when the heart muscles are electrically silent.

Quick Tip

Understanding the electrical activity of the heart as represented in an ECG is crucial for diagnosing heart conditions and monitoring cardiac health.

---

**191. 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.

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

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

**Correct Answer:** **(2)** Both Statement I and Statement II are correct.

**Solution:**

- Statement I is correct as bone marrow is indeed the primary site for the production of all types of blood cells, including lymphocytes.
- Statement II is also correct because the bone marrow provides the environment for B-lymphocyte development, and the thymus is crucial for T-lymphocyte maturation.

Quick Tip

The bone marrow and thymus are essential components of the immune system, each playing specialized roles in cellular immunity.

---

**192. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis.**

GnRH $\rightarrow$ LH $\downarrow$

(A) $\rightarrow$ (B) $\rightarrow$ Androgens $\rightarrow$ (C) $\rightarrow$ Formation of spermatids $\rightarrow$ (D)

choose the most appropriate answer from the options given below:

**(1)** ICSH, Leydig cells, Sertoli cells, spermatogenesis. **(2)** FSH, Leydig cells, Sertoli cells, spermatogenesis. **(3)** ICSH, Interstitial cells, Leydig cells, spermiogenesis. **(4)** FSH, Sertoli cells, Leydig cells, spermatogenesis.

**Correct Answer:** **(2)** FSH, Leydig cells, Sertoli cells, spermatogenesis.

**Solution:**

- GnRH stimulates the release of LH.
- (A) FSH stimulates the Sertoli cells.
- (B) Leydig cells produce androgens under the influence of LH.

- (C) Androgens act on Sertoli cells to promote spermatogenesis.
- (D) The final result is the formation of spermatids.

**Quick Tip**

Understanding the hormonal control of spermatogenesis is vital for comprehending reproductive biology and the interplay between different hormones and cells in the testes.

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**193. Match List I with List II:**

**List I**

A. Exophthalmic goiter

B. Acromegaly

C. Cushing's syndrome

D. Cretinism

**List II**

I. Excess secretion of cortisol, moon face & hyperglycemia.

II. Hypo-secretion of thyroid hormone and stunted growth.

III. Hyper secretion of thyroid hormone & protruding eye balls.

IV. Excessive secretion of growth hormone.

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: Exophthalmic goiter is characterized by hypersecretion of thyroid hormone leading to protruding eyeballs.
- B-IV: Acromegaly results from excessive secretion of growth hormone.

- C-I: Cushing's syndrome involves excessive cortisol secretion, causing moon face and hyperglycemia.
- D-II: Cretinism results from hypo-secretion of thyroid hormone, leading to stunted growth.

Quick Tip

Understanding hormonal disorders and their effects on the body provides insights into how hormonal imbalances impact overall health.

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**194. 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.

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

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

**Correct Answer: (4)** Statement I is correct but Statement II is incorrect.

**Solution:** Statement I is correct as the corpus callosum indeed connects the cerebral hemispheres. Statement II is incorrect because the brain stem does not include the cerebrum; it comprises the medulla oblongata, pons, and midbrain.

Quick Tip

Knowledge of brain anatomy is crucial for understanding its function and diagnosing neurological conditions accurately.

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**195. Given below are two statements:**

**Statement I:** Gause's competitive exclusion principle states that two closely related species competing for different resources cannot exist indefinitely.

**Statement II:** According to Gause's principle, during competition, the inferior will be eliminated. This may be true if resources are limiting.

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

**(1)** Statement I is false but Statement II is true.

**(2)** Both Statement I and Statement II are true.

**(3)** Both Statement I and Statement II are incorrect.

**(4)** Statement I is true but Statement II is false.

**Correct Answer:** **(1)** Statement I is false but Statement II is true.

**Solution:** Statement I is incorrect because Gause's principle states that two closely related species competing for the same resources cannot coexist indefinitely, not different resources. Statement II correctly interprets the principle in that competition where resources are limited typically results in the elimination of the inferior competitor.

Quick Tip

Understanding ecological principles such as competitive exclusion is vital for studying biodiversity, conservation, and the dynamics of ecosystems.

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**196. Match List I with List II:**

**List I**

A. Mesozoic Era

B. Proterozoic Era

C. Cenozoic Era

D. Paleozoic Era

**List II**

I. Lower invertebrates

II. Fish & Amphibia

III. Birds & Reptiles

IV. Mammals

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-III: The Mesozoic Era is known for the dominance of dinosaurs and the early evolution of birds and reptiles.
- B-I: The Proterozoic Era is known for the early development of life, including lower invertebrates.
- C-IV: The Cenozoic Era is known as the age of mammals.
- D-II: The Paleozoic Era is famous for the development of fish and amphibians.

Quick Tip

Understanding geological time scales and the dominant life forms of each era helps in studying the evolutionary biology and history of life on Earth.

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**197. Match List I with List II:**

**List I**

A. Unicellular glandular epithelium

B. Compound epithelium

C. Multicellular glandular epithelium

D. Endocrine glandular epithelium

**List II**

I. Salivary glands

II. Pancreas

III. Goblet cells of alimentary canal

IV. Moist surface of buccal cavity

Choose the correct answer from the options given below:

**(1)** A-I, B-I, C-IV, D-IV

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

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

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

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

**Solution:**

- A-III: Unicellular glandular epithelium like goblet cells are found in the alimentary canal.
- B-IV: Compound epithelium does not relate directly to glandular structures; however, it's involved in protective surfaces.
- C-I: Multicellular glandular epithelium, such as in the salivary glands, produces various secretions.
- D-II: Endocrine glandular epithelium, like that in the pancreas, secretes hormones directly into the blood.

Quick Tip

Recognizing different types of epithelial tissues and their functions is crucial for understanding human anatomy and physiology, especially in the context of glandular secretion.

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**198. Regarding catalytic cycle of an enzyme action, select the correct sequential steps:**

A. Substrate enzyme complex formation.

B. Freeze enzyme ready to bind with another substrate.

C. Release of products.

D. Chemical bonds of the substrate broken.

E. Substrate binding to active site.

Choose the correct answer from the options given below:

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

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

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

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

**Correct Answer:** **(2)** E, A, D, C, B

**Solution:** The correct sequence of enzyme action is:

- E: The substrate first binds to the enzyme's active site.
- A: This binding leads to the formation of a substrate-enzyme complex.
- D: Chemical bonds within the substrate are then broken down.
- C: The products of the reaction are released.
- B: The enzyme is now free and ready to bind with another substrate, restarting the cycle.

Quick Tip

Understanding the steps involved in enzyme catalysis is fundamental to biochemistry and molecular biology, providing insights into how biological reactions are facilitated.

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**199. Match List I with List II related to digestive system of cockroach:**

**List I**

A. The structures used for storing of food

B. Ring of 6-8 blind tubules at junction of foregut and midgut.

C. Ring of 100-150 yellow coloured thin filaments at junction of midgut and hindgut.

D. The structures used for grinding the food.

**List II**

I. Gizzard

II. Gastric Caeca

III. Malpighian tubules

IV. Crop

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution:**

- A-IV: The crop is used for storing food in the cockroach.
- B-II: Gastric caeca are found at the junction of the foregut and midgut, aiding in secretion and digestion.
- C-III: Malpighian tubules, located at the junction of the midgut and hindgut, help in excretion.
- D-I: The gizzard is used for grinding the food.

Quick Tip

Understanding the anatomical features and functions of the cockroach's digestive system can provide insights into the broader category of insect physiology.

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**200. Given below are two statements:**

**Statement I:** Mitochondria and chloroplasts both have double membranes bound organelles.

**Statement II:** Inner membrane of mitochondria is relatively less permeable, as compared to chloroplast.

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

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

**Correct Answer: (4)** Statement I is correct but Statement II is incorrect.

**Solution:**

- Statement I is correct as both mitochondria and chloroplasts are double-membraned organelles, which is fundamental to their functions in cellular respiration and photosynthesis, respectively.
- Statement II is incorrect because the inner membrane of mitochondria is actually highly impermeable, which is essential for establishing the proton gradient necessary for ATP synthesis, while the inner membranes of chloroplasts, involved in the light reactions of photosynthesis, must allow for more permeability to facilitate the movement of ions and molecules necessary for the light-dependent reactions.

**Quick Tip**

Understanding the structural and functional aspects of cell organelles like mitochondria and chloroplasts is crucial for grasping key concepts in cell biology and bioenergetics.

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