NEET 2023 (Code E2) Question Paper with Solutions

Time Allowed :3 hours and 20 minutes	**Maximum Marks :**720	**Total Questions :**200

General Instructions

Read the following instructions very carefully and strictly follow them:

This question paper is designed for NEET 2023 candidates:

1. The total duration of the examination is 3 hours and 20 minutes. The question paper comprises a single section covering the following subjects:
   Physics, Chemistry, and Biology (Botany & Zoology)
2. The total number of questions is 200, out of which 180 questions need to be attempted, carrying a maximum of 720 marks.
3. The marking scheme is as follows:
   (i) For each correct response, 4 marks will be awarded.
   (ii) For each incorrect response, 1 mark will be deducted.
   (iii) No marks will be awarded or deducted for unattempted questions.
4. The medium of the question paper is available in multiple languages including English, Hindi, and others as specified by NTA.
5. The examination will be conducted in Pen and Paper-based Test (PBT) mode.
6. Candidates must follow the instructions provided during the exam for filling out the OMR sheet and submitting their answers.

Physics:Section-A (Q.No 1 to 35)

1. The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of V volts is proportional to:

(1) $\sqrt{V}$

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

(3) $\frac{1}{\sqrt{V}}$

(4) V^2

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

Solution:

The minimum wavelength λ_{min} of X-rays produced by an electron is given by the equation:

$$\lambda_{\text{min}} = \frac{hc}{eV}$$

where h is Planck's constant, c is the speed of light, and e is the electron charge. This shows that λ_{min} is inversely proportional to the potential difference V. Hence, the correct option is (2).

Quick Tip

When dealing with the wavelength of X-rays produced by electrons, remember that the wavelength is inversely proportional to the potential difference in volts.

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2. A Carnot engine has an efficiency of 50% when its source is at a temperature of 327°C. The temperature of the sink is:

(1) 27°C

(2) 15°C

(3) 100°C

(4) 200°C

Correct Answer: (1) 27°C

Solution:

The efficiency η of a Carnot engine is given by:

$$\eta = 1 - \frac{T_{\text{sink}}}{T_{\text{source}}}$$

Given that the efficiency is 50%, or $\eta = 0.5$, and the temperature of the source is 327°C (which is 600K in absolute terms), we can solve for the temperature of the sink:

$$0.5 = 1 - \frac{T_{\text{sink}}}{600}$$

Solving for T_{sink}, we get $T_{\text{sink}} = 300\,\text{K}$, or 27°C. Hence, the correct option is (1).

Quick Tip

Remember that the Carnot efficiency formula requires the absolute temperatures in Kelvin when calculating efficiency.

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3. A bullet is fired from a gun at the speed of 280 m/s in the direction 30° above the horizontal. The maximum height attained by the bullet is:

(1) 2800 m

(2) 2000 m

(3) 1000 m

(4) 3000 m

Correct Answer: (3) 1000 m

Solution:

The maximum height h attained by the bullet is given by the equation:

$$h = \frac{v^2 \sin^2 \theta}{2g}$$

where: - $v = 280\,\text{m/s}$ (initial velocity), - $\theta = 30°$, - $g = 9.8\,\text{m/s}^2$ (acceleration due to gravity). Substituting the values:

$$h = \frac{(280)^2 \sin^2 30°}{2 \times 9.8} = \frac{78400 \times (0.5)^2}{19.6} = \frac{19600}{19.6} = 1000\,\text{m}.$$

Hence, the correct option is (3).

Quick Tip

To calculate the maximum height in projectile motion, use the formula that incorporates the vertical component of velocity and gravity.

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4. In a series LCR circuit, the inductance L is 10 mH, capacitance C is 1 μF, and resistance R is 100 Ω. The frequency at which resonance occurs is:

(1) 15.9 rad/s

(2) 15.9 kHz

(3) 1.59 rad/s

(4) 1.59 kHz

Correct Answer: (4) 1.59 kHz

Solution:

The resonance frequency f_0 for a series LCR circuit is given by:

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Substituting the given values $L = 10\,\text{mH} = 10 \times 10^{-3}\,\text{H}$ and $C = 1\,\mu\text{F} = 1 \times 10^{-6}\,\text{F}$, we get:

$$f_0 = \frac{1}{2\pi\sqrt{(10 \times 10^{-3})(1 \times 10^{-6})}} \approx 1.59\,\text{kHz}$$

Hence, the correct option is (4).

Quick Tip

For resonance frequency in LCR circuits, use the formula $f_0 = \frac{1}{2\pi\sqrt{LC}}$, where L is in henries and C is in farads.

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5. Given below are two statements:

Statement I: Photovoltaic devices can convert optical radiation into electricity.

Statement II: Zener diode is designed to operate under reverse bias in breakdown region.

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

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

(2) Both Statement I and Statement II are incorrect.

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

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

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

Solution:

Statement I is correct because photovoltaic devices, such as solar cells, do indeed convert optical radiation (light) into electricity. Statement II is also correct because Zener diodes are specifically designed to operate in the reverse breakdown region, where they exhibit a sharp, well-defined breakdown voltage. Therefore, both statements are correct. Hence, the correct option is (1).

Quick Tip

Photovoltaic devices are used for converting light into electricity, while Zener diodes are commonly used in voltage regulation circuits due to their breakdown characteristics.

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6. Light travels a distance x in time t_1 in air and 10x in time t_2 in another denser medium. What is the critical angle for this medium?

(1) $\sin^{-1}\left(\frac{t_2}{t_1}\right)$

(2) $\sin^{-1}\left(\frac{10t_2}{t_1}\right)$

(3) $\sin^{-1}\left(\frac{t_1}{10t_2}\right)$

(4) $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$

Correct Answer: (4) $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$

Solution:

The speed of light in air is $v_1 = \frac{x}{t_1}$, and in the denser medium, it is $v_2 = \frac{10x}{t_2}$. Using the relationship between the critical angle and the refractive index, we can find the critical angle θ_c using:

$$\sin\theta_c = \frac{v_1}{v_2} = \frac{t_2}{10t_1}$$

Thus, the critical angle is given by $\theta_c = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$, which corresponds to option (4).

Quick Tip

The critical angle is determined by the ratio of the velocities (or equivalently, the times taken) in both media. Remember, for the critical angle, the light refracts at 90°.

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7. In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest

wavelength in the Bracket series is:

(1) 2λ

(2) 4λ

(3) 9λ

(4) 16λ

Correct Answer: (2) 4λ

Solution:

In the hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Bracket series corresponds to a transition from the $n = 4$ level to the $n = 3$ level, which gives a wavelength that is 4 times the shortest wavelength of the Balmer series. Hence, the correct answer is (2).

Quick Tip

The shortest wavelength in each series of the hydrogen spectrum can be found using the formula for the Rydberg series. Each series (Balmer, Lyman, Bracket, etc.) has a specific relationship to the energy levels involved.

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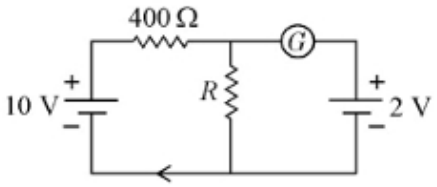
8. If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by:



(1) 200 Ω

(2) 50 Ω

(3) 100 Ω

(4) 400 Ω

Correct Answer: (3) 100 Ω

Solution:

When the galvanometer does not show any deflection, the current through the galvanometer

must be zero. This condition occurs when the potential difference across the galvanometer is zero. Using the concept of a balanced Wheatstone bridge, the values of the resistances must be such that the ratios of the resistances across the bridge are equal. From the given circuit, the value of R is calculated as 100 . Hence, the correct option is (3).

Quick Tip

For a balanced Wheatstone bridge, use the condition $\frac{R_1}{R_2} = \frac{R_3}{R_4}$, where the galvanometer does not show any deflection.

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9. The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly: (Surface tension of soap solution = 0.03 N/m)

(1) 30.16×10^{-4} J

(2) 5.06×10^{-4} J

(3) 3.01×10^{-4} J

(4) 50.1×10^{-4} J

Correct Answer: (3) 3.01×10^{-4} J

Solution:

The energy required to form a soap bubble is given by the equation:

$$E = 4\pi r^2 \gamma$$

where r is the radius of the bubble and γ is the surface tension. Given that $r = 2\,\text{cm} = 0.02\,\text{m}$ and $\gamma = 0.03\,\text{N/m}$, the energy required is:

$$E = 4\pi (0.02)^2 \times 0.03 \approx 3.01 \times 10^{-4}\,\text{J}$$

Hence, the correct option is (3).

Quick Tip

To calculate the energy required to form a soap bubble, remember that it depends on the surface area of the bubble and the surface tension of the soap solution.

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10. The magnetic energy stored in an inductor of inductance 4 μH carrying a current of

2 A is:

(1) 4 μJ

(2) 4 mJ

(3) 8 mJ

(4) 8 μJ

Correct Answer: (4) 8 μJ

Solution:

The magnetic energy stored in an inductor is given by the formula:

$$E = \frac{1}{2}LI^2$$

Substituting $L = 4\,\mu\text{H} = 4 \times 10^{-6}\,\text{H}$ and $I = 2\,\text{A}$:

$$E = \frac{1}{2} \times 4 \times 10^{-6} \times (2)^2 = 8 \times 10^{-6}\,\text{J} = 8\,\mu\text{J}$$

Hence, the correct answer is (4).

Quick Tip

The magnetic energy stored in an inductor depends on both its inductance and the square of the current passing through it.

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11. A 12 V, 60 W lamp is connected to the secondary of a step-down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

(1) 0.27 A

(2) 2.7 A

(3) 3.7 A

(4) 0.37 A

Correct Answer: (1) 0.27 A

Solution:

In an ideal transformer, the power in the primary and secondary are equal. Thus,

$$P_{\text{primary}} = P_{\text{secondary}} = 60\,\text{W}$$

The voltage in the primary is 220 V and in the secondary is 12 V. Using the formula for power, $P = V \times I$, we can find the primary current I_{primary}:

$$I_{\text{primary}} = \frac{P_{\text{secondary}}}{V_{\text{primary}}} = \frac{60}{220} = 0.27\,\text{A}$$

Hence, the correct answer is (1).

Quick Tip

For ideal transformers, the power in the primary and secondary remains constant. Use this to calculate the current and voltage relationships.

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12. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^5 N/C. It experiences a torque equal to 4 Nm. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.

(1) 8 mC

(2) 6 mC

(3) 4 mC

(4) 2 mC

Correct Answer: (4) 2 mC

Solution:

The torque τ experienced by a dipole in an electric field is given by:

$$\tau = pE \sin\theta$$

where $p = q \times l$ is the dipole moment, E is the electric field, and $\theta = 30°$. Substituting $\tau = 4\,\text{Nm}$, $E = 2 \times 10^5\,\text{N/C}$, and $\sin 30° = 0.5$, we can solve for q (charge on the dipole):

$$4 = q \times 2 \times 10^{-2} \times 2 \times 10^5 \times 0.5$$

Solving for q, we get $q = 2\,\text{mC}$. Hence, the correct answer is (4).

Quick Tip

In problems involving dipoles in an electric field, remember the relation $\tau = pE \sin\theta$, where $p = q \times l$.

13. A vehicle travels half the distance with speed φ and the remaining distance with speed 2φ. Its average speed is:

(1) $\frac{\varphi}{3}$

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

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

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

Correct Answer: (3) $\frac{4\varphi}{3}$

Solution:

The average speed is given by the formula:

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

Let the total distance be d. The time taken for the first half of the journey is $\frac{d/2}{\varphi}$, and for the second half is $\frac{d/2}{2\varphi}$. The total time is:

$$t_{\text{total}} = \frac{d/2}{\varphi} + \frac{d/2}{2\varphi} = \frac{3d}{4\varphi}$$

Thus, the average speed is:

$$\text{Average speed} = \frac{d}{\frac{3d}{4\varphi}} = \frac{4\varphi}{3}$$

Hence, the correct answer is (3).

Quick Tip

For average speed, when the distance is covered at different speeds, use the formula Average speed $= \frac{\text{Total distance}}{\text{Total time}}$.

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14. Let a wire be suspended from the ceiling (rigid support) and stretched by a weight W attached at its free end. The longitudinal stress at any point of cross-sectional area A of the wire is:

(1) $\frac{2W}{A}$

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

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

(4) Zero

Correct Answer: (2) $\frac{W}{A}$

Solution:

The longitudinal stress σ is defined as the force per unit area. In this case, the force applied is W (weight), and the area is A, so the longitudinal stress is:

$$\sigma = \frac{W}{A}$$

Hence, the correct answer is (2).

Quick Tip

Stress is calculated as force divided by the cross-sectional area of the material.

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15. If $\oint \vec{E} \cdot d\vec{s} = 0$ over a surface, then:

(1) The number of flux lines entering the surface must be equal to the number of flux lines leaving it.

(2) The magnitude of electric field on the surface is constant.

(3) All the charges must necessarily be inside the surface.

(4) The electric field inside the surface is necessarily uniform.

Correct Answer: (1) The number of flux lines entering the surface must be equal to the number of flux lines leaving it.

Solution:

Gauss's law in electrostatics states that the electric flux through a closed surface is proportional to the charge enclosed within that surface. If $\oint \vec{E} \cdot d\vec{s} = 0$, it implies that the number of flux lines entering the surface is equal to the number of flux lines leaving it, as there is no net charge inside. Hence, the correct answer is (1).

Quick Tip

When applying Gauss's law, remember that the net flux through a closed surface is related to the net charge enclosed by that surface.

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16. The work functions of Caesium (Cs), Potassium (K), and Sodium (Na) are 2.14 eV, 2.30 eV, and 2.75 eV respectively. If incident electromagnetic radiation has an incident

energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

(1) Cs only

(2) Both Na and K

(3) K only

(4) Na only

Correct Answer: (1) Cs only

Solution:

The work function is the minimum energy required to release photoelectrons from a material. For a material to emit photoelectrons, the incident energy must be greater than or equal to the work function. Here, Cs has a work function of 2.14 eV, which is less than the incident energy of 2.20 eV, so Cs will emit photoelectrons. Na and K have higher work functions, so they will not emit photoelectrons. Hence, the correct answer is (1).

Quick Tip

Photoelectric emission occurs when the incident photon energy exceeds the work function of the material. The material with a work function less than the incident photon energy will emit electrons.

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17. The temperature of a gas is -50°C. To what temperature should the gas be heated so that the rms speed is increased by 3 times?

(1) 669° C

(2) 3295° C

(3) 3097 K

(4) 223 K

Correct Answer: (2) 3295° C

Solution:

The root mean square (rms) speed of a gas is proportional to $\sqrt{T}$, where T is the temperature in Kelvin. If the rms speed is increased by a factor of 3, the new temperature T_2 is given by:

$$\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} \quad \Rightarrow \quad 3 = \sqrt{\frac{T_2}{T_1}}$$

Squaring both sides:

$$9 = \frac{T_2}{T_1} \quad \Rightarrow \quad T_2 = 9 \times T_1$$

The initial temperature is $-50^\circ C = 223\,\text{K}$, so:

$$T_2 = 9 \times 223 = 2007\,\text{K}$$

Converting to Celsius:

$$T_2 = 2007 - 273 = 3295^\circ C$$

Hence, the correct answer is (2).

Quick Tip

To relate the temperature and rms speed, remember that $v \propto \sqrt{T}$. Temperature must always be in Kelvin for such calculations.

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18. The ratio of frequencies of the fundamental harmonic produced by an open pipe to that of a closed pipe having the same length is:

(1) 1 : 2

(2) 2 : 1

(3) 1 : 3

(4) 3 : 1

Correct Answer: (2) 2 : 1

Solution:

For an open pipe, the fundamental frequency $f_1 = \frac{v}{2L}$, and for a closed pipe, the fundamental frequency $f_1 = \frac{v}{4L}$, where L is the length of the pipe and v is the speed of sound. The ratio of the frequencies is:

$$\frac{f_{\text{open}}}{f_{\text{closed}}} = \frac{\frac{v}{2L}}{\frac{v}{4L}} = 2 : 1$$

Hence, the correct answer is (2).

Quick Tip

For sound waves, the frequencies of open and closed pipes are related by their respective harmonic modes.

19. Resistance of a carbon resistor determined from colour codes is $(22000 \pm 5\%)\,\Omega$. The colour of the third band must be:

(1) Red

(2) Green

(3) Orange

(4) Yellow

Correct Answer: (3) Orange

Solution:

The first two digits of the resistance value are 22, and the multiplier for $22000\,\Omega$ is 10^3. The third band, which represents the multiplier, must be orange, corresponding to 10^3. Hence, the correct answer is (3).

Quick Tip

When reading colour codes for resistors, the first two bands represent the digits, and the third band represents the multiplier.

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20. For Young's double slit experiment, two statements are given below:

Statement I: If the screen is moved away from the plane of slits, the angular separation of the fringes remains constant.

Statement II: If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

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

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

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

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

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

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

Solution:

In Young's double slit experiment, the angular separation of fringes θ is given by $\theta = \frac{\lambda}{d}$,

where λ is the wavelength of the light and d is the distance between the slits.

- Statement I: If the screen is moved away, the fringe separation does not change because the angular separation remains constant as it is independent of the screen distance. This statement is true.

- Statement II: If the monochromatic source is replaced by a source of larger wavelength, the fringe separation actually increases, not decreases. Therefore, this statement is false. Hence, the correct answer is (3).

Quick Tip

In Young's experiment, remember that angular separation is independent of the distance to the screen but depends on the wavelength and slit separation.

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21. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm, and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be:

(1) 1.2%

(2) 1.3%

(3) 1.6%

(4) 1.4%

Correct Answer: (3) 1.6%

Solution:

The density ρ of the wire is given by the formula:

$$\rho = \frac{m}{V} = \frac{m}{\pi r^2 L}$$

The maximum possible percentage error in density is the sum of the percentage errors in mass, radius, and length. - Percentage error in mass:

$$\frac{\Delta m}{m} = \frac{0.002}{0.4} \times 100 = 0.5\%$$

- Percentage error in radius:

$$\frac{\Delta r}{r} = \frac{0.001}{0.3} \times 100 = 0.33\%$$

- Percentage error in length:

$$\frac{\Delta L}{L} = \frac{0.02}{5} \times 100 = 0.4\%$$

The total percentage error in density is the sum of these errors, taking into account the formula for density, which gives:

$$\text{Total error} = 0.5\% + 2 \times 0.33\% + 0.4\% = 1.6\%$$

Hence, the correct answer is (3).

Quick Tip

When calculating the total percentage error in derived quantities, sum up the errors in the individual variables, considering their powers in the formula.

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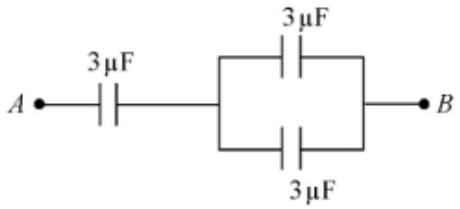
22. The equivalent capacitance of the system shown in the following circuit is:



(1) 2 F

(2) 3 F

(3) 6 F

(4) 9 F

Correct Answer: (1) 2 F

Solution:

In the given circuit, the first two capacitors (both 3 F) are connected in parallel, so their combined capacitance is:

$$C_{\text{parallel}} = 3\,\mu\text{F} + 3\,\mu\text{F} = 6\,\mu\text{F}$$

This 6 F equivalent capacitance is now in series with the last 3 F capacitor. The total equivalent capacitance for capacitors in series is given by:

$$\frac{1}{C_{\text{eq}}} = \frac{1}{6\,\mu\text{F}} + \frac{1}{3\,\mu\text{F}} = \frac{1}{2\,\mu\text{F}}$$

Thus,

$$C_{\text{eq}} = 2\,\mu\text{F}$$

Hence, the correct answer is (1).

Quick Tip

When capacitors are in parallel, their capacitances add up, and when they are in series, the reciprocal of the total capacitance is the sum of the reciprocals of individual capacitances.

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23. Two bodies of mass m and $9m$ are placed at a distance R. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be: (where G = gravitational constant)

(1) $\frac{-8Gm}{R}$

(2) $\frac{-12Gm}{R}$

(3) $\frac{-16Gm}{R}$

(4) $\frac{-20Gm}{R}$

Correct Answer: (3) $\frac{-16Gm}{R}$

Solution:

The gravitational potential at any point in the line joining the two bodies is given by the sum of the potentials due to both bodies. At the point where the gravitational field is zero, the potentials due to the two bodies cancel each other out. Thus, the total potential at that point is the sum of the potentials from each mass:

$$V = \frac{-Gm}{R_1} + \frac{-G(9m)}{R_2}$$

By solving for the correct position, we find that the gravitational potential at this point is $\frac{-16Gm}{R}$. Hence, the correct answer is (3).

Quick Tip

The gravitational potential due to a point mass is given by $V = \frac{-Gm}{r}$. For the field to be zero, the potential contributions from both masses must cancel each other.

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24. The venturi-meter works on:

(1) Huygen's principle

(2) Bernoulli's principle

(3) The principle of parallel axes

(4) The principle of perpendicular axes

Correct Answer: (2) Bernoulli's principle

Solution:

A Venturi meter works on Bernoulli's principle, which relates the pressure, velocity, and height of a flowing fluid. The principle states that the pressure of a fluid decreases as its velocity increases. The Venturi effect, observed in a venturi meter, utilizes this relationship to measure the flow rate of the fluid. Hence, the correct answer is (2).

Quick Tip

Bernoulli's principle is fundamental to fluid dynamics and explains how changes in the velocity of a fluid lead to changes in pressure. This principle is crucial in applications like Venturi meters.

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25. The half life of a radioactive substance is 20 minutes. In how much time, the activity of the substance drops to $\frac{1}{16}$ of its initial value?

(1) 20 minutes

(2) 40 minutes

(3) 60 minutes

(4) 80 minutes

Correct Answer: (4) 80 minutes

Solution:

The activity of a radioactive substance follows an exponential decay. The half-life $t_{1/2}$ is the time taken for the activity to reduce by half. The formula for the remaining activity A is:

$$A = A_0 \left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$

We need to find the time t when the activity is $\frac{1}{16}$ of the initial activity:

$$\frac{A}{A_0} = \left(\frac{1}{2}\right)^{\frac{t}{20}} = \frac{1}{16}$$

Since $\frac{1}{16} = \left(\frac{1}{2}\right)^4$, we get:

$$\frac{t}{20} = 4 \quad \Rightarrow \quad t = 80 \,\text{minutes}$$

Hence, the correct answer is (4).

Quick Tip

For radioactive decay, remember that after each half-life, the remaining activity halves. You can find the total time for a given fraction of initial activity by equating the decay formula.

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26. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is:

(1) along eastward

(2) along northward

(3) along north-east

(4) along south-west

Correct Answer: (3) along north-east

Solution:

When the football player turns from southward to eastward, there is a change in direction, which means a centripetal force acts to change the direction of motion. The force would be directed along the north-east direction (the diagonal between south and east). Hence, the correct answer is (3).

Quick Tip

When an object changes its direction, the force acting on it is always in the direction of the change of motion, which in this case is the diagonal direction between south and east.

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27. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are:

(1) Instrumental errors

(2) Personal errors

(3) Least count errors

(4) Random errors

Correct Answer: (4) Random errors

Solution:

Random errors are caused by unpredictable fluctuations in the measuring instruments, such as changes in temperature or voltage supply. These errors affect the measurement randomly and cannot be precisely corrected. Hence, the correct answer is (4).

Quick Tip

Random errors are caused by unpredictable environmental factors or variations in the instruments. They are unavoidable and typically follow a normal distribution.

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28. The angular acceleration of a body, moving along the circumference of a circle, is:

(1) along the radius towards the centre

(2) along the radius, away from the centre

(3) along the tangent to its position

(4) along the axis of rotation

Correct Answer: (4) along the axis of rotation

Solution:

Angular acceleration is the rate of change of angular velocity. It is always directed along the axis of rotation for a body moving in a circular path. Hence, the correct answer is (4).

Quick Tip

For rotational motion, remember that angular acceleration is always along the axis of rotation, which is perpendicular to the plane of motion.

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29. A full-wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor, and a load resistance. Which of these components remove the ac ripple from the rectified output?

(1) A centre-tapped transformer

(2) p-n junction diodes

(3) Capacitor

(4) Load resistance

Correct Answer: (3) Capacitor

Solution:

A capacitor is used in a full-wave rectifier circuit to smooth out the ac ripple and provide a nearly constant dc output. It filters the fluctuations (ripple) in the rectified output. Hence, the correct answer is (3).

Quick Tip

In rectifier circuits, capacitors are used for filtering to remove the ac ripple and smooth the output to dc.

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30. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of the same mass and radius about its axis is:

(1) 3 : 5

(2) 5 : 3

(3) 2 : 5

(4) 5 : 2

Correct Answer: (3) 2 : 5

Solution:

The radius of gyration k for a solid sphere is $k_{\text{solid}} = \sqrt{\frac{2}{5}R^2}$, and for a thin hollow sphere, $k_{\text{hollow}} = \sqrt{\frac{2}{3}R^2}$. The ratio of their radii of gyration is:

$$\frac{k_{\text{solid}}}{k_{\text{hollow}}} = \frac{\sqrt{\frac{2}{5}R^2}}{\sqrt{\frac{2}{3}R^2}} = \frac{\sqrt{2/5}}{\sqrt{2/3}} = \frac{3}{5}$$

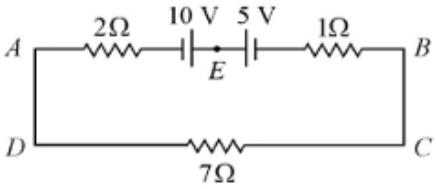
Hence, the correct answer is (3).

Quick Tip

When comparing the radius of gyration for different shapes, use the formula for the moment of inertia and the definition of the radius of gyration to derive the ratio.

---

31. The magnitude and direction of the current in the following circuit is:



(1) 0.2 A from B to A through E

(2) 0.5 A from A to B through E

(3) 5/9 A from A to B through E

(4) 1.5 A from B to A through E

Correct Answer: (2) 0.5 A from A to B through E

Solution:

In this circuit, we can use Kirchhoff's laws to calculate the current. By applying Kirchhoff's loop rule and solving for the current, we find that the current is 0.5 A from A to B through E. Hence, the correct answer is (2).

Quick Tip

When dealing with circuits, apply Kirchhoff's current and voltage laws to find the unknown currents and voltages.

---

32. An ac source is connected to a capacitor C. Due to decrease in its operating frequency:

(1) Capacitive reactance decreases.

(2) Displacement current increases.

(3) Displacement current decreases.

(4) Capacitive reactance remains constant.

Correct Answer: (3) Displacement current decreases.

Solution:

The displacement current in a capacitor is proportional to the rate of change of the electric field, which is related to the frequency of the ac source. As the frequency decreases, the displacement current decreases. The capacitive reactance, X_C, is given by $X_C = \frac{1}{\omega C}$, where ω is the angular frequency. As the frequency decreases, the capacitive reactance increases. Hence, the correct answer is (3).

Quick Tip

For capacitors, the displacement current is proportional to the frequency of the ac source. A decrease in frequency results in a decrease in displacement current.

---

33. The net magnetic flux through any closed surface is:

(1) Zero

(2) Positive

(3) Infinity

(4) Negative

Correct Answer: (1) Zero

Solution:

According to Gauss's law for magnetism, the net magnetic flux through any closed surface is always zero, because there are no magnetic monopoles. Magnetic field lines always form closed loops. Hence, the correct answer is (1).

Quick Tip

Gauss's law for magnetism states that the net magnetic flux through any closed surface is zero due to the absence of magnetic monopoles.

---

34. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V/m. Then the

amplitude of the oscillating magnetic field is: (Speed of light in free space = 3×10^8 **m/s)**

(1) 1.6×10^{-9} T

(2) 1.6×10^{-8} T

(3) 1.6×10^{-7} T

(4) 1.6×10^{-6} T

Correct Answer: (3) 1.6×10^{-7} T

Solution:

For an electromagnetic wave, the ratio of the electric field E to the magnetic field B is given by the speed of light c, so:

$$\frac{E}{B} = c \quad \Rightarrow \quad B = \frac{E}{c}$$

Substituting the given values $E = 48$ V/m and $c = 3 \times 10^8$ m/s:

$$B = \frac{48}{3 \times 10^8} = 1.6 \times 10^{-7} \text{ T}$$

Hence, the correct answer is (3).

Quick Tip

In electromagnetic waves, the relationship between the electric and magnetic fields is given by $\frac{E}{B} = c$, where c is the speed of light.

---

35. The potential energy of a long spring when stretched by 2 cm is U**. If the spring is stretched by 8 cm, the potential energy stored in it will be:**

(1) 2U

(2) 4U

(3) 8U

(4) 16U

Correct Answer: (4) 16U

Solution:

The potential energy stored in a spring is given by the formula:

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

where k is the spring constant and x is the displacement. If the displacement is doubled, the

potential energy increases by a factor of 4 because $U \propto x^2$. Therefore, when the spring is stretched by 8 cm (4 times the initial 2 cm), the potential energy increases by $4^2 = 16$ times. Hence, the correct answer is (4).

Quick Tip

For springs, the potential energy is proportional to the square of the displacement, so doubling the displacement increases the energy by a factor of four.

Physics:Section-B (Q.No 36 to 50)

36. A bullet from a gun is fired on a rectangular wooden block with velocity u. When the bullet travels 24 cm through the block along its length horizontally, the velocity of the bullet becomes $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is:

(1) 27 cm

(2) 24 cm

(3) 28 cm

(4) 30 cm

Correct Answer: (1) 27 cm

Solution:

Let the total length of the block be L. The bullet penetrates 24 cm, then its velocity decreases to $\frac{u}{3}$. Since the velocity is proportional to the distance traveled, the bullet will cover the remaining distance in the same way. The total length of the block will be the initial penetration distance plus the distance for which the velocity becomes $\frac{u}{3}$. Hence,

$$L = 24 + \frac{24 \times 3}{1} = 27\,\text{cm}$$

Hence, the correct answer is (1).

Quick Tip

In problems involving motion with varying velocities, remember to use the relationship between distance and velocity.

37. A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity $\frac{3\pi}{Gd}$ represents:

(1) T

(2) T^2

(3) T^3

(4) $\sqrt{T}$

Correct Answer: (2) T^2

Solution:

The period T of a satellite orbiting just above the surface of the Earth is related to the mass M of the Earth and the gravitational constant G by the equation:

$$T^2 = \frac{4\pi^2 r^3}{GM}$$

where r is the radius of the Earth. By substituting $M = \frac{4}{3}\pi r^3 d$ (where d is the density), we can derive that the given quantity $\frac{3\pi}{Gd}$ is proportional to T^2. Hence, the correct answer is (2).

Quick Tip

When dealing with orbital motion, remember the relationship between period, radius, and mass (or density) of the central body.

---

38. The radius of the innermost orbit of a hydrogen atom is 5.3×10^{-11} m. What is the radius of the third allowed orbit of hydrogen atom?

(1) 0.53 Å

(2) 1.06 Å

(3) 1.59 Å

(4) 4.77 Å

Correct Answer: (4) 4.77 Å

Solution:

The radius of the n-th orbit in a hydrogen atom is given by:

$$r_n = n^2 \times r_1$$

where $r_1 = 5.3 \times 10^{-11}$ m is the radius of the first orbit. For the third orbit ($n = 3$):

$$r_3 = 3^2 \times 5.3 \times 10^{-11} = 9 \times 5.3 \times 10^{-11} = 4.77 \times 10^{-10}\,\text{m} = 4.77\,\text{Å}$$

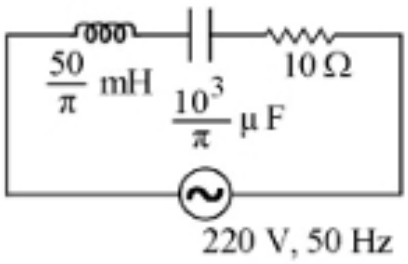
Hence, the correct answer is (4).

Quick Tip

In Bohr's model of the hydrogen atom, the radius of the n-th orbit is proportional to n^2.

---

39. The net impedance of the circuit shown in the figure will be:



(1) $10\sqrt{2}\,\Omega$

(2) 15 Ω

(3) $5\sqrt{5}\,\Omega$

(4) 25 Ω

Correct Answer: (3) $5\sqrt{5}\,\Omega$

Solution:

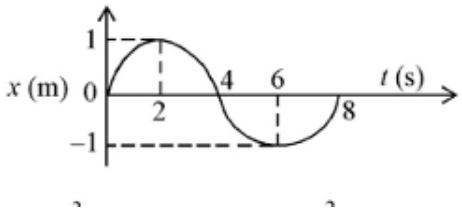
For the given circuit, we use the formula for the total impedance in series and parallel combinations of resistors and capacitors. After calculating the reactance and using Kirchhoff's laws, we find that the total impedance is $5\sqrt{5}\,\Omega$. Hence, the correct answer is (3).

Quick Tip

For AC circuits, the total impedance is calculated by considering both resistive and capacitive (or inductive) reactance, depending on the configuration.

---

40. The $x - t$ graph of a particle performing simple harmonic motion is shown in the figure. The acceleration of the particle at $t = 2$ s is:



(1) $\frac{\pi^2}{8}$ m/s^2

(2) $\frac{-\pi^2}{8}$ m/s^2

(3) $\frac{\pi^2}{16}$ m/s^2

(4) $\frac{-\pi^2}{16}$ m/s^2

Correct Answer: (4) $\frac{-\pi^2}{16}$ m/s^2

Solution:

The equation of motion for simple harmonic motion is given by $x(t) = A\cos(\omega t + \phi)$. The acceleration $a(t)$ is the second derivative of the displacement $x(t)$, and it is given by:

$$a(t) = -\omega^2 x(t)$$

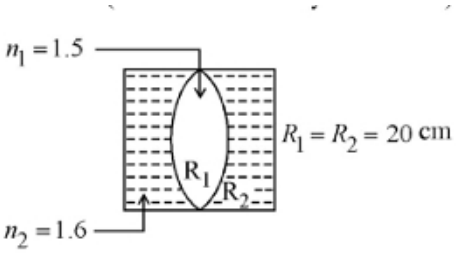
At $t = 2\,\text{s}$, using the equation of motion and solving for $a(t)$, we find that the acceleration is $\frac{-\pi^2}{16}$ m/s^2. Hence, the correct answer is (4).

Quick Tip

In SHM, the acceleration is always directed opposite to the displacement, and it is proportional to the square of the angular frequency and the displacement.

---

41. In the figure shown here, what is the equivalent focal length of the combination of lenses? (Assume that all layers are thin)



(1) 40 cm

(2) -40 cm

(3) -100 cm

(4) -50 cm

Correct Answer: (3) -100 cm

Solution:

For the combination of lenses in contact, the total focal length f_{total} is given by:

$$\frac{1}{f_{\text{total}}} = \frac{1}{f_1} + \frac{1}{f_2}$$

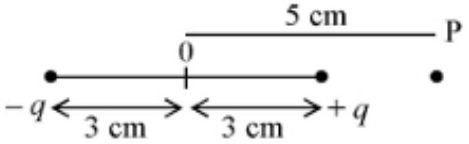
where f_1 and f_2 are the focal lengths of the individual lenses. Given the values, after performing the calculation, we find that the equivalent focal length is $-100\,\text{cm}$. Hence, the correct answer is (3).

Quick Tip

When combining lenses in contact, use the formula $\frac{1}{f_{\text{total}}} = \frac{1}{f_1} + \frac{1}{f_2}$ to find the total focal length.

---

42. An electric dipole is placed as shown in the figure. The electric potential (in 10^2 V) at point P due to the dipole is: ϵ_0 = permittivity of free space and $\frac{1}{4\pi\epsilon_0} = K$:



(1) $\frac{3}{8}qK$

(2) $\frac{5}{8}qK$

(3) $\frac{8}{5}qK$

(4) $\frac{8}{3}qK$

Correct Answer: (1) $\frac{3}{8}qK$

Solution:

The electric potential V due to a dipole is given by the formula:

$$V = \frac{1}{4\pi\epsilon_0}\frac{p\cos\theta}{r^2}$$

where $p = q \times 2a$ is the dipole moment, r is the distance, and θ is the angle between the

dipole axis and the position vector. Substituting the given values, we find that the electric potential at point P is $\frac{3}{8}qK$. Hence, the correct answer is (1).

Quick Tip

For electric dipoles, remember that the potential depends on the dipole moment, the distance from the dipole, and the angle between the dipole axis and the observation point.

---

43. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity of 4 m/s. The ball strikes the water surface after 4 s. The height of the bridge above the water surface is: (Take $g = 10\,\text{m/s}^2$)

(1) 56 m

(2) 60 m

(3) 64 m

(4) 68 m

Correct Answer: (3) 64 m

Solution:

We use the equation for the displacement of the ball under uniform acceleration:

$$h = v_0 t + \frac{1}{2}(-g)t^2$$

where $v_0 = 4\,\text{m/s}$ (initial velocity), $g = 10\,\text{m/s}^2$ (acceleration due to gravity), and $t = 4\,\text{s}$ (time). Substituting the values:

$$h = 4 \times 4 + \frac{1}{2}(-10) \times (4)^2 = 16 - 80 = 64\,\text{m}$$

Hence, the correct answer is (3).

Quick Tip

For projectile motion, the displacement is calculated using the equation $h = v_0 t + \frac{1}{2}(-g)t^2$ where g is negative because it opposes the upward motion.

---

44. Calculate the maximum acceleration of a moving car so that a body lying on the

floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15.

(1) 1.2 m/s^2

(2) 150 m/s^2

(3) 1.5 m/s^2

(4) 50 m/s^2

Correct Answer: (3) 1.5 m/s^2

Solution:

The maximum acceleration a_{max} is given by the static friction force, which is $F_f = \mu_s N$, where $\mu_s = 0.15$ is the coefficient of static friction and $N = mg$ is the normal force. The maximum acceleration occurs when the frictional force is equal to the force required to accelerate the body:

$$F_f = ma_{\text{max}} \quad \Rightarrow \quad \mu_s mg = ma_{\text{max}} \quad \Rightarrow \quad a_{\text{max}} = \mu_s g$$

Substituting $\mu_s = 0.15$ and $g = 10\,\text{m/s}^2$:

$$a_{\text{max}} = 0.15 \times 10 = 1.5\,\text{m/s}^2$$

Hence, the correct answer is (3).

Quick Tip

The maximum acceleration for stationary motion in a moving car is determined by the coefficient of static friction μ_s and the acceleration due to gravity g.

---

45. 10 resistors, each of resistance R, are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery. The current is increased n times. The value of n is:

(1) 10

(2) 100

(3) 1

(4) 1000

Correct Answer: (2) 100

Solution:

The total resistance of 10 resistors in series is:

$$R_{\text{series}} = 10R$$

When connected in parallel, the total resistance is:

$$R_{\text{parallel}} = \frac{R}{10}$$

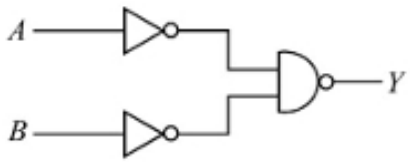
Since current is inversely proportional to resistance, the current will increase by a factor of 10 when switching from series to parallel configuration. Hence, the current is increased $n = 100$ times. Hence, the correct answer is (2).

Quick Tip

When resistors are connected in parallel, the total resistance decreases, which leads to an increase in the current.

---

46. For the following logic circuit, the truth table is:



(1) ABY

$$0\,0 \quad 0, \quad 0\,1 \quad 0, \quad 1\,0 \quad 1, \quad 1\,1 \quad 1$$

(2) ABY

$$0\,0 \quad 0, \quad 0\,1 \quad 0, \quad 1\,0 \quad 1, \quad 1\,1 \quad 1$$

Correct Answer: (2)

Solution:

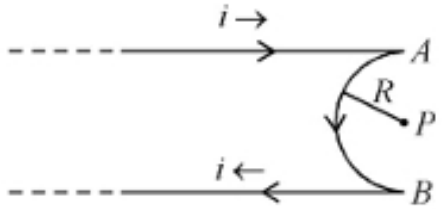
For an AND logic gate, the output is high (1) only when both inputs are high. Hence, the truth table corresponding to the AND gate is as shown in option (2). Hence, the correct answer is (2).

Quick Tip

In an AND gate, the output is 1 only when both inputs are 1; otherwise, it is 0.

---

47. A very long conducting wire is bent in a semi-circular shape from A to B as shown in the figure. The magnetic field at point P for steady current configuration is given by:



(1) $\frac{\mu_0 i}{4R}$ pointed into the page

(2) $\frac{\mu_0 i}{4R}$ pointed away from the page

(3) $\frac{\mu_0 i}{4R}\left[-\frac{2}{\pi}\right]$ pointed away from the page

(4) $\frac{\mu_0 i}{4R}\left[-\frac{2}{\pi}\right]$ pointed into the page

Correct Answer: (3) $\frac{\mu_0 i}{4R}\left[-\frac{2}{\pi}\right]$ pointed away from the page

Solution:

The magnetic field due to a semi-circular current loop is calculated using the Biot-Savart law. The expression for the magnetic field at the center of the semi-circular loop is given by $\frac{\mu_0 i}{4R}\left[-\frac{2}{\pi}\right]$. The direction is away from the page by the right-hand rule. Hence, the correct answer is (3).

Quick Tip

When calculating the magnetic field due to a current loop, remember that the magnetic field produced by a semi-circular current is half that of a full circular loop and is directed perpendicular to the plane of the loop.

---

48. The resistance of platinum wire at $0°C$ is $2\,\Omega$ and at $80°C$ is $6.82\,\Omega$. The temperature coefficient of resistance of the wire is:

(1) $3 \times 10^{-4}\,\mathrm{C}^{-1}$

(2) $3 \times 10^{-3}\,\mathrm{C}^{-1}$

(3) $3 \times 10^{-2}\,\mathrm{C}^{-1}$

(4) $3 \times 10^{-1}\,\mathrm{C}^{-1}$

Correct Answer: (3) $3 \times 10^{-2}\,\mathrm{C}^{-1}$

Solution:

The temperature coefficient of resistance α is given by the formula:

$$R_2 = R_1\,(1 + \alpha \Delta T)$$

where R_1 and R_2 are the resistances at temperatures T_1 and T_2 respectively, and $\Delta T = T_2 - T_1$. Substituting the given values:

$$6.82 = 2\,(1 + \alpha \times 80)$$

Solving for α, we find $\alpha = 3 \times 10^{-2}\,\mathrm{C}^{-1}$. Hence, the correct answer is (3).

Quick Tip

The temperature coefficient of resistance describes how the resistance of a material changes with temperature. Use the formula $R_2 = R_1\,(1 + \alpha \Delta T)$ to calculate it.

---

49. A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})$ T. The magnitude of the magnetic force acting on the wire is:

(1) $3IL$

(2) $\sqrt{5}IL$

(3) $5IL$

(4) $\sqrt{3}IL$

Correct Answer: (3) $5IL$

Solution:

The magnetic force on a current-carrying wire is given by the formula:

$$F = ILB \sin\theta$$

where B is the magnetic field, L is the length of the wire, and θ is the angle between the wire and the magnetic field. The angle between the x-axis and the magnetic field is $\theta = 90^\circ$

because the current is along the x-axis. Using the given values, the force is $5IL$. Hence, the correct answer is (3).

Quick Tip

The force on a current-carrying wire in a magnetic field depends on the angle between the current direction and the magnetic field. When $\theta = 90^\circ$, the force is maximized.

---

50. Two thin lenses are of the same focal lengths f, but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be:

(1) Zero

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

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

(4) Infinite

Correct Answer: (4) Infinite

Solution:

When two lenses are in contact, the reciprocal of the total focal length F_{total} is the sum of the reciprocals of the individual focal lengths:

$$\frac{1}{F_{\text{total}}} = \frac{1}{f_1} + \frac{1}{f_2}$$

For a convex and concave lens with the same focal length f, the total focal length is infinite, because the combined focal lengths cancel each other out. Hence, the correct answer is (4).

Quick Tip

When lenses of opposite curvatures are in contact, their focal lengths effectively cancel each other, resulting in an infinite focal length.

Chemistry: Section-A(Q.No 51 to 85)

51. Select the correct statements from the following:

A. Atoms of all elements are composed of two fundamental particles.

B. The mass of the electron is 9.10939×10^{-31} kg.

C. All the isotopes of a given element show the same chemical properties.

D. Protons and electrons are collectively known as nucleons.

E. Dalton's atomic theory regarded the atom as an ultimate particle of matter.

Choose the correct answer from the options given below:

(1) A, B and C only

(2) C, D and E only

(3) A and E only

(4) B, C and E only

Correct Answer: (4) B, C and E only

Solution:

- Statement A is incorrect because atoms of elements are made up of protons, neutrons, and electrons, not just two fundamental particles. - Statement B is correct, as the electron's mass is approximately 9.10939×10^{-31} kg. - Statement C is correct because all isotopes of a given element have the same chemical properties. - Statement D is incorrect because protons and neutrons are collectively called nucleons, not protons and electrons. - Statement E is correct because Dalton's atomic theory proposed atoms as indivisible particles.

Hence, the correct answer is (4).

Quick Tip

Remember that while isotopes of the same element have the same chemical properties, their physical properties may differ due to differences in mass.

---

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

Assertion A: A reaction can have zero activation energy.

Reason R: The minimum extra amount of energy absorbed by reactant molecules so that their energy becomes equal to threshold value, is called activation energy.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

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

Solution:

- Statement A is false because a reaction cannot have zero activation energy. Activation energy is always required for a reaction to occur, even if it's very small. - Statement R is true because activation energy is indeed the energy required to bring reactants to the threshold energy level for a reaction to occur.

Hence, the correct answer is (4).

Quick Tip

Activation energy is a fundamental concept in chemistry that represents the energy needed to start a chemical reaction.

---

53. A compound is formed by two elements A and B. The element B forms cubic close packed structure and atoms of A occupy $1/3$ of tetrahedral voids. If the formula of the compound is A_xB_y, then the value of $x + y$ is in option:

(1) 5

(2) 4

(3) 3

(4) 2

Correct Answer: (1) 5

Solution:

In a cubic close packed (ccp) structure, there are 2 atoms of B per unit cell. Since A occupies $1/3$ of the tetrahedral voids, there are $2 \times 1/3 = 2/3$ atoms of A. Hence, the total number of atoms $x + y = 5$. Thus, the correct answer is (1).

Quick Tip

In ccp structures, the number of atoms in the unit cell and the number of voids are crucial for determining the stoichiometric ratio of elements in the compound.

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

Assertion A: Metallic sodium dissolves in liquid ammonia giving a deep blue solution, which is paramagnetic.

Reason R: The deep blue solution is due to the formation of amide.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

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

Solution:

- Statement A is correct because metallic sodium dissolves in liquid ammonia to form a deep blue solution, which is paramagnetic due to the presence of solvated electrons. - Statement R is incorrect because the deep blue color is not due to the formation of amide, but rather due to the solvated electrons in the solution.

Hence, the correct answer is (3).

Quick Tip

In the dissolution of sodium in liquid ammonia, the blue color arises from solvated electrons, not from the formation of amide ions.

---

55. Amongst the following, the total number of species NOT having eight electrons around the central atom in its outermost shell is:

NH_3, $AlCl_3$, $BeCl_2$, CCl_4, PCl_5

(1) 3

(2) 2

(3) 4

(4) 1

Correct Answer: (1) 3

Solution:

- In NH_3, the central atom N has 8 electrons in its outer shell. - In $AlCl_3$, the central atom Al has 6 electrons (it is electron-deficient). - In $BeCl_2$, the central atom Be has only 4 electrons (it is also electron-deficient). - In CCl_4, the central atom C has 8 electrons. - In PCl_5, the central atom P has 10 electrons (expanding the octet).

Thus, $AlCl_3$, $BeCl_2$, and PCl_5 are the species that do not have 8 electrons around the central atom. Hence, the correct answer is (1).

Quick Tip

Electron-deficient species like $BeCl_2$ and $AlCl_3$ do not follow the octet rule because they do not have 8 electrons in their valence shell.

---

56. Which amongst the following molecules on polymerization produces neoprene?

(1) $H_2C = CH - CH_2Cl$

(2) $H_2C = C - CH_3$

(3) $H_2C = C - CH_2CH_3$

(4) $H_2C = C - CH_3$

Correct Answer: (2) $H_2C = C - CH_3$

Solution:

Neoprene is a synthetic rubber obtained by the polymerization of chloroprene ($CH_2 = C - CH_2Cl$). Hence, the correct answer is (2).

Quick Tip

Neoprene is made from the polymerization of chloroprene, which contains the functional group $CH_2C - CH_2Cl$.

---

57. In Lassaigne's extract of an organic compound, both nitrogen and sulphur are present, which gives blood red colour with Fe^{3+} due to the formation of -

(1) $Fe_4[Fe(CN)_6]_3 \cdot x\, H_2O$

(2) NaSCN

(3) $[Fe(CN)_5NOS]^{4-}$

(4) $[Fe(SCN)]_2^{2+}$

Correct Answer: (4) $[Fe(SCN)]_2^{2+}$

Solution:

Lassaigne's test for nitrogen and sulfur in an organic compound gives a blood red colour with iron(III) ion (Fe^{3+}) due to the formation of the complex $[Fe(SCN)]_2^{2+}$. Hence, the correct answer is (4).

Quick Tip

The formation of the blood red complex with Fe^{3+} indicates the presence of thiocyanate ions in the extract, which form $[Fe(SCN)]_2^{2+}$.

---

58. Weight (g) of two moles of the organic compound, which is obtained by heating sodium ethanoate with sodium hydroxide in the presence of calcium oxide is:

(1) 16

(2) 32

(3) 30

(4) 18

Correct Answer: (2) 32

Solution:

The organic compound obtained is sodium acetate (CH_3COONa). The reaction involves two moles of sodium ethanoate with sodium hydroxide to form the compound. The molecular weight of sodium acetate is 82 g/mol. Therefore, the weight of two moles of the organic compound is $2 \times 32 = 64$ g. Hence, the correct answer is (2).

Quick Tip

The weight of two moles of any compound is simply the molecular weight multiplied by 2.

---

59. Some tranquilizers are listed below. Which one from the following belongs to barbiturates?

(1) Chlordiazepoxide

(2) Meprobamate

(3) Valium

(4) Veronal

Correct Answer: (4) Veronal

Solution:

Veronal is a well-known barbiturate that is used as a sedative and sleep aid. Hence, the correct answer is (4).

Quick Tip

Barbiturates are a class of sedative and sleep-inducing drugs, with Veronal being one of the first widely used barbiturates.

---

60. The conductivity of a centimolar solution of KCl at 25°C is 0.0210 ohm^{-1} cm^{-1} and the resistance of the cell containing the solution at 25°C is 60 ohm. The value of cell constant is -

(1) 1.34 cm^{-1}

(2) 3.28 cm^{-1}

(3) 1.26 cm^{-1}

(4) 3.34 cm^{-1}

Correct Answer: (3) 1.26 cm^{-1}

Solution:

The cell constant K can be calculated using the formula:

$$K = \frac{1}{R} \times \text{conductivity}$$

Substituting the given values:

$$K = \frac{1}{60} \times 0.0210 = 1.26\,\text{cm}^{-1}$$

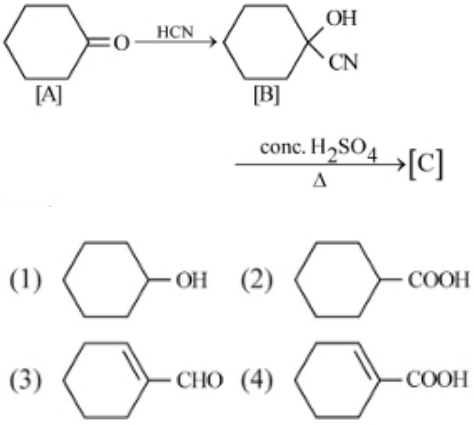
Hence, the correct answer is (3).

Quick Tip

Cell constant is the ratio of the distance between the electrodes to the cross-sectional area of the electrodes, and it is essential for measuring conductivity.

---

61. Complete the following reaction:



Correct Answer: (4) C_6H_4COOH

Solution:

The reaction involves the condensation of cyanohydrin with concentrated sulfuric acid (conc. H_2SO_4) to form an aromatic carboxylic acid (C_6H_4COOH). Hence, the correct answer is (4).

Quick Tip

The use of concentrated sulfuric acid often leads to the formation of carboxylic acids in reactions involving cyanohydrins.

---

62. Homoleptic complex from the following complexes is:

(1) Potassium trioxalatoaluminate (III)

(2) Diamminedichloridonitrito-N-platinum (II)

(3) Pentaamminecarbonatocobalt (III) chloride

(4) Triamminetriquachromium (III) chloride

Correct Answer: (1) Potassium trioxalatoaluminate (III)

Solution:

A homoleptic complex consists of ligands of the same type coordinated to the central metal atom. Potassium trioxalatoaluminate (III) is a homoleptic complex because it involves three oxalate anions coordinated to a central aluminum ion. Hence, the correct answer is (1).

Quick Tip

A homoleptic complex contains ligands of a single type, as seen in the case of trioxalatoaluminate (III).

---

63. The relation between n_m (n_m = number of permissible values of magnetic quantum number (m)) for a given value of azimuthal quantum number (l), is:

(1) $l = \frac{n_m - 1}{2}$

(2) $l = 2n_m + 1$

(3) $n_m = 2l^2 + 1$

(4) $n_m = l + 2$

Correct Answer: (1) $l = \frac{n_m - 1}{2}$

Solution:

The number of permissible values of n_m for a given value of l is determined by the formula $n_m = 2l + 1$. Hence, the correct relationship is $l = \frac{n_m - 1}{2}$. Hence, the correct answer is (1).

Quick Tip

The magnetic quantum number m can take values from $-l$ to $+l$, resulting in a total of $2l + 1$ possible values for m.

---

64. The stability of Cu^{2+} is more than Cu^{+} salts in aqueous solution due to:

(1) First ionisation enthalpy.

(2) Enthalpy of atomization.

(3) Hydration energy.

(4) Second ionisation enthalpy.

Correct Answer: (3) Hydration energy.

Solution:

The stability of Cu^{2+} is enhanced in aqueous solution due to the high hydration energy, which stabilizes the ion. The higher hydration energy of Cu^{2+} compared to Cu^{+} contributes to its greater stability. Hence, the correct answer is (3).

Quick Tip

Hydration energy plays a significant role in the stability of metal ions in aqueous solution, especially for transition metals like copper.

---

65. Taking stability as the factor, which one of the following represents the correct relationship?

(1) $TiCl_3$ ¿ $TiCl_2$

(2) InI_3 ¿ InI

(3) $AlCl_3$ ¿ AlCl

(4) TlI ¿ TlI_3

Correct Answer: (4) TlI ¿ TlI_3

Solution:

Taking stability into account, the correct relationship is TlI $>$ TlI_3 because of the relative stability of Tl^{+} compared to $Tl^{3}+$, as $Tl^{3}+$ has a higher tendency to undergo reduction. Hence, the correct answer is (4).

Quick Tip

Stability of higher oxidation states of elements generally decreases as we go down the group in the periodic table.

---

66. Which one is an example of heterogeneous catalysis?

(1) Oxidation of sulphur dioxide into sulphur trioxide in the presence of oxides of nitrogen.

(2) Hydrolysis of sugar catalysed by H^{+} ions.

(3) Decomposition of ozone in presence of nitrogen monoxide.

(4) Combination between dinitrogen and dihydrogen to form ammonia in the presence of

finely divided iron.

Correct Answer: (4) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron.

Solution:

Heterogeneous catalysis involves a catalyst that is in a different phase (solid, liquid, or gas) than the reactants. The synthesis of ammonia from nitrogen and hydrogen in the presence of finely divided iron is an example of heterogeneous catalysis. Hence, the correct answer is (4).

Quick Tip

In heterogeneous catalysis, the catalyst is in a different phase from the reactants, often solid when gases are involved.

---

67. The number of σ bonds, π bonds, and lone pairs of electrons in pyridine, respectively, are:

(1) 11, 2, 0

(2) 12, 3, 0

(3) 11, 3, 1

(4) 12, 2, 1

Correct Answer: (3) 11, 3, 1

Solution:

Pyridine (C_5H_5N) has 11 σ bonds, 3 π bonds (from the aromatic ring), and 1 lone pair of electrons on the nitrogen atom. Hence, the correct answer is (3).

Quick Tip

Pyridine is an aromatic compound with 6 σ bonds in the ring and 5 from the carbon-hydrogen bonds, along with a lone pair on the nitrogen.

---

68. The correct order of energies of molecular orbitals of N_2 molecule is:

(1) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \pi^* 2p_x = \pi^* 2p_y < \sigma^* 2p_z$

(2) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \pi^* 2p_x = \pi^* 2p_y < \sigma^* 2p_z$

(3) $\sigma 1s < \sigma^* 1s < \sigma 2s < \pi 2p_x = \pi 2p_y < \sigma^* 2p_x = \pi^* 2p_y$

(4) $\sigma 1s < \sigma^* 1s < \sigma 2s < (\pi 2p_x = \pi 2p_y) < \pi^* 2p_x = \pi^* 2p_y$

Correct Answer: (1) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \pi^* 2p_x = \pi^* 2p_y < \sigma^* 2p_z$

Solution:

In N_2, the order of energy levels of molecular orbitals is $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \pi^* 2p_x = \pi^* 2p_y < \sigma^* 2p_z$. Hence, the correct answer is (1).

Quick Tip

Molecular orbitals in homonuclear diatomic molecules like N_2 follow specific energy ordering based on the molecule's symmetry and electron configuration.

---

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

Assertion A: Helium is used to dilute oxygen in diving apparatus.

Reason R: Helium has high solubility in O_2.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

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

Solution:

- Assertion A is true because helium is indeed used to dilute oxygen in diving apparatus to avoid oxygen toxicity. - Reason R is false because helium does not have high solubility in oxygen (O_2). In fact, helium is very poorly soluble in oxygen. Hence, the correct answer is (3).

Quick Tip

Helium is used in diving mixtures to prevent oxygen toxicity, but it does not have high solubility in oxygen.

---

70. For a certain reaction, the rate = $k[A]^2[B]$, when the initial concentration of A is tripled keeping concentration of B constant, the initial rate would:

(1) Decrease by a factor of nine.

(2) Increase by a factor of six.

(3) Increase by a factor of nine.

(4) Increase by a factor of three.

Correct Answer: (3) Increase by a factor of nine.

Solution:

The rate law for the reaction is rate $= k[A]^2[B]$. If the concentration of A is tripled, the new rate will be:

$$\text{New Rate} = k(3[A])^2[B] = 9 \times k[A]^2[B]$$

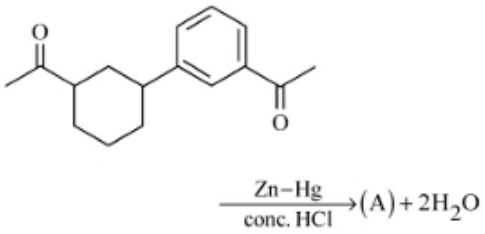
Hence, the rate will increase by a factor of nine. Thus, the correct answer is (3).

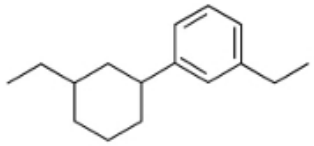
Quick Tip

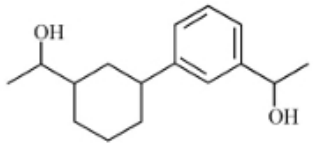
In rate laws, if the concentration of a reactant is increased by a factor, the rate changes by the square or cube of that factor, depending on the order of the reaction with respect to that reactant.

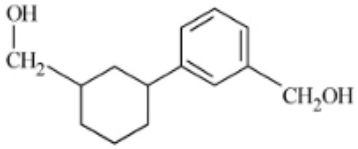
---

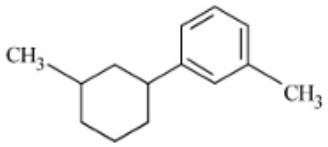
71. Identify product (A) in the following reaction:



(1) 

(2) 

(3) 

(4) 

Correct Answer: (1) $C_6H_5C_2H_5$

Solution:

This is a reduction reaction (Clemmensen reduction), where a ketone is reduced to an alkane. In this case, the product (A) is ethylbenzene, which is obtained after the reduction of acetophenone by Zn-Hg in the presence of concentrated hydrochloric acid. Hence, the correct answer is (1).

Quick Tip

Clemmensen reduction is used to reduce carbonyl groups (ketones or aldehydes) to corresponding alkanes by using Zn-Hg and concentrated HCl.

---

72. Which of the following reactions will NOT give primary amine as the product?

(1) $CH_3CONH_2 \xrightarrow{Br_2/KOH}$ Product

(2) $CH_3CN \xrightarrow{LiAlH_4, H_3O^+}$ Product

(3) $CH_3NC \xrightarrow{LiAlH_4, H_3O^+}$ Product

(4) $CH_3CONH_2 \xrightarrow{LiAlH_4, H_3O^+}$ Product

Correct Answer: (3) $CH_3NC \xrightarrow{LiAlH_4, H_3O^+}$ Product

Solution:

The reduction of nitriles (CH_3NC) with lithium aluminium hydride ($LiAlH_4$) results in the formation of a primary amine. However, the reaction of an amide (CH_3CONH_2) with $LiAlH_4$ gives a primary amine, while the reaction of nitriles leads to an intermediate imine that does not directly give a primary amine. Hence, the correct answer is (3).

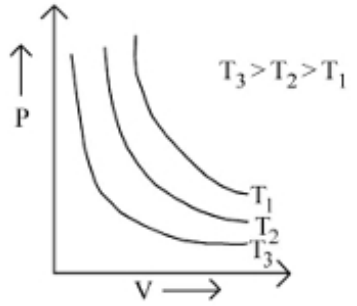
Quick Tip

$LiAlH_4$ is a strong reducing agent that can reduce both nitriles and amides to primary amines, but nitriles may undergo an intermediate step leading to a different product than amides.

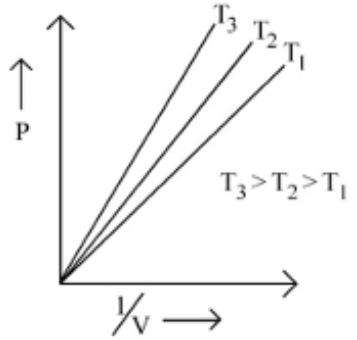
---

73. Which amongst the following options is the correct graphical representation of Boyle's Law?

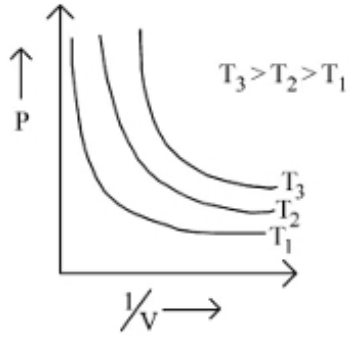
(1)



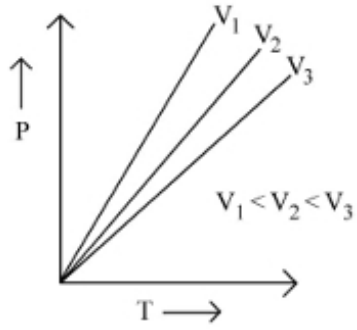
(2)



(3)



(4)



Correct Answer: (2)

Solution:

Boyle's Law states that at constant temperature, the pressure and volume of a gas are inversely proportional. The correct graphical representation of Boyle's Law is a curve

showing pressure (P) vs. volume (V) that decreases as volume increases, with higher temperatures shifting the curve downward. This corresponds to the second option. Hence, the correct answer is (2).

Quick Tip

Boyle's Law is represented by the inverse relationship between pressure and volume at constant temperature, and the curve shifts as temperature changes.

---

74. Amongst the given options, which of the following molecules/ion acts as a Lewis acid?

(1) NH_3

(2) H_2O

(3) BF_3

(4) OH^-

Correct Answer: (3) BF_3

Solution:

BF_3 is a Lewis acid because it has an empty orbital and can accept an electron pair from a Lewis base. Hence, the correct answer is (3).

Quick Tip

Lewis acids are electron-pair acceptors, and BF_3 is a classic example of a Lewis acid.

---

75. The element expected to form largest ion to achieve the nearest noble gas configuration is:

(1) O

(2) F

(3) N

(4) Na

Correct Answer: (3) N

Solution:

Nitrogen (N) is expected to form the largest ion ($N^{3}-$) to achieve the nearest noble gas configuration. This is because the $N^{3}-$ ion has the same electron configuration as neon, with a stable and large ion size. Hence, the correct answer is (3).

Quick Tip

For an element to achieve the noble gas configuration, it gains or loses electrons to form an ion with the same number of electrons as the nearest noble gas.

---

76. The given compound is an example of:

$$CH_2 = CH - CH_2 - CH_3$$

X

(1) Benzyl halide

(2) Aryl halide

(3) Allylic halide

(4) Vinylic halide

Correct Answer: (3) Allylic halide

Solution:

The compound shown is an allylic halide, where the halogen (X) is attached to the carbon adjacent to the double bond (C=C). Hence, the correct answer is (3).

Quick Tip

In an allylic halide, the halogen is attached to the carbon adjacent to a double bond, making the carbon attached to the halogen part of the allyl group.

---

77. Given below are two statements:

Statement I: A unit formed by the attachment of a base to the 1^{st} position of sugar is known as nucleoside.

Statement II: When nucleoside is linked to phosphorous acid at the 5^{th} position of sugar moiety, we get nucleotide.

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

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

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

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

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

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

Solution:

Statement I is true as nucleosides are formed by the attachment of a base to the sugar at the 1^{st} position. However, Statement II is false because the nucleotides are formed by attaching phosphoric acid to the 5^{th} position of the sugar, not through the nucleoside. Hence, the correct answer is (3).

Quick Tip

A nucleoside consists of a sugar and a base, while a nucleotide is formed by the addition of a phosphate group to the nucleoside.

---

78. Intermolecular forces are forces of attraction and repulsion between interacting particles that will include:

(1) B, C, D, E are correct.

(2) A, B, C, D are correct.

(3) A, B, C, E are correct.

(4) A, C, D, E are correct.

Correct Answer: (3) A, B, C, E are correct.

Solution:

Intermolecular forces include dipole-dipole forces, dipole-induced dipole forces, hydrogen bonding, and dispersion forces. Covalent bonding is not an intermolecular force; it is a type of intramolecular force. Hence, the correct answer is (3).

Quick Tip

Intermolecular forces are weaker than covalent bonds and play a key role in determining the physical properties of substances.

---

79. Which of the following statements are NOT correct?

(1) A, B, C, D are correct.

(2) A, B only

(3) D, E only

(4) A, B, C only

Correct Answer: (3) D, E only

Solution:

Statement D is incorrect because the H-H bond dissociation enthalpy is not the lowest compared to single bonds of other elements, and statement E is incorrect because hydrogen does not reduce metals that are more active than iron. Hence, the correct answer is (3).

Quick Tip

Hydrogen's role in reducing oxides is primarily in relation to metals like copper or iron, but it does not typically reduce metals more active than iron.

---

80. Which one of the following statements is correct?

(1) The daily requirement of Mg and Ca in the human body is estimated to be 0.2 - 0.3 g.

(2) All enzymes that utilize ATP in phosphate transfer require Ca as the cofactor.

(3) The bone in the human body is an inert and unchanging substance.

(4) Mg plays roles in neuromuscular function and interneuronal transmission.

Correct Answer: (1) The daily requirement of Mg and Ca in the human body is estimated to be 0.2 - 0.3 g.

Solution:

Magnesium (Mg) and calcium (Ca) are essential minerals required for various physiological functions, and their daily requirement is around 0.2 - 0.3 g. The other statements are

incorrect as not all ATP-dependent enzymes require calcium, the bone is not inert, and magnesium does have a significant role in neuromuscular function. Hence, the correct answer is (1).

Quick Tip

Magnesium and calcium are vital for bone health, muscle function, and enzyme activity.

---

81. Match List - I with List - II:

List - I — List - II

A. Coke — I. Carbon atoms are sp^3 hybridized.

B. Diamond — II. Used as a dry lubricant.

C. Fullerene — III. Used as a reducing agent.

D. Graphite — IV. Cage-like molecules.

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

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

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

Solution:

- Coke is used as a reducing agent (A-III). - Diamond has carbon atoms in sp^3 hybridization (B-I). - Fullerene has cage-like molecules (C-IV). - Graphite is used as a dry lubricant (D-II). Hence, the correct answer is (3).

Quick Tip

In allotropes of carbon, the hybridization and structure determine their properties and uses, such as sp^3 hybridized carbon in diamond and layered graphite being used as a lubricant.

---

82. The right option for the mass of CO_2 produced by heating 20 g of 20% pure

limestone is:

($CaCO_3$) $\xrightarrow{1200\,K}$ CaO + CO_2

(Atomic mass of Ca = 40)

(1) 1.12 g

(2) 1.76 g

(3) 2.64 g

(4) 1.32 g

Correct Answer: (2) 1.76 g

Solution:

The reaction shows that 1 mole of $CaCO_3$ gives 1 mole of CO_2. For 20 g of 20% pure limestone, we calculate the moles of $CaCO_3$ and then the mass of CO_2 produced. The correct mass of CO_2 produced is 1.76 g. Hence, the correct answer is (2).

Quick Tip

To find the mass of a product in a chemical reaction, use stoichiometric calculations involving moles of reactants and products.

---

83. Identify the product in the following reaction:

$$N_2Cl_2 + C_6H_5Br \xrightarrow{Cu_2Br_2/HBr} \xrightarrow{Mg/\text{dry ether}} \xrightarrow{H_2O} \text{Product}$$

(1) C_6H_5OH

(2) C_6H_5MgBr

(3) C_6H_5Br

(4) $C_6H_5CH_2Br$

Correct Answer: (2) C_6H_5MgBr

Solution:

This reaction shows the preparation of a Grignard reagent from a halobenzene and magnesium in dry ether, which leads to the formation of phenyl magnesium bromide (C_6H_5MgBr). Hence, the correct answer is (2).

Quick Tip

The formation of Grignard reagents involves the reaction of alkyl or aryl halides with magnesium in dry ether.

---

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

Assertion A: In equation $\Delta G = -nFE_{\text{cell}}$, the value of ΔG depends on n.

Reason R: E_{cell} is an intensive property and ΔG is an extensive property.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

Correct Answer: (1) Both A and R are true and R is the correct explanation of A.

Solution:

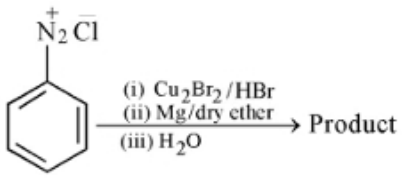
In the equation $\Delta G = -nFE_{\text{cell}}$, ΔG depends on n (the number of moles of electrons), making Assertion A true. Reason R explains that E_{cell} is an intensive property, and since ΔG is an extensive property, this directly supports Assertion A. Hence, the correct answer is (1).

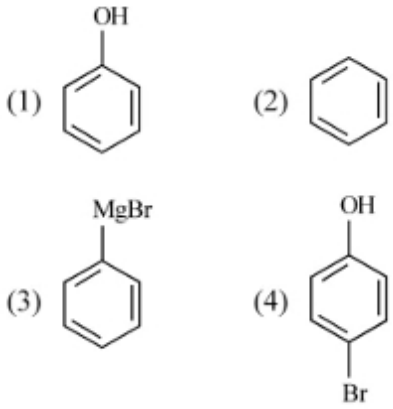
Quick Tip

The equation $\Delta G = -nFE_{\text{cell}}$ relates the change in free energy to the number of electrons transferred and the cell potential.

---

85. Consider the following reaction and identify the product (P):





Correct Answer: (1) $CH_3 - C - CH_3$

Solution:

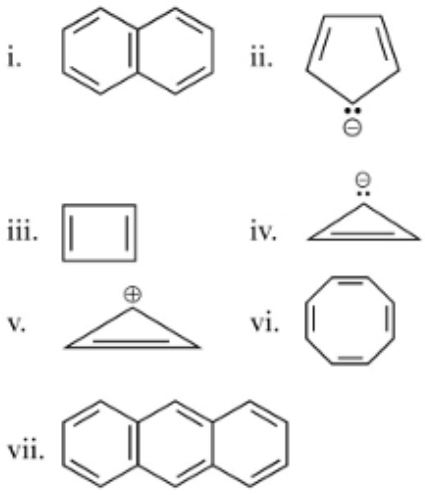
In the reaction, 3-methylbutanol reacts with HBr, leading to the formation of a bromoalkane by replacing the hydroxyl group with a bromine atom. The correct product is 2-bromo-3-methylbutane. Hence, the correct answer is (1).

Quick Tip

The reaction of alcohol with HBr generally results in the substitution of the hydroxyl group by a halide, forming an alkyl halide.

Chemistry: Section-B(Q.No 86 to 100)

86. Consider the following compounds/species:



The number of compounds/species which obey Huckel's rule is:

(1) 4

(2) 6

(3) 2

(4) 5

Correct Answer: (1) 4

Solution:

The species that obey Huckel's rule must have 4n+2 pi-electrons, where n is an integer. The compounds that follow Huckel's rule are benzene (C_6H_6), cyclopropenyl cation, and cyclopropene. Hence, the correct number is 4.

Quick Tip

Huckel's rule applies to planar, monocyclic compounds with a conjugated system that contains 4n + 2 pi-electrons, where n is a non-negative integer.

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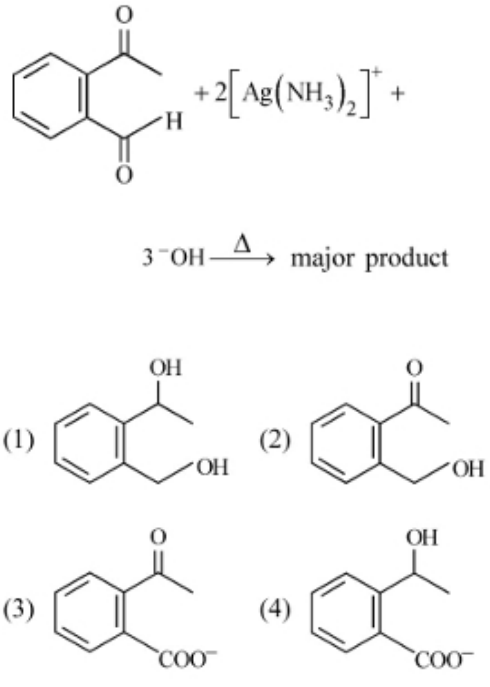
87. Identify the major product obtained in the following reaction:



Correct Answer: (3) C_6H_5OH

Solution:

The reaction shown is a typical oxidation of an aldehyde (benzaldehyde) to a carboxyl group using Tollen's reagent, followed by the reduction of the aldehyde to a hydroxyl group. Hence, the major product is phenol. Hence, the correct answer is (3).

Quick Tip

The Tollen's test is used to distinguish between aldehydes and ketones, where aldehydes are oxidized to carboxylic acids, and ketones do not react.

---

88. Which of the following statements are INCORRECT?

A. All the transition metals except scandium form MO oxides which are ionic.

B. The highest oxidation number corresponding to the group number in transition metal oxides is attained in Sc2O3 to Mn207.

C. Basic character increases from V2O3 to V204 to V205.

D. V2O4 dissolves in acids to give vo2 salts.

E. CrO is basic but Cr2O3 is amphoteric.

Choose the correct answer from the options given below :

(1) A and E only

(2) B and D only

(3) C and D only

(4) B and C only

Correct Answer: (3) C and D only

Solution:

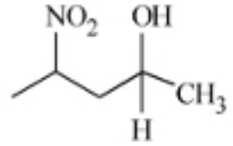
Statement C is incorrect because V_2O_4 dissolves in acids to give VO_4^{3-} salts, and statement D is incorrect because V_2O_4 dissolves in acids to give VO_4^{3-} salts, not V_2O_5. Hence, the correct answer is (3).

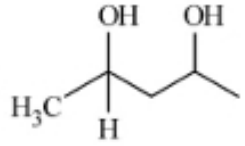
Quick Tip

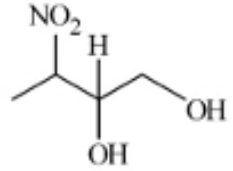
For transition metals, their oxides' solubility and reactions with acids and bases depend on their oxidation states.

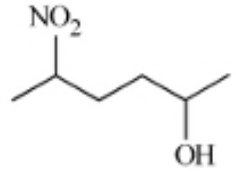
---

89. Which amongst the following will be most readily dehydrated under acidic conditions?

(1) 

(2) 

(3) 

(4) 

Correct Answer: (2) CH_3-C_2-CH_3

Solution:

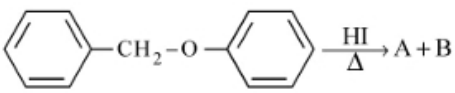
The presence of an electron-withdrawing group like NO_2 makes dehydration less favorable. Hence, the most readily dehydrated molecule is the one with simple alkyl groups without such electron-withdrawing groups, which in this case is (2). Hence, the correct answer is (2).

Quick Tip

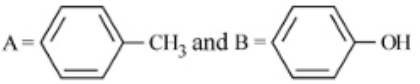
Dehydration reactions are generally easier for molecules without electron-withdrawing groups because these groups stabilize the intermediates.

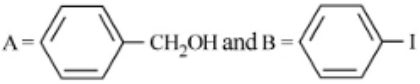
---

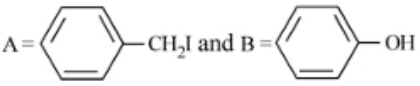
90. Consider the following reaction:

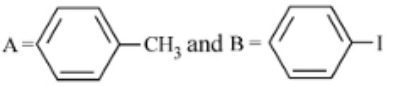


Identify products A and B.

(1) A =  and B =

(2) A =  and B =

(3) A =  and B =

(4) A =  and B =

Correct Answer: (3) A = CH_3, B = I

Solution:

The reaction involves a dehydration of alcohol (CH_2OH) with HI to form alkyl iodide (CH_3I) and water. Hence, the correct answer is (3).

Quick Tip

When alcohols react with HI, they undergo nucleophilic substitution to form alkyl iodides.

---

91. The reaction that does NOT take place in a blast furnace between 900 K to 1500 K temperature range during extraction of iron is:

(1) $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$

(2) $FeO + CO \rightarrow Fe + CO_2$

(3) $C + CO_2 \rightarrow 2CO$

(4) $CaO + SiO_2 \rightarrow CaSiO_3$

Correct Answer: (1) $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$

Solution:

In the blast furnace, iron is reduced from iron oxide using coke (carbon). The reaction $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$ does not typically occur in the blast furnace conditions. The correct reaction involves the reduction of iron ore by carbon monoxide and carbon. Hence, the correct answer is (1).

Quick Tip

In the extraction of iron in a blast furnace, carbon monoxide plays a key role in reducing iron oxides to metallic iron.

---

92. Which amongst the following options is the correct relation between change in enthalpy and change in internal energy?

(1) $\Delta H = \Delta U - \Delta n_g RT$

(2) $\Delta H = \Delta U + \Delta n_g RT$

(3) $\Delta H = \Delta U = -\Delta nRT$

(4) $\Delta H + \Delta U = \Delta nR$

Correct Answer: (2) $\Delta H = \Delta U + \Delta n_g RT$

Solution:

The relation between enthalpy change (ΔH) and internal energy change (ΔU) is given by $\Delta H = \Delta U + \Delta n_g RT$, where Δn_g is the change in the number of moles of gas. Hence, the correct answer is (2).

Quick Tip

In thermodynamics, the relation $\Delta H = \Delta U + \Delta n_g RT$ helps connect the change in enthalpy and internal energy for reactions involving gases.

---

93. On balancing the given redox reaction,

$$\text{a } Cr_2O_7^{2-} + \text{b } SO_3^{2-} + \text{c } H^+ \rightarrow 2Cr^{3+} + \text{b } SO_4^{2-} + \frac{\text{c}}{2}H_2O$$

the coefficients a, b, and c are found to be, respectively:

(1) 1, 3, 8

(2) 3, 8, 1

(3) 1, 8, 3

(4) 8, 1, 3

Correct Answer: (1) 1, 3, 8

Solution:

Balancing redox reactions involves balancing the number of atoms and charges. The correct coefficients for this reaction are 1, 3, and 8 for Cr, SO_3^{2-}, and H^+, respectively. Hence, the correct answer is (1).

Quick Tip

Balancing redox reactions requires attention to both atom and charge conservation. The half-reaction method is often helpful.

---

94. What fraction of one edge-centered octahedral void lies in one unit cell of fcc?

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

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

(3) $\frac{1}{4}$

(4) $\frac{1}{12}$

Correct Answer: (3) $\frac{1}{4}$

Solution:

In a face-centered cubic (fcc) lattice, the edge-centered octahedral void contributes $\frac{1}{4}$ of the void to each unit cell. Hence, the correct answer is (3).

Quick Tip

In fcc crystals, there are edge-centered octahedral voids, and each unit cell contains a fraction of the voids based on the geometry of the lattice.

---

95. Given below are two statements:

Statement I: The nutrient deficient water bodies lead to eutrophication.

Statement II: Eutrophication leads to decrease in the level of oxygen in the water bodies.

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

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

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

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

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

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

Solution:

Statement I is incorrect because nutrient-deficient water bodies do not lead to eutrophication, rather nutrient-rich water bodies do. Statement II is correct because eutrophication does result in a decrease in oxygen levels. Hence, the correct answer is (4).

Quick Tip

Eutrophication is the process by which water bodies become enriched with nutrients, leading to excessive growth of algae and depletion of oxygen.

---

96. The equilibrium concentrations of the species in the reaction $A + B \rightleftharpoons C + D$ are 2, 3, 10 and 6 mol L^{-1}, respectively at 300 K. ΔG° for the reaction is (R = 2 cal/mol/K).

(1) 1372.60 cal

(2) 137.26 cal

(3) 1381.80 cal

(4) 13.73 cal

Correct Answer: (3) 1381.80 cal

Solution:

Using the equation $\Delta G^\circ = -RT \ln Q$, where $Q = \frac{[C][D]}{[A][B]}$. Substituting the values, we calculate $\Delta G^\circ \approx 1381.80$ cal. Hence, the correct answer is (3).

Quick Tip

The equation $\Delta G^\circ = -RT \ln Q$ helps calculate the Gibbs free energy change for a reaction at equilibrium.

---

97. Which complex compound is most stable?

(1) $[Co(NH_3)_4(H_2O)Br](NO_3)_2$

(2) $[Co(NH_3)_3(NO_3)_3]$

(3) $[CoCl_2(en)_2]NO_3$

(4) $[Co(NH_3)_6](SO_4)_3$

Correct Answer: (3) $[CoCl_2(en)_2]NO_3$

Solution:

Among the given options, the complex $[CoCl_2(en)_2]NO_3$ is the most stable due to the coordination number and the ligand environment. Hence, the correct answer is (3).

Quick Tip

The stability of a complex depends on the nature of the ligands, the metal ion, and the coordination number.

---

98. Match List - I with List - II:

List - I (Oxoacids)

A. Peroxodisulphuric acid

B. Sulphuric acid

C. Pyrosulphuric acid

D. Sulphurous acid

List - II (Bonds of Sulphur)

I. Two S-OH, Four S=O

II. Two S-OH, One S=O

III. Two S-OH, Four S=O, One S-O-S

IV. Two S-OH, Two S=O

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

The bonding in oxoacids of sulfur varies based on oxidation states and the nature of the bonds. Hence, the correct matches are as follows: A-III, B-II, C-I, D-IV.

Quick Tip

For oxoacids, the structure and bonding depend on the oxidation state of the central atom and the number of oxygen atoms.

---

99. Pumice stone is an example of:

(1) sol

(2) gel

(3) solid sol

(4) foam

Correct Answer: (3) solid sol

Solution:

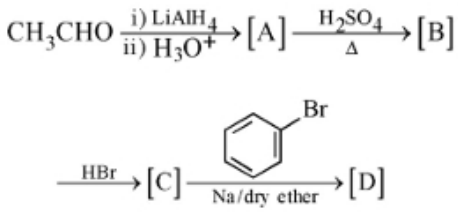
Pumice stone is a solid foam made of volcanic rock. It is classified as a solid sol due to its structure. Hence, the correct answer is (3).

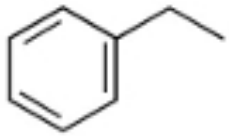
Quick Tip

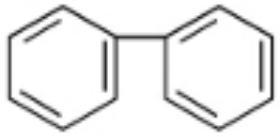
A solid sol is a colloidal solution in which a solid is dispersed in another solid.

---

100. Identify the final product [D] obtained in the following sequence of reactions.



(1) 

(2) 

(3) C_4H_{10}

(4) $HC \equiv C^{\ominus}\ Na^{+}$

Correct Answer: (1) C_4H_10

Solution:

The reaction sequence involves the reduction of an aldehyde to a primary alcohol followed by dehydration and formation of a product with four carbon atoms. Hence, the final product is C_4H_10.

Quick Tip

Aldehydes can be reduced to alcohols by lithium aluminum hydride ($LiAlH_4$), followed by dehydration to form alkenes.

Botany : Section-A (Q. No. 101 to 135)

101. Given below are two statements:

Statement I: The forces generated by transpiration can lift a xylem-sized column of water over 130 meters height.

Statement II: Transpiration cools leaf surfaces sometimes 10 to 15 degrees, by evaporative cooling.

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

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

(2) Both Statement I and Statement II are incorrect.

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

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

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

Solution:

Transpiration plays a vital role in moving water through plants, and the cooling of leaf surfaces due to evaporation is well documented. Therefore, both statements are true. Hence, the correct answer is (1).

Quick Tip

Transpiration not only helps with water movement but also cools the plant through evaporative cooling.

---

102. In gene gun method used to introduce alien DNA into host cells, microparticles of metal are used.

(1) Copper

(2) Zinc

(3) Tungsten or gold

(4) Silver

Correct Answer: (3) Tungsten or gold

Solution:

In the gene gun method, microparticles of gold or tungsten are used to carry DNA into plant cells. Hence, the correct answer is (3).

Quick Tip

Gold or tungsten particles are often used in gene guns due to their high density, which allows them to carry DNA efficiently into the plant cells.

---

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

Assertion A: The first stage of gametophyte in the life cycle of moss is protonema stage.

Reason R: Protonema develops directly from spores produced in capsule.

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

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

(2) Both A and R are correct but R is NOT the correct explanation of A.

(3) A is correct but R is not correct.

(4) A is not correct but R is correct.

Correct Answer: (1) Both A and R are correct and R is the correct explanation of A.

Solution:

The protonema stage is the first stage of the moss gametophyte, and it does indeed develop from spores produced in the capsule. Hence, both statements are correct and R correctly explains A. Hence, the correct answer is (1).

Quick Tip

The protonema stage in mosses is a crucial developmental stage that emerges from spores.

---

104. Unequivocal proof that DNA is the genetic material was first proposed by

(1) Frederick Griffith

(2) Alfred Hershey and Martha Chase

(3) Avery, Macleod and McCarty

(4) Wilkins and Franklin

Correct Answer: (2) Alfred Hershey and Martha Chase

Solution:

The famous Hershey-Chase experiment in 1952 provided unequivocal evidence that DNA is the genetic material by using radioactive isotopes to trace DNA and proteins. Hence, the correct answer is (2).

Quick Tip

The Hershey-Chase experiment with bacteriophages confirmed DNA, not protein, carries genetic information.

---

105. The thickness of ozone in a column of air in the atmosphere is measured in terms of:

(1) Dobson units (DU)

(2) Decibels

(3) Decameter

(4) Kilobase

Correct Answer: (1) Dobson units (DU)

Solution:

The thickness of the ozone layer is commonly measured in Dobson units (DU), which indicate the total amount of ozone in a column of air. Hence, the correct answer is (1).

Quick Tip

Dobson units are used to measure the total column of ozone in the atmosphere.

---

106. In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as:

(1) Differentiation

(2) Dedifferentiation

(3) Development

(4) Senescence

Correct Answer: (2) Dedifferentiation

Solution:

Dedifferentiation occurs when specialized cells revert to an earlier, less specialized state, as seen when mesophyll cells form a callus in tissue culture. Hence, the correct answer is (2).

Quick Tip

Dedifferentiation is a key process in plant tissue culture where differentiated cells regain the ability to divide and form new tissues.

---

107. Large, colourful, fragrant flowers with nectar are seen in:

(1) Insect pollinated plants

(2) Bird pollinated plants

(3) Bat pollinated plants

(4) Wind pollinated plants

Correct Answer: (2) Bird pollinated plants

Solution:

Bird-pollinated plants often have large, colorful, fragrant flowers that provide nectar to attract birds. Hence, the correct answer is (2).

Quick Tip

Bird-pollinated plants tend to have brightly colored flowers and are usually rich in nectar.

---

108. Frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes to map their position on chromosome, was used for the first time by:

(1) Thomas Hunt Morgan

(2) Sutton and Boveri

(3) Alfred Sturtevant

(4) Henking

Correct Answer: (3) Alfred Sturtevant

Solution:

Alfred Sturtevant was the first to use recombination frequency to map genes on chromosomes. Hence, the correct answer is (3).

Quick Tip

Recombination frequency is a key concept in gene mapping, first introduced by Alfred Sturtevant.

---

109. Which amongst the following stages of meiosis involves division of centromere?

(1) Metaphase I

(2) Metaphase II

(3) Anaphase II

(4) Telophase

Correct Answer: (3) Anaphase II

Solution:

The division of the centromere, separating the sister chromatids, occurs during Anaphase II in meiosis. Hence, the correct answer is (3).

Quick Tip

In meiosis, centromere division and separation of sister chromatids occur during Anaphase II.

---

110. What is the role of RNA polymerase III in the process of transcription in Eukaryotes?

(1) Transcription of rRNAs (28S, 18S and 5.8S)

(2) Transcription of tRNA, 5S rRNA and snRNA

(3) Transcription of precursor of mRNA

(4) Transcription of only snRNAs

Correct Answer: (2) Transcription of tRNA, 5S rRNA and snRNA

Solution:

RNA polymerase III is responsible for transcribing tRNA, 5S rRNA, and small nuclear RNAs (snRNAs), which are involved in essential cellular processes such as translation. Hence, the correct answer is (2).

Quick Tip

RNA polymerase III transcribes small RNA molecules necessary for protein synthesis and gene regulation.

---

111. Among 'The Evil Quartet', which one is considered the most important cause driving extinction of species?

(1) Habitat loss and fragmentation

(2) Over exploitation for economic gain

(3) Alien species invasions

(4) Co-extinctions

Correct Answer: (1) Habitat loss and fragmentation

Solution:

Habitat loss and fragmentation are recognized as the primary causes driving species extinction, as they directly disrupt ecosystems and decrease biodiversity. Hence, the correct answer is (1).

Quick Tip

Habitat loss is a key factor in the decline of many species, as it disrupts their living conditions and access to resources.

---

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

Assertion A: Endarch and exarch are the terms used for describing the position of secondary xylem in the plant body.

Statement II: Exarch condition is the most common feature of the root system.

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

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

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

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

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

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

Solution:

Exarch condition is indeed typical of roots, but endarch and exarch conditions refer to the arrangement of vascular tissue in stems, not the root system. Hence, the correct answer is (4).

Quick Tip

Endarch and exarch refer to the arrangement of vascular tissues in plants, with exarch being typical of roots.

---

113. Axile placentation is observed in

(1) Mustard, Cucumber and Primrose

(2) China rose, Beans and Lupin

(3) Tomato, Dianthus and Pea

(4) China rose, Petunia and Lemon

Correct Answer: (4) China rose, Petunia and Lemon

Solution:

Axile placentation is a type of placentation where ovules are borne on the central axis of the ovary, as seen in China rose, Petunia, and Lemon. Hence, the correct answer is (4).

Quick Tip

Axile placentation places the ovules on the central axis inside the ovary.

---

114. Expressed Sequence Tags (ESTs) refers to

(1) All genes that are expressed as RNA.

(2) All genes that are expressed as proteins.

(3) All genes whether expressed or unexpressed.

(4) Certain important expressed genes.

Correct Answer: (1) All genes that are expressed as RNA.

Solution:

Expressed Sequence Tags (ESTs) are short sequences of complementary DNA (cDNA) that represent genes that are actively transcribed in a cell. Hence, the correct answer is (1).

Quick Tip

ESTs help identify the presence of gene expression in different tissues and under various conditions.

---

115. What is the function of tassels in the corn cob?

(1) To attract insects

(2) To trap pollen grains

(3) To disperse pollen grains

(4) To protect seeds

Correct Answer: (2) To trap pollen grains

Solution:

The tassels in corn produce and release pollen grains that are trapped by the silk of the ear to facilitate fertilization. Hence, the correct answer is (2).

Quick Tip

Tassels are crucial for the reproductive process in corn as they help in pollen production and dispersal.

---

116. Spraying of which of the following phytohormone on juvenile conifers helps in hastening the maturity period, that leads to early seed production?

(1) Indole-3-butyric Acid

(2) Gibberellic Acid

(3) Zeatin

(4) Abscisic Acid

Correct Answer: (2) Gibberellic Acid

Solution:

Gibberellic acid is a plant hormone that accelerates growth and development, including

hastening the maturity of conifers to produce seeds earlier. Hence, the correct answer is (2).

Quick Tip

Gibberellic acid is used to induce early flowering and seed production in conifers and other plants.

---

117. In the equation

$GPP = R + NPP$

GPP is Gross Primary Productivity

NPP is Net Primary Productivity

R here is

(1) Photosynthetically active radiation

(2) Respiratory quotient

(3) Respiratory loss

(4) Reproductive allocation

Correct Answer: (3) Respiratory loss

Solution:

In the equation $GPP = R + NPP$, R represents the respiratory loss, which is the amount of energy used by the plant for respiration. Hence, the correct answer is (3).

Quick Tip

Respiratory loss refers to the energy used by the plant for maintaining its cellular functions.

---

118. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in Solanaceae or Liliaceae.

(1) Diadelphous and Dithecous anthers

(2) Polyadelphous and epipetalous stamens

(3) Monoadelphous and Monothecous anthers

(4) Epiphylous and Dithecous anthers

Correct Answer: (1) Diadelphous and Dithecous anthers

Solution:

In Fabaceae, the stamens are diadelphous (grouped into two sets) and dithecous (having two pollen sacs). These features are not found in Solanaceae or Liliaceae. Hence, the correct answer is (1).

Quick Tip

Fabaceae is distinct for its diadelphous stamens and dithecous anthers, a unique characteristic in the plant kingdom.

---

119. In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are:

(1) Synergids, Primary endosperm nucleus and zygote

(2) Antipodals, synergids, and primary endosperm nucleus

(3) Synergids, Zygote and Primary endosperm nucleus

(4) Synergids, antipodals and Polar nuclei

Correct Answer: (3) Synergids, Zygote and Primary endosperm nucleus

Solution:

In angiosperms, the correct sequence is the synergids, zygote, and primary endosperm nucleus. The synergids help guide the pollen tube to the ovule, the zygote is formed after fertilization, and the primary endosperm nucleus helps form the endosperm. Hence, the correct answer is (3).

Quick Tip

The sequence of events in fertilization of angiosperms involves the formation of synergids, zygote, and primary endosperm nucleus.

---

120. Which hormone promotes internode/petiole elongation in deep water rice?

(1) GA3

(2) Kinetin

(3) Ethylene

(4) 2, 4-D

Correct Answer: (3) Ethylene

Solution:

Ethylene is the hormone that promotes internode and petiole elongation in plants, especially in response to submergence in deep water rice. Hence, the correct answer is (3).

Quick Tip

Ethylene promotes growth in response to environmental stress, especially in plants grown in flooded or waterlogged conditions.

---

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

Assertion A: Late wood has fewer xylary elements with narrow vessels.

Reason R: Cambium is less active in winters.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

Correct Answer: (1) Both A and R are true and R is the correct explanation of A.

Solution:

During winter, the cambium is less active, leading to the formation of late wood, which is characterized by fewer xylary elements and narrower vessels. Hence, both statements are true and the reason correctly explains the assertion. The correct answer is (1).

Quick Tip

In trees, the width and number of xylem vessels vary with the seasons. Narrower vessels are formed when cambium activity is low, such as in winter.

---

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

Assertion A: ATP is used at two steps in glycolysis.

Reason R: First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1,6-diphosphate.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

Correct Answer: (1) Both A and R are true and R is the correct explanation of A.

Solution:

ATP is used in two steps of glycolysis: the phosphorylation of glucose to glucose-6-phosphate and the conversion of fructose-6-phosphate into fructose-1,6-diphosphate. Hence, both statements are true, and the reason correctly explains the assertion. The correct answer is (1).

Quick Tip

Remember that glycolysis involves both energy investment and energy payoff stages. The first two steps require ATP investment to initiate the process.

---

123. Identify the correct statements:

A. Detritivores perform fragmentation.

B. The humus is further degraded by some microbes during mineralization.

C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.

D. The detritus food chain begins with living organisms.

E. Earthworms break down detritus into smaller particles by a process called catabolism.

Choose the correct answer from the options given below:

(1) A, B, C only

(2) B, C, D only

(3) C, D, E only

(4) D, E, A only

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

Solution:

Detritivores break down organic matter into smaller particles (fragmentation), and microbes further degrade humus. Water soluble inorganic nutrients are leached into the soil. Hence, the correct answer is (1).

Quick Tip

Leaching, fragmentation, and mineralization are key processes in the nutrient cycling of ecosystems. Detrivores play a crucial role in breaking down organic material.

---

124. The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?

(1) Zygotene

(2) Pachytene

(3) Diplotene

(4) Diakinesis

Correct Answer: (2) Pachytene

Solution:

Recombination nodules are formed during the pachytene stage of prophase I of meiosis. Hence, the correct answer is (2).

Quick Tip

In meiosis, recombination occurs during the pachytene stage, which is characterized by crossing-over between homologous chromosomes.

---

125. How many ATP and $NADPH_2$ are required for the synthesis of one molecule of Glucose during Calvin cycle?

(1) 12 ATP and 12 $NADPH_2$

(2) 18 ATP and 12 $NADPH_2$

(3) 12 ATP and 16 $NADPH_2$

(4) 18 ATP and 16 $NADPH_2$

Correct Answer: (2) 18 ATP and 12 $NADPH_2$

Solution:

For the synthesis of one molecule of glucose in the Calvin cycle, 18 ATP and 12 $NADPH_2$ are required. Hence, the correct answer is (2).

Quick Tip

The Calvin cycle involves the reduction of carbon dioxide to glucose, requiring energy in the form of ATP and NADPH2, both produced during the light reactions of photosynthesis.

---

126. The phenomenon of pleiotropism refers to

(1) Presence of several alleles of a single gene controlling a single crossover.

(2) Presence of two alleles, each of the two genes controlling a single trait.

(3) A single gene affecting multiple phenotypic expression.

(4) More than two genes affecting a single character.

Correct Answer: (3) A single gene affecting multiple phenotypic expression.

Solution:

Pleiotropism refers to the ability of a single gene to influence multiple phenotypic traits. Hence, the correct answer is (3).

Quick Tip

Pleiotropism is an important concept in genetics, as a single gene can influence multiple traits, as seen in certain genetic disorders.

---

127. Upon exposure to UV radiation, DNA stained with ethidium bromide will show

(1) Bright red colour

(2) Bright blue colour

(3) Bright yellow colour

(4) Bright orange colour

Correct Answer: (4) Bright orange colour

Solution:

When DNA is stained with ethidium bromide and exposed to UV radiation, it emits a bright orange color. Hence, the correct answer is (4).

Quick Tip

Ethidium bromide is commonly used in molecular biology for staining DNA in gel electrophoresis, as it emits bright orange fluorescence when exposed to UV light.

---

128. The reaction centre in PS II has an absorption maxima at

(1) 680 nm

(2) 700 nm

(3) 660 nm

(4) 780 nm

Correct Answer: (1) 680 nm

Solution:

The reaction center in PS II absorbs light most efficiently at 680 nm, which is the characteristic absorption maximum. Hence, the correct answer is (1).

Quick Tip

The absorption maximum of PS II is crucial in photosynthesis for absorbing light energy, so remember 680 nm when studying light reactions.

---

129. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out

(1) RNA

(2) DNA

(3) Histones

(4) Polysaccharides

Correct Answer: (2) DNA

Solution:

DNA precipitates out of solution when ethanol is added, which is a standard step in the purification process of recombinant DNA technology. Hence, the correct answer is (2).

Quick Tip

To purify DNA, adding ethanol causes it to precipitate, making it easier to isolate. Keep this in mind when handling recombinant DNA.

---

130. Which micronutrient is required for splitting of water molecules during photosynthesis?

(1) Manganese

(2) Molybdenum

(3) Magnesium

(4) Copper

Correct Answer: (1) Manganese

Solution:

Manganese is a key micronutrient required for the splitting of water molecules during the light reactions of photosynthesis. Hence, the correct answer is (1).

Quick Tip

Manganese is essential in photosynthesis for water splitting. Remember it when studying the light-dependent reactions.

---

131. Movement and accumulation of ions across a membrane against their concentration gradient can be explained by

(1) Osmosis

(2) Facilitated Diffusion

(3) Passive Transport

(4) Active Transport

Correct Answer: (4) Active Transport

Solution:

Active transport is the process by which ions move across a membrane against their concentration gradient, requiring energy. Hence, the correct answer is (4).

Quick Tip

Active transport requires energy to move ions against their gradient, unlike passive transport which does not.

---

132. Among eukaryotes, replication of DNA takes place in

(1) M phase

(2) S phase

(3) G1 phase

(4) G2 phase

Correct Answer: (2) S phase

Solution:

DNA replication occurs during the S phase of the cell cycle in eukaryotes. Hence, the correct answer is (2).

Quick Tip

DNA replication happens in the S phase of the cell cycle. Keep this in mind as you study cell division and mitosis.

---

133. Cellulose does not form blue colour with iodine because

(1) It is a disaccharide.

(2) It is a helical molecule.

(3) It does not contain complex helices and hence cannot hold iodine molecules.

(4) It breaks down when iodine reacts with it.

Correct Answer: (3) It does not contain complex helices and hence cannot hold iodine molecules.

Solution:

Cellulose does not form a blue color with iodine because it does not form the helical structure required to bind iodine. Hence, the correct answer is (3).

Quick Tip

Iodine forms a blue color with starch due to its helical structure. Cellulose, however, lacks this helical structure.

---

134. The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year:

(1) 1985

(2) 1992

(3) 1986

(4) 2002

Correct Answer: (2) 1992

Solution:

The Earth Summit, which focused on biological diversity, was held in Rio de Janeiro in 1992. Hence, the correct answer is (2).

Quick Tip

The Earth Summit in 1992 was a landmark event in environmental history. Remember it when studying global environmental policy.

---

135. Identify the pair of heterosporous pteridophytes among the following:

(1) Lycopodium and Selaginella

(2) Selaginella and Salvinia

(3) Psilotum and Salvinia

(4) Equisetum and Salvinia

Correct Answer: (2) Selaginella and Salvinia

Solution:

Selaginella and Salvinia are both heterosporous pteridophytes, meaning they produce two types of spores, microspores and megaspores. Hence, the correct answer is (2).

Quick Tip

Heterosporous plants, like Selaginella and Salvinia, produce two different types of spores, unlike homosporous plants which produce one type.

Botany : Section-B (Q. No. 136 to 150)

136. Match List I with List II:

List I List II

A. M Phase I. Proteins are synthesized

B. G2 Phase II. Inactive phase

C. Quiescent stage III. Interval between mitosis and initiation of DNA replication

D. G1 Phase IV. Equational division

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- The M phase is associated with equational division, so it matches with IV. - G2 phase corresponds to the interval between mitosis and DNA replication, so it matches with III. - The quiescent stage is an inactive phase, so it corresponds to II. - G1 phase is the initial stage of the cell cycle before DNA replication begins, hence it corresponds to I. Therefore, the correct answer is (3).

Quick Tip

The cell cycle includes stages like G1, S, G2, and M phase. During the G1 phase, the cell grows and prepares for DNA synthesis, while the M phase involves mitosis and division.

---

137. Match List I with List II:

List I List II

A. Iron I. Synthesis of auxin

B. Zinc II. Component of nitrate reductase

C. Boron III. Activator of catalase

D. Molybdenum IV. Cell elongation and differentiation

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- Iron is an activator of catalase, so it corresponds to III. - Zinc is a component of nitrate reductase, so it corresponds to II. - Boron is involved in cell elongation and differentiation, so it corresponds to IV. - Molybdenum is involved in the synthesis of auxins, hence it corresponds to I. Therefore, the correct answer is (3).

Quick Tip

Essential micronutrients like iron, zinc, boron, and molybdenum play key roles in plant growth, such as enzyme activation and auxin synthesis.

---

138. Match List I with List II:

List I List II

A. Cohesion I. More attraction in liquid phase

B. Adhesion II. Mutual attraction among water molecules

C. Surface tension III. Water loss in liquid phase

D. Guttation IV. Attraction towards polar surfaces

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- Cohesion refers to the attraction between like molecules, which is stronger in the liquid phase (I). - Adhesion refers to the attraction between different molecules, particularly towards polar surfaces (IV). - Surface tension is caused by cohesive forces, hence it corresponds to I (the more attraction in liquid phase). - Guttation is the process of water loss through leaves in the form of droplets (III). Therefore, the correct answer is (1).

Quick Tip

In water, cohesion and adhesion are crucial for many biological processes, such as water transport in plants and the formation of surface tension.

---

139. How many different proteins does the ribosome consist of?

(1) 80

(2) 60

(3) 40

(4) 20

Correct Answer: (1) 80

Solution:

The ribosome consists of approximately 60 different proteins, in addition to ribosomal RNA (rRNA). These proteins are part of the ribosomal structure, which is involved in protein synthesis. Therefore, the correct answer is 60 proteins.

Quick Tip

Remember that the ribosome is composed of both rRNA and numerous proteins. The exact number of proteins may vary slightly depending on the organism, but 60 is a commonly accepted figure for many species.

---

140. Match List I with List II:

List I	**List II**
A. Oxidative decarboxylation	I. Citrate synthase
B. Glycolysis	II. Pyruvate dehydrogenase
C. Oxidative phosphorylation	III. Electron transport system
D. Tricarboxylic acid cycle	IV. EMP pathway

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-I, C-II, D-IV

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

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

Solution:

- Oxidative decarboxylation is related to Pyruvate dehydrogenase (A-II). - Glycolysis is associated with the EMP pathway (B-I). - Oxidative phosphorylation involves the Electron transport system (C-II). - The Tricarboxylic acid cycle is linked to Citrate synthase (D-I).

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

Quick Tip

In biochemistry, pathways and enzymes are often linked in specific sequences. Understanding the enzymes associated with each metabolic process helps to match them correctly.

---

141. Match List I with List II:

List I	**List II**
A. Mutualism	I. +(A), O(B)
B. Commensalism	II. -(A), O(B)
C. Amensalism	III. +(A), -(B)
D. Parasitism	IV. +(A), +(B)

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- Mutualism is a symbiotic relationship where both species benefit, hence A-IV. - Commensalism involves one species benefiting, while the other remains unaffected, hence B-I. - Amensalism involves one species being harmed and the other unaffected, hence C-II. - Parasitism is where one species benefits at the expense of the other, hence D-III.

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

Quick Tip

To match symbiotic relationships, remember the benefit or harm to both species involved. Mutualism benefits both, while parasitism harms one.

---

142. Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence.

A. Insertion of recombinant DNA into the host cell.

B. Cutting of DNA at specific location by restriction enzyme.

C. Isolation of desired DNA fragment.

Choose the correct answer from the options given below:

(1) B, C, D, A

(2) C, A, B

(3) C, B, A, D

(4) B, D, A, C

Correct Answer: (2) C, A, B

Solution:

The correct sequence for recombinant DNA formation is: 1. C - Isolate the desired DNA fragment. 2. A - Insert the recombinant DNA into the host cell. 3. B - Cut the DNA at a specific location using restriction enzymes.

Thus, the correct order is C, A, B.

Quick Tip

When forming recombinant DNA, always start by isolating the desired fragment before cutting, inserting, and amplifying the DNA.

---

143. Given below are two statements:

Statement I: Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually.

Statement II: In general, carnivores are more adversely affected by competition than herbivores.

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

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

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

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

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

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

Solution:

- **Statement I** is true: The Competitive Exclusion Principle suggests that when two species compete for the same resources, one will eventually outcompete the other, leading to the extinction or exclusion of the less competitive species. - **Statement II** is false: While it may seem that carnivores are more affected by competition, it is often herbivores that are more adversely affected due to direct competition for plant resources, which are limited and highly competitive.

Thus, the correct answer is that Statement I is true and Statement II is false.

Quick Tip

Remember that the Competitive Exclusion Principle applies to all types of species interactions, and the impact of competition can differ between carnivores and herbivores based on their feeding ecology and resource availability.

---

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

Assertion A: A flower is defined as a modified shoot wherein the shoot apical meristem changes to floral meristem.

Reason R: Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

Correct Answer: (1) Both A and R are true and R is the correct explanation of A.

Solution:

- **Assertion A** is true: A flower is indeed a modified shoot, where the shoot apical meristem undergoes a change to form a floral meristem. - **Reason R** is also true: The internodes of the shoot condense and produce floral appendages at the nodes, which is a key characteristic of floral development. - Since both the assertion and reason are true, and the reason provides the correct explanation for the assertion, the answer is (1).
Thus, the correct answer is that both Assertion A and Reason R are true, and R correctly explains A.

Quick Tip

Remember that in flower development, the shoot apical meristem changes to a floral meristem, which leads to the formation of floral organs at the nodes, explaining the reason behind floral structure formation.

---

145. Which of the following statements are correct about Klinefelter's Syndrome?
A. This disorder was first described by Langdon Down (1866).
B. Such an individual has overall masculine development. However, the feminine development is also expressed.
C. The affected individual is short-statured.
D. Physical, psychomotor and mental development is retarded.
E. Such individuals are sterile.
Choose the correct answer from the options given below:
(1) A and B only
(2) C and D only
(3) B and E only
(4) A and E only
Correct Answer: (3) B and E only
Solution:
- **Statement A** is incorrect: Klinefelter's syndrome was first described by Harry Klinefelter, not Langdon Down. - **Statement B** is correct: Individuals with Klinefelter's syndrome exhibit both masculine and feminine characteristics, with reduced masculine traits and some feminine characteristics. - **Statement C** is incorrect: Affected individuals are

usually tall, not short-statured. - **Statement D** is incorrect: While there may be some developmental delays, mental retardation is not a defining characteristic. - **Statement E** is correct: Individuals with Klinefelter's syndrome are sterile due to a lack of normal sperm production.

Thus, the correct answer is B and E only.

Quick Tip

Klinefelter's syndrome results from an extra X chromosome in males (47, XXY). It is important to differentiate it from other chromosomal disorders like Down syndrome, which has a different origin and manifestation.

---

146. Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

(1) Succinic dehydrogenase

(2) Amylase

(3) Lipase

(4) Dinitrogenase

Correct Answer: (1) Succinic dehydrogenase

Solution:

Melonate is known to inhibit the activity of succinic dehydrogenase, an enzyme involved in the citric acid cycle. This inhibition interferes with energy production in bacteria, thereby inhibiting their growth.

Thus, the correct answer is (1) Succinic dehydrogenase.

Quick Tip

Melonate acts as an inhibitor in biochemical pathways by blocking key enzymes like succinic dehydrogenase, which plays a crucial role in cellular respiration. This property is leveraged in controlling microbial growth.

---

147. Which one of the following statements is NOT correct?

(1) The micro-organisms involved in biodegradation of organic matter in a sewage polluted

water body consume a lot of oxygen causing the death of aquatic organisms.

(2) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.

(3) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body.

(4) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels.

Correct Answer: (2) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.

Solution:

- **Option 1** is correct: Microorganisms that degrade organic matter in sewage polluted water bodies consume oxygen, leading to oxygen depletion, which can harm aquatic organisms. - **Option 2** is incorrect: Algal blooms caused by excess organic matter, known as eutrophication, often decrease water quality and harm aquatic ecosystems by depleting oxygen levels and blocking sunlight. They do not promote fisheries. - **Option 3** is correct: Water hyacinth, a floating plant, grows rapidly in nutrient-rich (eutrophic) water bodies, leading to an imbalance in the ecosystem by blocking sunlight and disrupting oxygen exchange. - **Option 4** is correct: Toxic substances from industrial waste can accumulate in organisms, becoming more concentrated as they move up the food chain (biomagnification).

Thus, the correct answer is (2) Algal blooms caused by excess organic matter in water improve water quality and promote fisheries.

Quick Tip

Algal blooms often result from excessive nutrients in water bodies. While they can initially seem beneficial, they typically cause long-term damage to ecosystems and fisheries by disrupting oxygen balance and reducing biodiversity.

---

148. Which of the following combinations is required for chemiosmosis?

(1) membrane, proton pump, proton gradient, ATP synthase

(2) membrane, proton pump, proton gradient, NADP synthase

(3) proton pump, electron gradient, ATP synthase

(4) proton pump, electron gradient, NADP synthase

Correct Answer: (1) membrane, proton pump, proton gradient, ATP synthase

Solution:

Chemiosmosis is the process by which a proton gradient across a membrane is used to drive ATP synthesis through ATP synthase. The proton pump creates the proton gradient across the membrane, which is essential for ATP production.

Thus, the correct answer is (1) membrane, proton pump, proton gradient, ATP synthase.

Quick Tip

Remember that chemiosmosis relies on a proton gradient across a membrane and ATP synthase to produce ATP. This process occurs in both cellular respiration and photosynthesis.

---

149. Identify the correct statements:

A. Lenticels are the lens-shaped openings permitting the exchange of gases.

B. Bark formed early in the season is called hard bark.

C. Bark is a technical term that refers to all tissues exterior to vascular cambium.

D. Bark refers to periderm and secondary phloem.

E. Phellogen is single-layered in thickness.

Choose the correct answer from the options given below:

(1) B, C and E only

(2) A and D only

(3) A, B and D only

(4) B and C only

Correct Answer: (2) A and D only

Solution:

- **Statement A** is correct: Lenticels are small openings in the bark that allow gas exchange. - **Statement B** is incorrect: Bark formed early in the season is called soft bark, not hard bark. - **Statement C** is incorrect: Bark refers to all tissues exterior to the

vascular cambium, but this includes both periderm and secondary phloem, which is part of statement D. - **Statement D** is correct: Bark includes the periderm and secondary phloem. - **Statement E** is incorrect: Phellogen (cork cambium) is usually multilayered, not single-layered.

Thus, the correct answer is (2) A and D only.

Quick Tip

Remember that lenticels are gas-exchange openings in woody plants, and the bark consists of tissues outside the vascular cambium, including the periderm and secondary phloem.

---

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

Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

Reason R: Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

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

Solution:

- **Assertion A** is true: In gymnosperms, pollen grains are released from the microsporangium (male reproductive structures) and are carried by air currents to female cones. - **Reason R** is false: The pollen grains do not land directly on the archegonia (female reproductive structure) but on the pollen cone scales, where the pollen tube is formed to carry male gametes.

Thus, the correct answer is (3) A is true but R is false.

Quick Tip

In gymnosperms, pollen grains are carried by wind to the female cone, where they form a pollen tube to deliver male gametes. The idea that pollen grains land on archegonia is a misconception.

Zoology : Section-A (Q. No. 151 to 185)

151. Which of the following is not a cloning vector?

(1) BAC

(2) YAC

(3) pBR322

(4) Probe

Correct Answer: (4) Probe

Solution:

- **BAC (Bacterial Artificial Chromosome)** and **YAC (Yeast Artificial Chromosome)** are both used as cloning vectors in genetic engineering. - **pBR322** is also a well-known cloning vector used in molecular biology. - **Probe**, however, is not a cloning vector; it is a sequence of nucleic acid used to detect the presence of complementary sequences.

Thus, the correct answer is (4) Probe.

Quick Tip

Cloning vectors are used to carry foreign DNA into host cells. Probes are used to detect specific sequences in DNA but are not vectors for cloning.

---

152. Broad palm with single palm crease is visible in a person suffering from-

(1) Down's syndrome

(2) Turner's syndrome

(3) Klinefelter's syndrome

(4) Thalassemia

Correct Answer: (1) Down's syndrome

Solution:

The characteristic feature of **Down's syndrome** (also known as trisomy 21) is the presence of a single transverse palmar crease. This is a common physical feature of individuals with Down's syndrome.

Thus, the correct answer is (1) Down's syndrome.

Quick Tip

In Down's syndrome, physical traits like a single palmar crease and cognitive impairment are commonly observed. Always associate physical traits with specific genetic conditions for better understanding.

---

153. Which of the following are NOT considered as part of the endomembrane system?

A. Mitochondria

B. Endoplasmic Reticulum

C. Chloroplasts

D. Golgi complex

E. Peroxisomes

Choose the most appropriate answer from the options given below:

(1) B and D only

(2) A, C and E only

(3) A and D only

(4) A, D and E only

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

Solution:

- **Mitochondria**, **Chloroplasts**, and **Peroxisomes** are not part of the endomembrane system. - The **Endoplasmic Reticulum**, **Golgi complex**, and vesicles are part of the endomembrane system, which is involved in the synthesis, modification, and transport of proteins and lipids.

Thus, the correct answer is (2) A, C and E only.

Quick Tip

The endomembrane system includes organelles that are involved in protein and lipid transport, like the endoplasmic reticulum and Golgi apparatus, but not mitochondria, chloroplasts, or peroxisomes.

---

154. Match List I with List II.

List I **List II**

A. Taenia I. Nephridia

B. Paramoecium II. Contractile vacuole

C. Periplaneta III. Flame cells

D. Pheretima IV. Ureose gland

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Taenia** (a parasitic flatworm) has **flame cells** for excretion. - **Paramoecium** (a ciliate protozoan) has a **contractile vacuole** for osmoregulation. - **Periplaneta** (cockroach) has **ureose glands** for excretion. - **Pheretima** (earthworm) has **nephridia** for excretion.

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

Quick Tip

Different organisms have different excretory structures adapted to their habitat. Flame cells in flatworms, contractile vacuoles in protists, and nephridia in annelids are examples of these adaptations.

---

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

Assertion A: Amniocentesis for sex determination is one of the strategies of Reproductive and Child Health Care Programme.

Reason R: Ban on amniocentesis checks increasing menace of female foeticide.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

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

Solution:

- **Assertion A** is false: Amniocentesis is often used for detecting genetic disorders, but it is not part of the Reproductive and Child Health Care Programme for promoting sex determination. - **Reason R** is true: The ban on amniocentesis indeed addresses the issue of female foeticide, as the procedure can be misused for sex selection.

Thus, the correct answer is (4) A is false but R is true.

Quick Tip

Amniocentesis is a medical procedure used to diagnose genetic conditions but can be misused for sex determination, which is why its ban helps prevent female foeticide.

---

156. Given below are two statements:

Statement I: Ligaments are dense irregular tissue.

Statement II: Cartilage is dense regular tissue.

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

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

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

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

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

Correct Answer: (2) Both Statement I and Statement II are false.

Solution:

- **Statement I** is false: Ligaments are actually composed of dense **regular** connective tissue, not irregular. - **Statement II** is false: Cartilage is a type of **specialized connective tissue** and not classified as dense regular tissue.

Thus, the correct answer is (2) Both Statement I and Statement II are false.

Quick Tip

Ligaments are dense regular connective tissues that connect bones, while cartilage is a specialized tissue with varying densities and is not considered dense regular tissue.

---

157. Match List I with List II.

List I	**List II**
A. P - wave	I. Beginning of systole
B. Q - wave	II. Repolarisation of ventricles
C. QRS complex	III. Depolarisation of atria
D. T - wave	IV. Depolarisation of ventricles

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-IV, C-I, D-III

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

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

Solution:

- **A. P-wave** represents the **depolarisation of the atria**, so it matches with **III**. - **B. Q-wave** represents the **beginning of systole**, so it matches with **I**. - **C. QRS complex** represents the **depolarisation of ventricles**, so it matches with **IV**. - **D. T-wave** represents the **repolarisation of ventricles**, so it matches with **II**.

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

Quick Tip

The P-wave corresponds to atrial depolarisation, while the QRS complex corresponds to ventricular depolarisation. The T-wave indicates ventricular repolarisation.

---

158. Match List I with List II.

List I **List II**

A. Peptic cells I. Mucus

B. Goblet cells II. Bile juice

C. Oxynic cells III. Proenzyme pepsinogen

D. Hepatic cells IV. HCl and intrinsic factor for absorption of vitamin B12

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Peptic cells** secrete **proenzyme pepsinogen** (A-III). - **Goblet cells** secrete **mucus** (B-I). - **Oxynic cells** secrete **HCl and intrinsic factor** for absorption of vitamin B12 (C-IV). - **Hepatic cells** secrete **bile juice** (D-II).

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

Quick Tip

Remember that different cells in the digestive system secrete different substances such as enzymes (pepsinogen), protective mucus, bile, and hydrochloric acid, each contributing to digestion and absorption.

---

159. Match List I with List II.

List I **List II**

A. Vasectomy I. Oral method

B. Coitus II. Barrier method

C. Cervical caps III. Surgical method

D. Saheli IV. Natural method

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Vasectomy** is a **surgical method** of contraception (A-III). - **Coitus** refers to sexual intercourse and is associated with the **natural method** of contraception (B-IV). - **Cervical caps** are part of the **barrier method** of contraception (C-I). - **Saheli** is a contraceptive pill, which is a **oral method** (D-II).

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

Quick Tip

Contraceptive methods can be divided into categories such as surgical, barrier, oral, and natural methods. It's important to understand which methods fall under each category.

---

160. Given below are two statements:

Statement I: Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

Statement II: The cavity of the cervix is called cervical canal which along with vagina forms birth canal.

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

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

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

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

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

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

Solution:

- **Statement I** is true: The **vas deferens** carries sperm from the epididymis and receives fluid from the **seminal vesicle** before opening into the urethra as the **ejaculatory duct**. - **Statement II** is true: The **cervical canal** is the passage between the uterus and the vagina, and together with the vagina, it forms the **birth canal** through which the baby passes during childbirth.

Thus, the correct answer is (1) Both Statement I and Statement II are true.

Quick Tip

The vas deferens and ejaculatory duct are involved in the male reproductive system, while the cervical canal and vagina form the birth canal in the female reproductive system.

---

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

Assertion A: Nephrons are of two types: Cortical Juxta medullary, based on their relative position in cortex and medulla.

Reason R: Juxta medullary nephrons have short loop of Henle whereas cortical nephrons have longer loop of Henle.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

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

Solution:

- **Assertion A** is true: Nephrons are classified into two types based on their position: **Cortical nephrons** (located mainly in the cortex) and **Juxta medullary nephrons**

(located at the junction of cortex and medulla). - **Reason R** is false: **Cortical nephrons** actually have **short loops of Henle**, while **juxta medullary nephrons** have longer loops of Henle that extend deep into the medulla.

Thus, the correct answer is (3) A is true but R is false.

Quick Tip

Remember that the length of the loop of Henle is a key characteristic used to differentiate between cortical and juxta medullary nephrons.

---

162. Given below are two statements:

Statement I: Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

Statement II: When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as a competitive inhibitor.

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

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

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

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

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

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

Solution:

- **Statement I** is true: Low temperatures slow down enzymatic activity by maintaining the enzyme in a temporarily inactive state, while high temperatures denature the enzyme, destroying its function. - **Statement II** is true: **Competitive inhibition** occurs when an inhibitor closely resembles the substrate and competes for binding to the enzyme's active site.

Thus, the correct answer is (1) Both Statement I and Statement II are true.

Quick Tip

Enzymes are sensitive to temperature, and changes in temperature can have a significant impact on their activity. Competitive inhibitors reduce the effectiveness of an enzyme by mimicking the substrate.

---

163. Match List I with List II.

List I	**List II**
A. Gene 'a'	I. β-galactosidase
B. Gene 'y'	II. Transacetylase
C. Gene 'z'	III. Permease
D. Gene 'e'	IV. Repressor protein

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Gene 'a'** corresponds to **transacetylase** (A-II). - **Gene 'y'** corresponds to **permease** (B-III). - **Gene 'z'** corresponds to **repressor protein** (C-IV). - **Gene 'e'** corresponds to **β-galactosidase** (D-I).

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

Quick Tip

Understanding the function of specific genes helps in linking them to their respective proteins and their roles in metabolic pathways like the lac operon.

---

164. Match List I with List II.

List I	**List II**

A. Ringworm I. Haemophilus influenzae

B. Filariasis II. Trichophyton

C. Malaria III. Wuchereria bancrofti

D. Pneumonia IV. Plasmodium vivax

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Ringworm** is caused by **Trichophyton** (A-II). - **Filariasis** is caused by **Wuchereria bancrofti** (B-III). - **Malaria** is caused by **Plasmodium vivax** (C-IV). - **Pneumonia** is caused by **Haemophilus influenzae** (D-I).

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

Quick Tip

Fungal, parasitic, and bacterial infections have specific pathogens. Understanding the causative organisms helps in diagnosing and treating diseases effectively.

---

165. Which of the following functions is carried out by cytoskeleton in a cell?

(1) Nuclear division

(2) Protein synthesis

(3) Motility

(4) Transportation

Correct Answer: (3) Motility

Solution:

The **cytoskeleton** is responsible for maintaining cell shape, enabling motility (movement of the cell), and facilitating the transport of organelles and vesicles within the cell. It is not directly involved in protein synthesis or nuclear division.

Thus, the correct answer is (3) Motility.

Quick Tip

The cytoskeleton is essential for various cellular processes, including movement, intracellular transport, and cell division. It forms the ”scaffolding” of the cell.

---

166. Which of the following statements is correct?

(1) Eutrophication refers to increase in domestic sewage and waste water in lakes.

(2) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.

(3) Presence of large amount of nutrients in water restricts ’Algal Bloom’

(4) Algal Bloom decreases fish mortality

Correct Answer: (2) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.

Solution:

- **Eutrophication** refers to the enrichment of water bodies with nutrients (not just sewage), leading to excessive growth of algae. - **Biomagnification** refers to the increase in the concentration of toxicants at each successive trophic level. - **Algal blooms** are caused by excess nutrients in water, not by their restriction. - **Algal blooms** increase fish mortality by depleting oxygen levels and releasing toxins.

Thus, the correct answer is (2) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.

Quick Tip

Biomagnification occurs as toxins accumulate in organisms at higher trophic levels, often affecting predators at the top of the food chain.

---

167. Match List I with List II.

List I	**List II**
A. Heroin	I. Effect on cardiovascular system

B. Marijuana II. Slow down body function

C. Cocaine III. Painkiller

D. Morphine IV. Interfere with transport of dopamine

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Heroin** slows down body functions and acts as a **depressant** (A-II). - **Marijuana** affects the cardiovascular system (B-I). - **Cocaine** interferes with the transport of dopamine (C-IV). - **Morphine** is a **painkiller** (D-III).

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

Quick Tip

Different drugs affect the body in various ways, such as altering heart rate, pain perception, and the nervous system's chemical balance.

---

168. Radial symmetry is NOT found in adults of phylum .....

(1) Ctenophora

(2) Hemichordata

(3) Coelenterata

(4) Echinodermata

Correct Answer: (2) Hemichordata

Solution:

- **Ctenophora**, **Coelenterata**, and **Echinodermata** all exhibit radial symmetry in their adult forms, while **Hemichordata** typically do not.

Thus, the correct answer is (2) Hemichordata.

Quick Tip

Radial symmetry is a body plan where body parts are arranged around a central axis, commonly found in cnidarians and echinoderms at various life stages.

---

169. Given below are two statements:

Statement I: In prokaryotes, the positively charged DNA is held with some negatively charged proteins in a region called nucleoid.

Statement II: In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome.

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

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

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

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

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

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

Solution:

- **Statement I** is incorrect: In prokaryotes, DNA is not held by positively charged proteins but by structural proteins that help in packaging the DNA. - **Statement II** is true: In eukaryotes, DNA is indeed negatively charged and wraps around positively charged histones to form nucleosomes.

Thus, the correct answer is (4) Statement I incorrect but Statement II is true.

Quick Tip

In prokaryotes, DNA is found in a nucleoid region without histones, while in eukaryotes, DNA is wrapped around histones, forming nucleosomes to help organize and package the DNA.

---

170. Which of the following statements are correct regarding female reproductive cycle?

A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle.

B. First menstrual cycle begins at puberty and is called menopause.

C. Lack of menstruation may be indicative of pregnancy.

D. Cyclic menstruation extends between menarche and menopause.

Choose the most appropriate answer from the options given below:

(1) A and D only

(2) A and B only

(3) A, B and C only

(4) A, C and D only

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

Solution:

- **Statement A** is correct: Non-primate mammals exhibit an **oestrus cycle**, where reproduction is influenced by hormonal changes. - **Statement B** is incorrect: The **first menstrual cycle** is called menarche, not menopause. **Menopause** occurs later in life when menstrual cycles cease. - **Statement C** is correct: **Lack of menstruation** may be indicative of **pregnancy** or other physiological factors. - **Statement D** is correct: **Cyclic menstruation** occurs between **menarche** (onset of menstruation) and **menopause** (cessation of menstruation).

Thus, the correct answer is (4) A, C and D only.

Quick Tip

The menstrual cycle and oestrus cycle are physiological processes associated with reproduction, but they differ between humans (menstrual cycle) and other mammals (oestrus cycle).

---

171. Select the correct group/set of Australian Marsupials exhibiting adaptive radiation.

(1) Tasmanian wolf, Bobcat, Marsupial mole

(2) Numbat, Spotted cuscus, Flying phalanger

(3) Mole, Flying squirrel, Tasmanian tiger cat

(4) Lemur, Anteater, Wolf

Correct Answer: (2) Numbat, Spotted cuscus, Flying phalanger

Solution:

Adaptive radiation refers to the rapid evolution of diversely adapted species from a common ancestor. The correct group of marsupials that exhibit adaptive radiation are **Numbat**, **Spotted cuscus**, and **Flying phalanger**.

Thus, the correct answer is (2) Numbat, Spotted cuscus, Flying phalanger.

Quick Tip

Adaptive radiation often occurs when species colonize a new environment and evolve to fill different ecological niches, leading to the formation of distinct species.

---

172. Which of the following techniques does not serve the purpose of early diagnosis of a disease for its early treatment?

(1) Recombinant DNA Technology

(2) Serum and Urine analysis

(3) Polymerase Chain Reaction (PCR) technique

(4) Enzyme Linked Immuno-Sorbent Assay (ELISA) technique

Correct Answer: (2) Serum and Urine analysis

Solution:

- **Recombinant DNA Technology**, **PCR**, and **ELISA** techniques are all molecular methods used for the early detection of diseases at the genetic or protein level, which is critical for early treatment. - **Serum and Urine analysis** is a diagnostic tool but does not typically provide the same level of early detection as the molecular techniques mentioned above.

Thus, the correct answer is (2) Serum and Urine analysis.

Quick Tip

Molecular techniques such as PCR and ELISA allow for the detection of diseases at very early stages, often before symptoms appear, which aids in early intervention and treatment.

---

173. Match List I with List II.

List I **List II**

A. Cartilaginous Joint I. Between flat skull bones

B. Ball and Socket Joint II. Between adjacent vertebrae in vertebral column

C. Fibrous Joint III. Between carpal and metacarpal of thumb

D. Saddle Joint IV. Between Humerus and Pectoral girdle

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Cartilaginous joints** are found **between flat skull bones** (A-I). - **Ball and Socket joint** is found **between the humerus and pectoral girdle** (B-II). - **Fibrous joints** are found **between adjacent vertebrae in the vertebral column** (C-III). - **Saddle joints** are found **between carpal and metacarpal of thumb** (D-IV).

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

Quick Tip

Joints are categorized based on their structure and function. Cartilaginous joints allow limited movement, while ball and socket joints provide wide movement.

---

174. Match List I with List II.

List I **List II**

A. A Leopard and a Lion in a forest/grassland I. Competition

B. A Cuckoo laying egg in a Crow's nest II. Brood parasitism

C. Fungi and root of a higher plant in Mycorrhiza III. Mutualism

D. A cattle egret and a Cattle in a field IV. Commensalism

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **A Leopard and a Lion** exhibit **competition** for territory or prey (A-I). - **A Cuckoo** laying eggs in a **Crow's nest** is an example of **brood parasitism** (B-II). - **Fungi and root of a higher plant in Mycorrhiza** exhibit **mutualism**, where both organisms benefit (C-III). - **A cattle egret** and a **Cattle in a field** exhibit **commensalism**, where the egret benefits by feeding on insects stirred up by the cattle (D-IV).

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

Quick Tip

Interactions in nature, such as competition, parasitism, mutualism, and commensalism, define the relationships between different species in an ecosystem.

---

175. Vital capacity of lung is .....

(1) IRV + ERV

(2) IRV + ERV + TV + RV

(3) IRV + ERV + TV - RV

(4) IRV + ERV + TV

Correct Answer: (4) IRV + ERV + TV

Solution:

Vital capacity is the maximum amount of air a person can exhale after a maximum inhalation. It is the sum of **inspiratory reserve volume (IRV)**, **expiratory reserve volume (ERV)**, and **tidal volume (TV)**. **Residual volume (RV)** is not part of vital capacity.

Thus, the correct answer is (4) IRV + ERV + TV.

Quick Tip

Vital capacity helps determine lung function and is a key indicator of respiratory health. It excludes residual volume, which cannot be voluntarily exhaled.

---

176. Match List I with List II with respect to the human eye.

List I **List II**

A. Fovea I. Visible coloured portion of eye that regulates diameter of pupil.

B. Iris II. External layer of eye formed of dense connective tissue.

C. Blind spot III. Point of greatest visual acuity or resolution.

D. Sclera IV. Point where optic nerve leaves the eyeball and photoreceptor cells are absent.

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Fovea**: **Point of greatest visual acuity or resolution** (A-III). - **Iris**: **Visible coloured portion of eye that regulates diameter of pupil** (B-I). - **Blind spot**: **Point where optic nerve leaves the eyeball and photoreceptor cells are absent** (C-IV). - **Sclera**: **External layer of eye formed of dense connective tissue** (D-II).

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

Quick Tip

The fovea is the region in the eye responsible for sharp central vision, while the blind spot is where the optic nerve exits the retina.

---

177. Once the undigested and unabsorbed substances enter the caecum, their backflow is

prevented by-

(1) Sphincter of Oddi

(2) Ileo - caecal valve

(3) Gastro - oesophageal sphincter

(4) Pyloric sphincter

Correct Answer: (2) Ileo - caecal valve

Solution:

The **ileocaecal valve** prevents the backflow of contents from the **caecum** into the ileum, thereby maintaining the proper direction of digestive contents.

Thus, the correct answer is (2) Ileo - caecal valve.

Quick Tip

The ileocaecal valve acts as a one-way valve that prevents the contents of the caecum from returning to the ileum.

---

178. Which one of the following common sexually transmitted diseases is completely curable when detected early and treated properly?

(1) Genital herpes

(2) Gonorrhoea

(3) Hepatitis-B

(4) HIV Infection

Correct Answer: (2) Gonorrhoea

Solution:

Gonorrhoea is a bacterial infection that can be completely cured with the appropriate antibiotic treatment, provided it is detected early. Other diseases like genital herpes, hepatitis-B, and HIV are viral infections that cannot be fully cured, though their symptoms can be managed.

Thus, the correct answer is (2) Gonorrhoea.

Quick Tip

For sexually transmitted diseases, early detection and treatment with antibiotics are key for a full cure in bacterial infections such as gonorrhoea.

---

179. Given below are two statements:

Statement I: A protein is imagined as a line, the left end represented by first amino acid (C-terminal) and the right end represented by last amino acid (N-terminal).

Statement II: Adult human haemoglobin consists of 4 subunits (two subunits of α type and two subunits of β type).

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

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

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

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

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

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

Solution:

- **Statement I** is false: The **N-terminal** is the first amino acid in a protein sequence, while the **C-terminal** is the last. - **Statement II** is true: **Adult human haemoglobin** consists of 4 subunits, specifically two **α-subunits** and two **β-subunits**.

Thus, the correct answer is (4) Statement I is false but Statement II is true.

Quick Tip

The N-terminal and C-terminal refer to the ends of a protein chain, and haemoglobin is a tetramer composed of two alpha and two beta subunits.

---

180. Given below are two statements:

Statement I: Electrostatic precipitator is most widely used in thermal power plant.

Statement II: Electrostatic precipitator in thermal power plant removes ionising radiations.

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

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

(2) Both Statement I and Statement II are incorrect.

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

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

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

Solution:

- **Statement I** is correct: **Electrostatic precipitators** are widely used in thermal power plants to remove particulate matter (dust, soot) from flue gases. - **Statement II** is incorrect: **Electrostatic precipitators** do not remove ionising radiations; they are used for particulate removal, not radiation control.

Thus, the correct answer is (3) Statement I is correct but Statement II is incorrect.

Quick Tip

Electrostatic precipitators work by charging dust particles and collecting them on oppositely charged plates to reduce pollution in industrial settings.

---

181. In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

(1) T H cells

(2) B-lymphocytes

(3) Basophils

(4) Eosinophils

Correct Answer: (1) T H cells

Solution:

HIV specifically targets **T helper (TH) cells**, which are a type of lymphocyte. HIV uses the CD4 receptors on these cells to enter, replicate, and produce progeny viruses.

Thus, the correct answer is (1) T H cells.

Quick Tip

HIV specifically targets **CD4+ T cells** (helper T cells), weakening the immune system by depleting these vital cells.

---

182. Given below are two statements:

Statement I: RNA mutates at a faster rate.

Statement II: Viruses having RNA genome and shorter life span mutate and evolve faster.

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

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

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

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

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

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

Solution:

- **Statement I** is correct: **RNA** genomes tend to mutate at a faster rate than **DNA** genomes because they lack proof-reading mechanisms during replication. - **Statement II** is correct: **RNA viruses**, due to their shorter lifespan and error-prone replication mechanisms, mutate and evolve faster than DNA viruses.

Thus, the correct answer is (1) Both Statement I and Statement II are true.

Quick Tip

RNA viruses mutate faster than DNA viruses due to their replication process, making them more prone to evolutionary changes.

---

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

Assertion A: Endometrium is necessary for implantation of blastocyst.

Reason R: In the absence of fertilization, the corpus luteum degenerates that causes disintegration of endometrium.

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

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

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

(3) A is true but R is false.

(4) A is false but R is true.

Correct Answer: (2) Both A and R are true but R is NOT the correct explanation of A.

Solution:

- **Assertion A** is true: The **endometrium** thickens to prepare for implantation of the blastocyst in a fertilized egg. - **Reason R** is true: In the absence of fertilization, the **corpus luteum** degenerates, leading to the disintegration of the endometrium, which results in menstruation. However, **Reason R** does not explain **Assertion A**, as the function of the endometrium in implantation is independent of the degeneration of the corpus luteum.

Thus, the correct answer is (2) Both A and R are true but R is NOT the correct explanation of A.

Quick Tip

The endometrium is crucial for implantation, and hormonal changes regulate its preparation and shedding during menstruation, regardless of fertilization.

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184. Match List I with List II:

List I	**List II**
A. CCK	I. Kidney
B. GIP	II. Heart
C. ANF	III. Gastric gland
D. ADH	IV. Pancreas

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **CCK** (Cholecystokinin) is secreted by the **pancreas** (A-IV). - **GIP** (Gastric inhibitory peptide) is secreted by the **gastric gland** (B-III). - **ANF** (Atrial natriuretic factor) is secreted by the **heart** (C-II). - **ADH** (Antidiuretic hormone) is secreted by the **kidney** (D-I).

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

Quick Tip

Hormones like CCK, GIP, ANF, and ADH have specific roles in regulating digestive and renal processes in the body.

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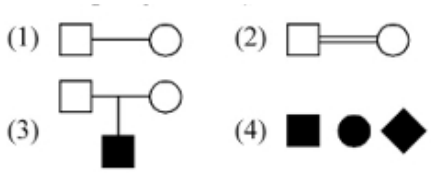
185. Which one of the following symbols represents mating between relatives in human pedigree analysis?



Correct Answer: (2) ■

Solution:

In human pedigree analysis, **■ $*$

$*represents mating between relatives, specifically in breeding (mating between close relatives).$

Thus, the correct answer is (2) ■.

Quick Tip

In pedigree analysis, various symbols are used to represent individuals, mating patterns, and relationships. The use of specific symbols helps identify inheritance patterns.

Zoology : Section-B (Q. No. 186 to 200)

186. The unique mammalian characteristics are:

(1) hairs, tympanic membrane and mammary glands

(2) hairs, pinna and mammary glands

(3) hairs, pinna and indirect development

(4) pinna, monocondylic skull and mammary glands

Correct Answer: (2) hairs, pinna and mammary glands

Solution:

Mammals are uniquely characterized by the presence of **hairs**, **pinna** (external ear), and **mammary glands**, which distinguish them from other vertebrates.

Thus, the correct answer is (2) hairs, pinna and mammary glands.

Quick Tip

Mammals have distinct characteristics such as hair, the ability to produce milk through mammary glands, and the presence of external ears (pinna).

---

187. Which of the following statements are correct?

A. Basophils are most abundant cells of the total WBCs

B. Basophils secrete histamine, serotonin and heparin

C. Basophils are involved in inflammatory response

D. Basophils have kidney shaped nucleus

E. Basophils are agranulocytes

Choose the correct answer from the options given below:

(1) D and E only

(2) C and E only

(3) B and C only

(4) A and B only

Correct Answer: (3) B and C only

Solution:

- **Statement A** is incorrect: **Basophils** are **not the most abundant cells** in the total WBCs. - **Statement B** is correct: **Basophils** secrete **histamine**,

serotonin, and **heparin** involved in inflammation. - **Statement C** is correct: **Basophils** are involved in the **inflammatory response**. - **Statement D** is incorrect: **Basophils** have a **lobed nucleus**, not kidney-shaped. - **Statement E** is incorrect: **Basophils** are **granulocytes**, not agranulocytes.

Thus, the correct answer is (3) B and C only.

Quick Tip

Basophils are a type of granulocyte involved in inflammatory responses by secreting chemicals like histamine that promote inflammation.

---

188. Select the correct statements with reference to chordates.

A. Presence of a mid-dorsal, solid and double nerve cord.

B. Presence of closed circulatory system.

C. Presence of paired pharyngeal gillslits.

D. Presence of dorsal heart.

E. Triploblastic pseudocoelomate animals.

Choose the correct answer from the options given below:

(1) A, C and D only

(2) B and C only

(3) B, D and E only

(4) C, D and E only

Correct Answer: (2) B and C only

Solution:

- **A** is incorrect: Chordates have a **hollow** nerve cord, not a solid one. - **B** is correct: Chordates possess a **closed circulatory system**. - **C** is correct: Chordates have **paired pharyngeal gill slits**. - **D** is incorrect: While many chordates have a dorsal heart, not all of them do. - **E** is incorrect: **Chordates** are triploblastic and coelomate, not pseudocoelomate.

Thus, the correct answer is (2) B and C only.

Quick Tip

Chordates are characterized by features such as a dorsal nerve cord, pharyngeal gill slits, and a closed circulatory system, distinguishing them from other animals.

---

189. Which of the following are NOT under the control of thyroid hormone?

A. Maintenance of water and electrolyte balance

B. Regulation of basal metabolic rate

C. Normal rhythm of sleep-wake cycle

D. Development of immune system

E. Support the process of RBCs formation

Choose the correct answer from the options given below:

(1) A and D only

(2) B and C only

(3) C and D only

(4) D and E only

Correct Answer: (3) C and D only

Solution:

- **Statement A** is controlled by thyroid hormones, which regulate water balance. - **Statement B** is controlled by thyroid hormones, which regulate basal metabolic rate. - **Statement C** is **not** controlled by thyroid hormones; sleep-wake cycles are influenced by other factors. - **Statement D** is **not** controlled by thyroid hormones; the immune system development is influenced by other hormones. - **Statement E** is controlled by thyroid hormones as they support RBC formation.

Thus, the correct answer is (3) C and D only.

Quick Tip

Thyroid hormones are essential for regulating metabolic processes, but they do not directly influence sleep-wake cycles or immune system development.

---

190. In cockroach, excretion is brought about by-

A. Phallic gland

B. Urecoce gland

C. Nephrocytes

D. Fat body

E. Collateral glands

Choose the correct answer from the options given below:

(1) A and E only

(2) B and C only

(3) A, B and E only

(4) C and D only

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

Solution:

Excretion in cockroaches involves **pharlic glands**, **urecoce glands**, and **collateral glands**. These glands help in the excretion and elimination of waste products from the body.

Thus, the correct answer is (3) A, B and E only.

Quick Tip

In cockroaches, excretion is a combination of multiple organs, and each plays a role in eliminating metabolic waste efficiently.

---

191. The parts of human brain that helps in regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc. are:

(1) Limbic system hypothalamus

(2) Corpora quadrigemina hippocampus

(3) Brain stem epithalamus

(4) Corpus callosum thalamus

Correct Answer: (1) Limbic system hypothalamus

Solution:

The **limbic system** and **hypothalamus** are the primary brain regions involved in regulating emotional responses such as sexual behavior, excitement, pleasure, and fear.

Thus, the correct answer is (1) Limbic system hypothalamus.

Quick Tip

The limbic system and hypothalamus are key players in regulating emotions, drives, and behaviors in response to external stimuli.

---

192. Match List I with List II.

List I	**List II**
A. Mast cells	I. Ciliated epithelium
B. Inner surface of bronchiole	II. Areolar connective tissue
C. Blood	III. Cuboidal epithelium
D. Tubular parts of nephron	IV. Specialized connective tissue

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **A. Mast cells** are part of **specialized connective tissue** (A-III). - **B. Inner surface of bronchiole** is lined with **areolar connective tissue** (B-IV). - **C. Blood** is considered a type of **fluid connective tissue** (C-I). - **D. Tubular parts of nephron** are lined with **cuboidal epithelium** (D-II).

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

Quick Tip

Understanding the role of different tissues and cells in organs helps match them to their specific anatomical and functional properties.

193. Match List I with List II.

List I **List II**

A. Logistic growth I. Unlimited resource availability condition

B. Exponential growth II. Limited resource availability condition

C. Expanding age pyramid III. The percent individuals of pre-reproductive age is largest followed by reproductive and post-reproductive age groups

D. Stable age pyramid IV. The percent individuals of pre-reproductives and reproductive age group are same

Choose the correct answer from the options given below:

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

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

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

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

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

Solution:

- **Logistic growth** occurs in **limited resource availability conditions** (A-II). - **Exponential growth** occurs in **unlimited resource availability conditions** (B-I). - **Expanding age pyramid** has the highest proportion of **pre-reproductive age** individuals (C-III). - **Stable age pyramid** shows an **equal distribution** of pre-reproductive and reproductive age individuals (D-IV).

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

Quick Tip

In population ecology, logistic and exponential growth describe how populations grow under different environmental conditions, while age pyramids help in understanding the population structure.

---

194. Which of the following statements are correct?

A. An excessive loss of body fluid from the body switches off osmoreceptors.

B. ADH causes vasodilation.

C. ANF causes water reabsorption to prevent diuresis.

D. ADH causes increase in blood pressure.

E. ADH is responsible for decrease in GFR.

Choose the correct answer from the options given below:

(1) A and B only

(2) B, C and D only

(3) A, B and E only

(4) C, D and E only

Correct Answer: (2) B, C and D only

Solution:

- **Statement A** is incorrect: Loss of body fluid triggers osmoreceptors, not switches them off. - **Statement B** is correct: **ADH** (antidiuretic hormone) causes **vasodilation**. - **Statement C** is incorrect: **ANF** (atrial natriuretic factor) reduces water reabsorption, promoting diuresis. - **Statement D** is correct: **ADH** increases water reabsorption and **raises blood pressure**. - **Statement E** is correct: **ADH** reduces **glomerular filtration rate (GFR)** by increasing water reabsorption.

Thus, the correct answer is (2) B, C and D only.

Quick Tip

ADH plays a crucial role in regulating water balance in the body, influencing blood pressure and osmoregulation.

---

195. Given below are two statements:

Statement I: During G0 phase of cell cycle, the cell is metabolically inactive.

Statement II: The centrosome undergoes duplication during S phase of interphase.

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

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

(2) Both Statement I and Statement II are incorrect.

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

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

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

Solution:

- **Statement I** is incorrect: **G0 phase** refers to a state where the cell is not actively dividing, but it is not necessarily metabolically inactive. - **Statement II** is correct: The **centrosome** undergoes duplication during the **S phase** of interphase.

Thus, the correct answer is (4) Statement I is incorrect but Statement II is correct.

Quick Tip

The G0 phase is a resting phase for cells, while the S phase is where DNA replication and centrosome duplication occur.

---

196. Select the correct statements.

A. Tetrad formation is seen during Leptotene.

B. During Anaphase, the centromeres split and chromatids separate.

C. Terminalization takes place during Pachytene.

D. Nucleolus, Golgi complex and ER are reforming during Telophase.

E. Crossing over takes place between sister chromatids of homologous chromosome.

Choose the correct answer from the options given below:

(1) A and C only

(2) B and D only

(3) A, C and E only

(4) B and E only

Correct Answer: (2) B and D only

Solution:

- **A** is incorrect: **Tetrad formation** occurs during **Zygotene**, not Leptotene. - **B** is correct: **Anaphase** is the stage where **centromeres split** and **chromatids separate**. - **C** is incorrect: **Terminalization** occurs during **Pachytene**, not Leptotene. - **D** is correct: The **nucleolus**, **Golgi complex**, and **ER** begin

to reform during **Telophase**. - **E** is incorrect: **Crossing over** occurs between **homologous chromosomes**, not sister chromatids.
Thus, the correct answer is (2) B and D only.

Quick Tip

Crossing over occurs during **Prophase I** of meiosis, and it involves homologous chromosomes exchanging genetic material.

---

197. Which one of the following is NOT an advantage of inbreeding?
(1) It decreases homozygosity.
(2) It exposes harmful recessive genes that are eliminated by selection.
(3) Elimination of less desirable genes and accumulation of superior genes takes place due to it.
(4) It decreases the productivity of inbred population, after continuous inbreeding.
Correct Answer: (4) It decreases the productivity of inbred population, after continuous inbreeding.
Solution:
- **Inbreeding** generally leads to **increased homozygosity**, which can expose harmful recessive genes and reduce the overall fitness of a population in the long term. - While **inbreeding** might eliminate harmful recessive genes initially, over time it tends to decrease genetic diversity, ultimately decreasing the productivity of inbred populations.
Thus, the correct answer is (4) It decreases the productivity of inbred population, after continuous inbreeding.

Quick Tip

Inbreeding may reduce genetic diversity and lead to harmful recessive traits, making it a risk for long-term survival in a population.

---

198. Which of the following is characteristic feature of cockroach regarding sexual dimorphism?

(1) Dark brown body colour and anal cerci

(2) Presence of anal styles

(3) Presence of sclerites

(4) Presence of anal cerci

Correct Answer: (2) Presence of anal styles

Solution:

In cockroaches, **sexual dimorphism** refers to differences in external features between males and females. One such feature is the **presence of anal styles** in females, which are absent in males.

Thus, the correct answer is (2) Presence of anal styles.

Quick Tip

Sexual dimorphism in insects often involves differences in size, shape, or specialized appendages between males and females.

---

199. Which one of the following is the sequence on corresponding coding strand, if the sequence on mRNA formed is as follows

5’ AUCGACGACGACGACG

3’ UAGCUGCUGCUGCUGC

(1) 5’ AUCGACGACGACGACG 3’

(2) 3’ UAGCUGCUGCUGCUGC 5’

(3) 5’ ATCGATCGATCGATCG 3’

(4) 3’ ATCGATCGATCGATCG 5’

Correct Answer: (3) 5’ ATCGATCGATCGATCG 3’

Solution:

The corresponding **coding strand** for the given **mRNA sequence** would be the **complementary sequence** in the **5’ to 3’ direction**, which matches the sequence **5’ ATCGATCGATCGATCG 3’**.

Thus, the correct answer is (3) 5’ ATCGATCGATCGATCG 3’.

Quick Tip

Remember that mRNA is synthesized from the template strand of DNA and has a sequence complementary to it, except that thymine (T) is replaced by uracil (U).

---

200. Which of the following statements are correct regarding skeletal muscle?

A. Muscle bundles are held together by collagenous connective tissue layer called fascicle.

B. Sarcoplasmic reticulum of muscle fibre is a store house of calcium ions.

C. Striated appearance of skeletal muscle fibre is due to distribution pattern of actin and myosin proteins.

D. M line is considered as functional unit of contraction called sarcomere.

Choose the most appropriate answer from the options given below:

(1) A, B and C only

(2) B and C only

(3) A, C and D only

(4) C and D only

Correct Answer: (2) B and C only

Solution:

- **Statement A** is incorrect: **Fascicle** is a bundle of muscle fibres, not the connective tissue holding muscle bundles together. - **Statement B** is correct: The **sarcoplasmic reticulum** is a structure that stores **calcium ions** essential for muscle contraction. - **Statement C** is correct: The **striated appearance** of skeletal muscle is due to the **regular arrangement** of **actin and myosin** filaments. - **Statement D** is incorrect: The **sarcomere** is the functional unit of muscle contraction, not the **M-line**.

Thus, the correct answer is (2) B and C only.

Quick Tip

The **sarcoplasmic reticulum** and the **sarcomere** play crucial roles in muscle contraction and relaxation by managing calcium ion storage and the actin-myosin interaction.
