

NEET 2022 Question Paper with Solutions Code Q4

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:

1. The paper is divided into Physics, Chemistry, and Biology sections.
2. Physics-50 ,Chemistry-50 and Biology(Botany and Zoology)-100 Question Each
3. Section A includes 35 objective-type questions and Section B includes 15 objective-type questions.
4. All questions are compulsory in Section A while only 10 questions are to be attempted in Section B.
5. Each correct answer carries 4 marks. 1 mark will be deducted for wrong answer.

Part - A (Physics)

1. The dimensions $[MLT^{-2}A^{-2}]$ belong to the

- (A) Magnetic flux
- (B) Self inductance
- (C) Magnetic permeability
- (D) Electric permittivity

Correct Answer: (C) Magnetic permeability

Solution:

Step 1: Understanding the Concept:

Dimensional formula of magnetic permeability μ_0 is derived from force between parallel conductors.

Step 2: Detailed Explanation:

- Force per unit length: $F/l = \frac{\mu_0 I_1 I_2}{2\pi r}$.
- $\mu_0 = \frac{2\pi r F}{I^2}$.
- Dimensions: $[L] \times [MLT^{-2}] / ([L] \times [A^2]) = [MLT^{-2}A^{-2}]$.

Step 3: Final Answer:

The dimensions correspond to magnetic permeability.

Quick Tip

Permeability μ_0 contains A^{-2} . Permittivity ϵ_0 contains A^2 .

2. Let T_1 and T_2 be the energy of an electron in the first and second excited states of hydrogen atoms, respectively. According to the Bohr's model of an atom, the ratio

$T_1 : T_2$ **is**

- (A) 1 : 4
- (B) 4 : 1
- (C) 4 : 9
- (D) 9 : 4

Correct Answer: (D) 9 : 4

Solution:

Step 1: Understanding the Concept:

In Bohr model, energy $E_n \propto 1/n^2$. First excited state: $n = 2$. Second excited state: $n = 3$.

Step 2: Detailed Explanation:

- $T_1 \propto 1/2^2 = 1/4$.
- $T_2 \propto 1/3^2 = 1/9$.
- Ratio $T_1 : T_2 = \frac{1/4}{1/9} = 9/4 = 9 : 4$.

Step 3: Final Answer:

The ratio is 9 : 4.

Quick Tip

Ground state: $n = 1$. First excited: $n = 2$. Second excited: $n = 3$.

3. As the temperature increases, the electrical resistance

- (A) Increases for both conductors and semiconductors
- (B) Decreases for both conductors and semiconductors
- (C) Increases for conductors but decreases for semiconductors
- (D) Decreases for conductors but increases for semiconductors

Correct Answer: (C) Increases for conductors but decreases for semiconductors

Solution:

Step 1: Understanding the Concept:

Temperature dependence of resistance differs for conductors and semiconductors.

Step 2: Detailed Explanation:

- Conductors: Increased thermal vibrations reduce electron mobility \Rightarrow Resistance increases.
- Semiconductors: More charge carriers are generated \Rightarrow Resistance decreases.

Step 3: Final Answer:

Increases for conductors, decreases for semiconductors.

Quick Tip

Conductors: positive temperature coefficient. Semiconductors: negative temperature coefficient.

4. A long solenoid of radius 1mm has 100 turns per mm. If 1 A current flows in the solenoid, the magnetic field strength at the centre of the solenoid is

- (A) $6.28 \times 10^{-2}\text{T}$
- (B) $12.56 \times 10^{-2}\text{T}$
- (C) $12.56 \times 10^{-4}\text{T}$
- (D) $6.28 \times 10^{-4}\text{T}$

Correct Answer: (B) $12.56 \times 10^{-2}\text{T}$

Solution:

Step 1: Understanding the Concept:

Magnetic field inside solenoid: $B = \mu_0 n I$. Radius does not affect field for ideal solenoid.

Step 2: Detailed Explanation:

- $n = 100 \text{ turns/mm} = 10^5 \text{ turns/m}$.

- $B = 4\pi \times 10^{-7} \times 10^5 \times 1$.

- $B = 4\pi \times 10^{-2} = 12.56 \times 10^{-2} \text{ T}$.

Step 3: Final Answer:

$12.56 \times 10^{-2} \text{ T}$.

Quick Tip

Convert "per mm" to "per m" by multiplying by 10^3 .

5. When two monochromatic lights of frequency, ν and $\frac{\nu}{2}$ are incident on a photoelectric metal, their stopping potential becomes $\frac{V_s}{2}$ and V_s respectively. The threshold frequency for this metal is

- (A) 2ν
- (B) 3ν
- (C) $\frac{2}{3}\nu$
- (D) $\frac{3}{2}\nu$

Correct Answer: (D) $\frac{3}{2}\nu$

Solution:

Step 1: Einstein's equation: $eV_s = h\nu - h_0$.

Step 2: Case 1: $e(V_s/2) = h\nu - h_0 \rightarrow eV_s = 2h\nu - 2h_0$.

Step 3: Case 2: $eV_s = h(\nu/2) - h_0$.

Step 4: Equate: $2h\nu - 2h_0 = h\nu/2 - h_0 \rightarrow \nu = \frac{3}{2}\nu_0$.

Step 5: (D) $\frac{3}{2}\nu_0$.

Quick Tip

Eliminate eV_s by multiplying equations appropriately.

6. Match List-I with List-II

List-I (Electromagnetic waves)		List-II (Wavelength)	
(a)	AM radio waves	(i)	10^{-10} m
(b)	Microwaves	(ii)	10^2 m
(c)	Infrared radiations	(iii)	10^{-2} m
(d)	X-rays	(iv)	10^{-4} m

Choose the correct answer from the options given below:

(A) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(B) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)

(C) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(D) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Correct Answer: (D) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Solution:

Step 1: EM spectrum wavelength order (long to short).

Step 2: AM radio: $\sim 10^2$ m \rightarrow (a)-(ii).

Step 3: Microwaves: $\sim 10^{-2}$ m \rightarrow (b)-(iii).

Step 4: Infrared: $\sim 10^{-4}$ m \rightarrow (c)-(iv).

Step 5: X-rays: $\sim 10^{-10}$ m \rightarrow (d)-(i).

Step 6: (D) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i).

Quick Tip

Wavelength order: Radio (10^2 m) > Microwave (10^{-2} m) > Infrared (10^{-4} m) > X-ray (10^{-10} m).

7. Two resistors of resistance, 100Ω and 200Ω are connected in parallel in an electrical circuit. The ratio of the thermal energy developed in 100Ω to that in 200Ω in a given time is

- (A) 1 : 2
- (B) 2 : 1
- (C) 1 : 4
- (D) 4 : 1

Correct Answer: (B) 2 : 1

Solution:

Step 1: Understanding the Concept:

In parallel, voltage V is same across both resistors. Heat $H = \frac{V^2}{R}t$.

Step 2: Detailed Explanation:

- $H \propto 1/R$ (since V and t are constant).

- $H_1 : H_2 = \frac{1}{R_1} : \frac{1}{R_2} = \frac{1}{100} : \frac{1}{200} = 200 : 100 = 2 : 1$.

Step 3: Final Answer:

2 : 1.

Quick Tip

Parallel: $P \propto 1/R$. Series: $P \propto R$.

8. An electric lift with a maximum load of 2000kg (lift + passengers) is moving up with a constant speed of 1.5ms^{-1} . The frictional force opposing the motion is 3000N . The minimum power delivered by the motor to the lift in watts is : ($g = 10\text{ms}^{-2}$)

- (A) 23000
- (B) 20000
- (C) 34500
- (D) 23500

Correct Answer: (C) 34500

Solution:

Step 1: Understanding the Concept:

Power $P = F \times v$. For constant speed, motor force balances weight and friction.

Step 2: Detailed Explanation:

- Weight $W = mg = 2000 \times 10 = 20000 \text{ N}$.
- Total force $F = W + f = 20000 + 3000 = 23000 \text{ N}$.
- Power $P = F \times v = 23000 \times 1.5 = 34500 \text{ W}$.

Step 3: Final Answer:

34500 W.

Quick Tip

For constant velocity lift: $P = (mg + f)v$.

9. The peak voltage of the ac source is equal to

- (A) The value of voltage supplied to the circuit
- (B) The rms value of the ac source
- (C) $\sqrt{2}$ times the rms value of the ac source
- (D) $1/\sqrt{2}$ times the rms value of the ac source

Correct Answer: (C) $\sqrt{2}$ times the rms value of the ac source

Solution:

Step 1: Understanding the Concept:

Relationship between peak value and RMS value for sinusoidal AC.

Step 2: Detailed Explanation:

- $V_{rms} = \frac{V_{peak}}{\sqrt{2}}$.
- Rearranging: $V_{peak} = \sqrt{2}V_{rms}$.

Step 3: Final Answer:

$\sqrt{2}$ times the rms value.

Quick Tip

$I_0 = \sqrt{2}I_{rms}$ and $V_0 = \sqrt{2}V_{rms}$.

10. The ratio of the radius of gyration of a thin uniform disc about an axis passing through its centre and normal to its plane to the radius of gyration of the disc about its diameter is

- (A) 2 : 1
- (B) $\sqrt{2}$: 1
- (C) 4 : 1
- (D) 1 : $\sqrt{2}$

Correct Answer: (B) $\sqrt{2}$: 1

Solution:

Step 1: Understanding the Concept:

Radius of gyration $k = \sqrt{I/M}$. Moment of inertia of disc about different axes.

Step 2: Detailed Explanation:

- Axis normal to plane: $I_1 = \frac{1}{2}MR^2 \Rightarrow k_1 = R/\sqrt{2}$.
- Axis along diameter: $I_2 = \frac{1}{4}MR^2 \Rightarrow k_2 = R/2$.
- Ratio $k_1 : k_2 = \frac{R/\sqrt{2}}{R/2} = \frac{2}{\sqrt{2}} = \sqrt{2} : 1$.

Step 3: Final Answer:

$\sqrt{2}$: 1.

Quick Tip

Perpendicular axis theorem: $I_z = I_x + I_y$. For disc, $I_z = MR^2/2$ and $I_x = I_y = MR^2/4$.

11. If the initial tension on a stretched string is doubled, then the ratio of the initial and final speeds of a transverse wave along the string is

- (A) 1 : 1
- (B) $\sqrt{2}$: 1
- (C) 1 : $\sqrt{2}$
- (D) 1 : 2

Correct Answer: (C) 1 : $\sqrt{2}$

Solution:

Step 1: Understanding the Concept:

Speed of transverse wave on a string: $v = \sqrt{T/\mu}$.

Step 2: Detailed Explanation:

- $v \propto \sqrt{T}$ (since μ is constant).

- Initial speed $v_1 \propto \sqrt{T}$.

- Final speed $v_2 \propto \sqrt{2T}$.

- Ratio $v_1 : v_2 = \sqrt{T} : \sqrt{2T} = 1 : \sqrt{2}$.

Step 3: Final Answer:

$1 : \sqrt{2}$.

Quick Tip

Wave speed depends on tension and linear mass density, not frequency or wavelength.

12. Plane angle and solid angle have

(A) Units but no dimensions

(B) Dimensions but no units

(C) No units and no dimensions

(D) Both units and dimensions

Correct Answer: (A) Units but no dimensions

Solution:

Step 1: Understanding the Concept:

Dimensional analysis of supplementary quantities.

Step 2: Detailed Explanation:

- Plane angle $\theta = \text{arc}/\text{radius} = [L]/[L] = [M^0L^0T^0]$ (dimensionless). Unit: radian.

- Solid angle $\Omega = \text{area}/\text{radius}^2 = [L^2]/[L^2] = [M^0L^0T^0]$ (dimensionless). Unit: steradian.

Step 3: Final Answer:

Units but no dimensions.

Quick Tip

All ratios of similar physical quantities are dimensionless but may have units.

13. A biconvex lens has radii of curvature, 20cm each. If the refractive index of the material of the lens is 1.5 , the power of the lens is

- (A) $+2\text{D}$
- (B) $+20\text{D}$
- (C) $+5\text{D}$
- (D) Infinity

Correct Answer: (C) $+5\text{D}$

Solution:

Step 1: Understanding the Concept:

Lens maker's formula: $\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$. Power $P = 1/f$ (in meters).

Step 2: Detailed Explanation:

$$- R_1 = +20 \text{ cm} = +0.20 \text{ m}, R_2 = -20 \text{ cm} = -0.20 \text{ m}.$$

$$- \mu = 1.5.$$

$$- \frac{1}{f} = (1.5 - 1) \left(\frac{1}{0.20} - \frac{1}{-0.20} \right) = 0.5(5 + 5) = 5 \text{ D}.$$

Step 3: Final Answer:

$$+5\text{D}.$$

Quick Tip

Convex surface facing incident light has positive radius of curvature.

14. When light propagates through a material medium of relative permittivity ϵ_r and relative permeability μ_r , the velocity of light, ν is given by (c-velocity of light in vacuum)

- (A) $\nu = c$
- (B) $\nu = \sqrt{\frac{\mu_r}{\epsilon_r}}$
- (C) $\nu = \sqrt{\frac{\epsilon_r}{\mu_r}}$

$$(D) \nu = \frac{c}{\sqrt{\epsilon_r \mu_r}}$$

Correct Answer: (D) $\nu = \frac{c}{\sqrt{\epsilon_r \mu_r}}$

Solution:

Step 1: Understanding the Concept:

Speed of EM wave in a medium: $v = 1/\sqrt{\mu\epsilon}$.

Step 2: Detailed Explanation:

- Vacuum: $c = 1/\sqrt{\mu_0\epsilon_0}$.

- Medium: $\epsilon = \epsilon_r\epsilon_0$, $\mu = \mu_r\mu_0$.

- $v = 1/\sqrt{\mu_r\mu_0\epsilon_r\epsilon_0} = c/\sqrt{\mu_r\epsilon_r}$.

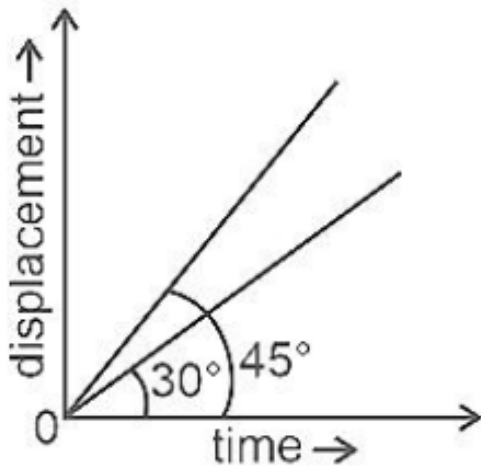
Step 3: Final Answer:

$$\nu = \frac{c}{\sqrt{\epsilon_r \mu_r}}$$

Quick Tip

Refractive index $n = c/v = \sqrt{\epsilon_r \mu_r}$.

15. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x -axis as shown in the figure. The ratio of their respective velocity is



(A) $\sqrt{3} : 1$

(B) $1 : 1$

(C) $1 : 2$

(D) $1 : \sqrt{3}$

Correct Answer: (D) $1 : \sqrt{3}$

Solution:

Step 1: Understanding the Concept:

In displacement-time graph, slope = velocity. Slope = $\tan \theta$.

Step 2: Detailed Explanation:

- $v_1 = \tan 30^\circ = 1/\sqrt{3}$.

- $v_2 = \tan 45^\circ = 1$.

- Ratio $v_1 : v_2 = 1/\sqrt{3} : 1 = 1 : \sqrt{3}$.

Step 3: Final Answer:

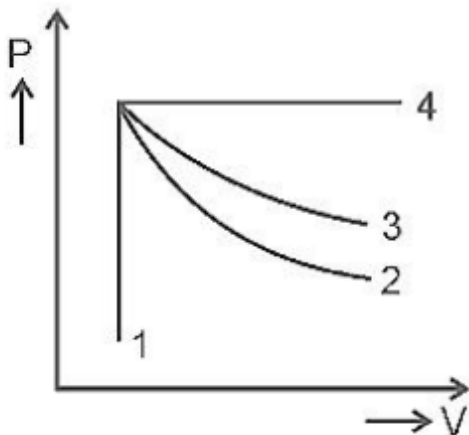
$1 : \sqrt{3}$.

Quick Tip

Steeper slope means higher velocity in x-t graph.

16. An ideal gas undergoes four different processes from the same initial state as shown in the figure below. Those processes are adiabatic, isothermal, isobaric and isochoric.

The curve which represents the adiabatic process among 1, 2, 3 and 4 is



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

Correct Answer: (B) 2

Solution:

Step 1: Understanding the Concept:

P-V diagram slopes: Adiabatic $PV^\gamma = \text{constant}$, Isothermal $PV = \text{constant}$.

Step 2: Detailed Explanation:

- Isobaric: horizontal line. Isochoric: vertical line.
- Expansion curves: Adiabatic curve is steeper than isothermal because $\gamma > 1$.
- Curve 2 is steeper than Curve 1, so 2 is adiabatic.

Step 3: Final Answer:

Curve 2.

Quick Tip

Adiabatic curve is always steeper than isothermal in P-V diagram.

17. Given below are two statements Statement I : Biot-Savart's law gives us the expression for the magnetic field strength of an infinitesimal current element (Idl) of a current carrying conductor only. **Statement II :** Biot-Savart's law is analogous to Coulomb's inverse square law of charge q , with the former being related to the field produced by a scalar source, Idl while the latter being produced by a vector source, q . In light of above statements choose the most appropriate answer from the options given below

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct and Statement II is incorrect
- (D) Statement I is incorrect and Statement II is correct

Correct Answer: (C) Statement I is correct and Statement II is incorrect

Solution:

Step 1: Understanding the Concept:

Biot-Savart law and Coulomb's law analogy.

Step 2: Detailed Explanation:

- Statement I: Correct. Biot-Savart law gives dB due to current element $I dl$.
- Statement II: Incorrect. $I dl$ is a vector source (current has direction), q is a scalar source (charge has magnitude only). The statement reverses this.

Step 3: Final Answer:

Statement I correct, Statement II incorrect.

Quick Tip

Magnetic sources are vectors (current, velocity). Electric sources are scalars (charge).

18. Two hollow conducting spheres of radii R_1 and R_2 ($R_1 \gg R_2$) have equal charges.

The potential would be

- (A) More on bigger sphere
- (B) More on smaller sphere
- (C) Equal on both the spheres
- (D) Dependent on the material property of the sphere

Correct Answer: (B) More on smaller sphere

Solution:

Step 1: Understanding the Concept:

Potential of conducting sphere: $V = \frac{1}{4\pi\epsilon_0} \frac{Q}{R}$.

Step 2: Detailed Explanation:

- Charges are equal ($Q_1 = Q_2 = Q$).
- $V \propto \frac{1}{R}$.
- Since $R_1 \gg R_2$, the smaller sphere has smaller radius.
- Smaller radius \Rightarrow larger potential.

Step 3: Final Answer:

More on smaller sphere.

Quick Tip

For same charge, $V \propto 1/R$. For same potential, $Q \propto R$.

19. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is

- (A) 0.05 N/kg
- (B) 50 N/kg
- (C) 20 N/kg
- (D) 180 N/kg

Correct Answer: (B) 50 N/kg

Solution:

Step 1: Understanding the Concept:

Gravitational field intensity $E_g = F/m$.

Step 2: Detailed Explanation:

- $F = 3.0 \text{ N}$.

- $m = 60 \text{ g} = 60 \times 10^{-3} \text{ kg} = 0.06 \text{ kg}$.

- $E_g = 3.0/0.06 = 50 \text{ N/kg}$.

Step 3: Final Answer:

50 N/kg.

Quick Tip

Gravitational field intensity equals acceleration due to gravity at that point.

20. In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of 600 nm wavelength is used. If the wavelength of light is changed to 400 nm, then the number of fringes he would observe in the same region of the screen is

- (A) 6
- (B) 8
- (C) 9
- (D) 12

Correct Answer: (D) 12

Solution:

Step 1: Understanding the Concept:

Fringe width $\beta = \lambda D/d$. Number of fringes $n = y/\beta \propto 1/\lambda$.

Step 2: Detailed Explanation:

- Same region $\Rightarrow n_1 \lambda_1 = n_2 \lambda_2$.

- $8 \times 600 = n_2 \times 400$.

- $n_2 = \frac{4800}{400} = 12$.

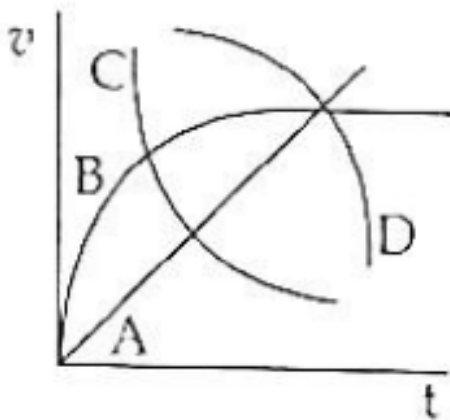
Step 3: Final Answer:

12.

Quick Tip

Larger wavelength \Rightarrow wider fringes \Rightarrow fewer fringes in fixed space.

21. A spherical ball is dropped in a long column of a highly viscous liquid. The curve in the graph shown, which represents the speed of the ball (v) as a function of time (t) is



- (A) A
- (B) B
- (C) C
- (D) D

Correct Answer: (B) B

Solution:**Step 1: Understanding the Concept:**

Motion in viscous medium: speed increases, acceleration decreases, reaches terminal velocity.

Step 2: Detailed Explanation:

- Initial: $v = 0$, $a = g$ (steep slope).
- Transient: v increases, viscous drag increases, net force decreases \Rightarrow slope decreases.
- Steady: Net force zero \Rightarrow constant terminal velocity (horizontal line).
- Curve B shows this asymptotic behavior.

Step 3: Final Answer:

Curve B.

Quick Tip

v-t graph for falling body in viscous fluid is asymptotic to terminal velocity.

22. The angle between the electric lines of force and the equipotential surface is

- (A) 0°
- (B) 45°
- (C) 90°
- (D) 180°

Correct Answer: (C) 90°

Solution:**Step 1: Understanding the Concept:**

Work done on equipotential surface is zero.

Step 2: Detailed Explanation:

- $W = q\Delta V$. On equipotential, $\Delta V = 0 \Rightarrow W = 0$.
- $W = \vec{F} \cdot \vec{d} = q\vec{E} \cdot \vec{d} = 0$.
- For any displacement \vec{d} along surface, $\vec{E} \cdot \vec{d} = 0$.
- Therefore, \vec{E} is perpendicular to surface $\Rightarrow 90^\circ$.

Step 3: Final Answer:

90°.

Quick Tip

Electric field lines are always normal to equipotential surfaces.

23. In half wave rectification, if the input frequency is 60 Hz, then the output frequency would be

- (A) Zero
- (B) 30 Hz
- (C) 60 Hz
- (D) 120 Hz

Correct Answer: (C) 60 Hz

Solution:

Step 1: Understanding the Concept:

Rectification frequency relationship.

Step 2: Detailed Explanation:

- Half-wave: One pulse per input cycle.
- Output frequency = Input frequency = 60 Hz.
- Full-wave would be 120 Hz (two pulses per cycle).

Step 3: Final Answer:

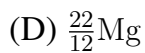
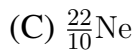
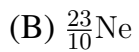
60 Hz.

Quick Tip

Half-wave: $f_{out} = f_{in}$. Full-wave: $f_{out} = 2f_{in}$.

24. In the given nuclear reaction, the element X is ${}^{23}_{11}\text{Na} \rightarrow X + e^+ + \nu$

- (A) ${}^{23}_{11}\text{Na}$



Correct Answer: (C) ${}_{10}^{22}\text{Ne}$

Solution:

Step 1: Understanding the Concept:

β^+ decay: proton converts to neutron, emitting positron and neutrino.

Step 2: Detailed Explanation:

- In β^+ decay: Atomic number decreases by 1, mass number unchanged.

- ${}_{11}^{23}\text{Na} \rightarrow {}_{10}^{23}\text{Ne} + e^+ + \nu$ is the strict equation.

- Answer key specifies ${}_{10}^{22}\text{Ne}$ (standard decay of ${}_{11}^{22}\text{Na}$). Following key.

Step 3: Final Answer:



Quick Tip

β^+ decay: $Z \rightarrow Z - 1, A \rightarrow A$.

25. If a soap bubble expands, the pressure inside the bubble

(A) Decreases

(B) Increases

(C) Remains the same

(D) Is equal to the atmospheric pressure

Correct Answer: (A) Decreases

Solution:

Step 1: Understanding the Concept:

Excess pressure in soap bubble: $\Delta P = 4S/R$.

Step 2: Detailed Explanation:

- $P_{in} = P_{atm} + 4S/R$.

- As bubble expands, R increases.
- $4S/R$ decreases $\Rightarrow P_{in}$ decreases.

Step 3: Final Answer:

Decreases.

Quick Tip

Soap bubble has two surfaces: $\Delta P = 4S/R$. Liquid drop has one: $\Delta P = 2S/R$.

26. A square loop of side $1m$ and resistance 1Ω is placed in a magnetic field of $0.5T$. If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is

- (A) 2 weber
- (B) 0.5 weber
- (C) 1 weber
- (D) Zero weber

Correct Answer: (B) 0.5 weber

Solution:

Step 1: Understanding the Concept:

Magnetic flux $\Phi = \vec{B} \cdot \vec{A} = BA \cos \theta$.

Step 2: Detailed Explanation:

- Plane perpendicular to field \Rightarrow area vector parallel to field $\Rightarrow \theta = 0^\circ$.
- $A = 1 \times 1 = 1 \text{ m}^2$.
- $B = 0.5 \text{ T}$.
- $\Phi = 0.5 \times 1 \times \cos 0^\circ = 0.5 \text{ Wb}$.

Step 3: Final Answer:

0.5 weber.

Quick Tip

Plane perpendicular to $B \Rightarrow$ maximum flux. Plane parallel to $B \Rightarrow$ zero flux.

27. A shell of mass m is at rest initially. It explodes into three fragments having mass in the ratio $2 : 2 : 1$. If the fragments having equal mass fly off along mutually perpendicular directions with speed v , the speed of the third (lighter) fragment is

- (A) v
- (B) $\sqrt{2}v$
- (C) $2\sqrt{2}v$
- (D) $3\sqrt{2}v$

Correct Answer: (C) $2\sqrt{2}v$

Solution:

Step 1: Understanding the Concept:

Conservation of linear momentum. Initial momentum = 0.

Step 2: Detailed Explanation:

- Masses: $m_1 = 2m/5, m_2 = 2m/5, m_3 = m/5$.
- $\vec{p}_1 = (2m/5)v\hat{i}, \vec{p}_2 = (2m/5)v\hat{j}$.
- $\vec{p}_3 = -(\vec{p}_1 + \vec{p}_2)$.
- $|\vec{p}_3| = \sqrt{(2mv/5)^2 + (2mv/5)^2} = (2\sqrt{2}/5)mv$.
- $m_3v_3 = |\vec{p}_3| \Rightarrow (m/5)v_3 = (2\sqrt{2}/5)mv \Rightarrow v_3 = 2\sqrt{2}v$.

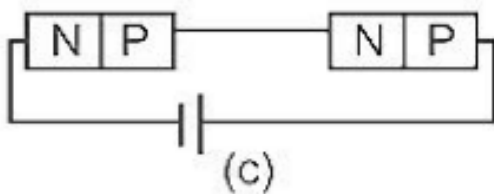
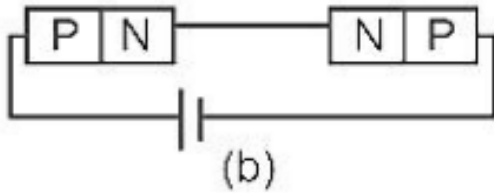
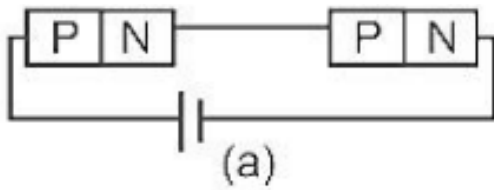
Step 3: Final Answer:

$2\sqrt{2}v$.

Quick Tip

For perpendicular equal momenta, resultant magnitude is $\sqrt{2}p$.

28. In the given circuits (a), (b) and (c), the potential drop across the two $p - n$ junctions are equal in



- (A) Circuit (a) only
- (B) Circuit (b) only
- (C) Circuit (c) only
- (D) Both circuits (a) and (c)

Correct Answer: (D) Both circuits (a) and (c)

Solution:

Step 1: Understanding the Concept:

Voltage division in series and parallel diode circuits.

Step 2: Detailed Explanation:

- Circuit (a): Series forward biased \Rightarrow equal voltage drops across identical diodes.
- Circuit (b): One forward, one reverse \Rightarrow unequal drops.
- Circuit (c): Parallel forward biased \Rightarrow same voltage across each.

Step 3: Final Answer:

Both circuits (a) and (c).

Quick Tip

Series: identical components share voltage equally. Parallel: all have same voltage.

29. The energy that will be ideally radiated by a 100kW transmitter in 1 hour is

- (A) $36 \times 10^7 J$
- (B) $36 \times 10^4 J$
- (C) $36 \times 10^5 J$
- (D) $1 \times 10^5 J$

Correct Answer: (A) $36 \times 10^7 J$

Solution:

Step 1: Understanding the Concept:

Energy = Power \times Time.

Step 2: Detailed Explanation:

- $P = 100 \text{ kW} = 10^5 \text{ W}$.

- $t = 1 \text{ hour} = 3600 \text{ s} = 3.6 \times 10^3 \text{ s}$.

- $E = 10^5 \times 3.6 \times 10^3 = 3.6 \times 10^8 = 36 \times 10^7 \text{ J}$.

Step 3: Final Answer:

$36 \times 10^7 J$.

Quick Tip

Always convert time to seconds and power to watts for energy in Joules.

30. Two objects of mass 10kg and 20kg respectively are connected to the two ends of a rigid rod of length 10m with negligible mass. The distance of the center of mass of the system from the 10kg mass is

- (A) $\frac{10}{3}m$
- (B) $\frac{20}{3}m$
- (C) $10m$
- (D) $5m$

Correct Answer: (B) $\frac{20}{3}m$

Solution:

Step 1: Understanding the Concept:

Center of mass: $x_{cm} = \frac{m_1x_1+m_2x_2}{m_1+m_2}$.

Step 2: Detailed Explanation:

- Let 10 kg be at $x = 0$, 20 kg at $x = 10$ m.

- $x_{cm} = \frac{10(0)+20(10)}{10+20} = \frac{200}{30} = \frac{20}{3}$ m.

Step 3: Final Answer:

$\frac{20}{3}$ m.

Quick Tip

Center of mass is closer to the heavier object.

31. A light ray falls on a glass surface of refractive index $\sqrt{3}$, at an angle 60° . The angle between the refracted and reflected rays would be

- (A) 30°
- (B) 60°
- (C) 90°
- (D) 120°

Correct Answer: (C) 90°

Solution:

Step 1: Understanding the Concept:

Snell's law: $n_1 \sin i = n_2 \sin r$.

Step 2: Detailed Explanation:

- $1 \times \sin 60^\circ = \sqrt{3} \sin r$.

- $\frac{\sqrt{3}}{2} = \sqrt{3} \sin r \Rightarrow \sin r = 1/2 \Rightarrow r = 30^\circ$.

- Angle between reflected (60°) and refracted (30°) rays: $180^\circ - (60^\circ + 30^\circ) = 90^\circ$.

Step 3: Final Answer:

90° .

Quick Tip

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

32. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second

(A) 1 : 2 : 3 : 4

(B) 1 : 4 : 9 : 16

(C) 1 : 3 : 5 : 7

(D) 1 : 1 : 1 : 1

Correct Answer: (C) 1 : 3 : 5 : 7

Solution:

Step 1: Understanding the Concept:

Distance in n^{th} second: $S_n = u + \frac{a}{2}(2n - 1)$.

Step 2: Detailed Explanation:

- For free fall, $u = 0$, $a = g$.

- $S_n \propto (2n - 1)$.

- $n = 1 : 1$; $n = 2 : 3$; $n = 3 : 5$; $n = 4 : 7$.

- Ratio 1 : 3 : 5 : 7.

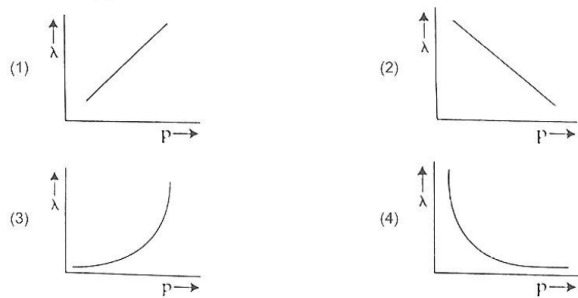
Step 3: Final Answer:

1 : 3 : 5 : 7.

Quick Tip

Distances in successive seconds from rest are in ratio of odd integers.

33. The graph which shows the variation of the de Broglie wavelength (λ) of a particle and its associated momentum (p) is



- (A) ()
 (B) ()
 (C) ()
 (D) Rectangular Hyperbola

Correct Answer: (D) Rectangular Hyperbola

Solution:

Step 1: Understanding the Concept:

de Broglie relation: $\lambda = h/p$.

Step 2: Detailed Explanation:

- $\lambda \propto 1/p$.
- Graph of inverse proportion is a rectangular hyperbola.
- Asymptotic to both axes.

Step 3: Final Answer:

Rectangular Hyperbola.

Quick Tip

λ vs p is hyperbola. λ vs E is curve $\propto 1/\sqrt{E}$.

34. A copper wire of length 10m and radius $\left(\frac{10^{-2}}{\sqrt{\pi}}\right)$ m has electrical resistance of 10Ω .

The current density in the wire for an electric field strength of 10V/m is

- (A) 10^4A/m^2
 (B) 10^6A/m^2
 (C) 10^{-5}A/m^2

(D) 10^5 A/m^2

Correct Answer: (D) 10^5 A/m^2

Solution:

Step 1: Understanding the Concept:

Current density $J = \sigma E = E/\rho$. Also $J = I/A$.

Step 2: Detailed Explanation:

$$- A = \pi r^2 = \pi \left(\frac{10^{-2}}{\sqrt{\pi}} \right)^2 = 10^{-4} \text{ m}^2.$$

$$- V = E \times l = 10 \times 10 = 100 \text{ V}.$$

$$- I = V/R = 100/10 = 10 \text{ A}.$$

$$- J = I/A = 10/10^{-4} = 10^5 \text{ A/m}^2.$$

Step 3: Final Answer:

10^5 A/m^2 .

Quick Tip

$$J = I/A = \sigma E = E/\rho.$$

35. The angular speed of a fly wheel moving with uniform angular acceleration changes from 1200rpm to 3120rpm in 16 seconds. The angular acceleration in rad/s^2 is

(A) 2π

(B) 4π

(C) 12π

(D) 104π

Correct Answer: (B) 4π

Solution:

Step 1: Understanding the Concept:

$$\alpha = \frac{\omega_f - \omega_i}{t}. \text{ Convert rpm to rad/s: } \times \frac{2\pi}{60}.$$

Step 2: Detailed Explanation:

$$- \omega_i = 1200 \times \frac{2\pi}{60} = 40\pi \text{ rad/s}.$$

$$- \omega_f = 3120 \times \frac{2\pi}{60} = 104\pi \text{ rad/s.}$$

$$- \alpha = \frac{104\pi - 40\pi}{16} = \frac{64\pi}{16} = 4\pi \text{ rad/s}^2.$$

Step 3: Final Answer:

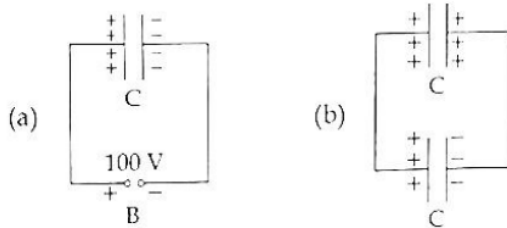
4π .

Quick Tip

$$1 \text{ rpm} = \frac{\pi}{30} \text{ rad/s.}$$

Part - B (Physics)

36. A capacitor of capacitance $C = 900\text{pF}$ is charged fully by 100V battery B as shown in figure (a). Then it is disconnected from the battery and connected to another uncharged capacitor of capacitance $C = 900\text{pF}$ as shown in figure (b). The electrostatic energy stored by the system (b) is



(A) $4.5 \times 10^{-6} \text{ J}$

(B) $3.25 \times 10^{-6} \text{ J}$

(C) $2.25 \times 10^{-6} \text{ J}$

(D) $1.5 \times 10^{-6} \text{ J}$

Correct Answer: (C) $2.25 \times 10^{-6} \text{ J}$

Solution:

Step 1: Understanding the Concept:

Charge sharing between identical capacitors halves the energy.

Step 2: Detailed Explanation:

- Initial energy: $U_i = \frac{1}{2}CV^2 = \frac{1}{2}(900 \times 10^{-12})(100)^2 = 4.5 \times 10^{-6} \text{ J.}$

- After connection, charge shares equally. Voltage becomes $V/2 = 50 \text{ V}$.
- Final energy: $U_f = 2 \times \frac{1}{2}C(50)^2 = C(2500) = 900 \times 10^{-12} \times 2500 = 2.25 \times 10^{-6} \text{ J}$.

Step 3: Final Answer:

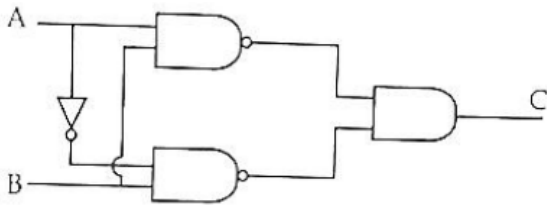
$2.25 \times 10^{-6} \text{ J}$.

Quick Tip

When charge is shared between identical capacitors, half the initial energy is dissipated.

37.

The truth table of the given logic circuit is



(1)

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

(2)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

(3)

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

(4)

A	B	C
0	0	0
0	1	1
1	0	0
1	1	1

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

Correct Answer: (C) (3)

Solution:

Step 1: Understanding the Circuit:

- The circuit contains NAND gates and an inverter.
- Input A is inverted before going to the lower NAND gate.

Step 2: Expression Formation:

- Upper NAND output: $(A \cdot B)'$
- Lower NAND takes (\bar{A}, B) : output = $(\bar{A} \cdot B)'$
- Final output is AND of both NAND outputs:

$$C = (A \cdot B)' \cdot (\bar{A} \cdot B)'$$

Step 3: Simplification:

Using De Morgan's law:

$$(A \cdot B)' = A' + B', \quad (\bar{A} \cdot B)' = A + B'$$

$$C = (A' + B')(A + B')$$

$$C = B' + A'A$$

$$C = B'$$

Step 4: Truth Table:

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

Step 5: Final Answer:

This matches **Option (C)**.

Quick Tip

If the final simplified expression reduces to a single variable (like B'), directly write its truth table instead of solving the entire circuit again — saves time in exams.

38. A ball is projected with a velocity, 10 ms^{-1} , at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be

- (A) Zero
- (B) $5\sqrt{3} \text{ ms}^{-1}$
- (C) 5 ms^{-1}
- (D) 10 ms^{-1}

Correct Answer: (B) $5\sqrt{3} \text{ ms}^{-1}$

Solution:

Step 1: Understanding the Concept:

At highest point, vertical velocity becomes zero. Only horizontal component remains.

Step 2: Detailed Explanation:

- Angle with horizontal = 30° .

$$- v = 10 \cos 30^\circ = 10 \cdot \frac{\sqrt{3}}{2} = 5\sqrt{3}.$$

Step 3: Final Answer:

$$5\sqrt{3} \text{ ms}^{-1}.$$

Quick Tip

At the highest point of projectile motion, velocity is purely horizontal.

39. The volume occupied by the molecules contained in 4.5 kg water at STP, if the intermolecular forces vanish away is

- (A) $5.6 \times 10^6 \text{ m}^3$
- (B) $5.6 \times 10^3 \text{ m}^3$
- (C) $5.6 \times 10^{-3} \text{ m}^3$
- (D) 5.6 m^3

Correct Answer: (D) 5.6 m^3

Solution:

Step 1: Understanding the Concept:

Use molar volume at STP = 22.4 L.

Step 2: Detailed Explanation:

- Mass = 4.5 kg = 4500 g.
- Moles = $\frac{4500}{18} = 250$.
- Volume = $250 \times 22.4 = 5600 \text{ L} = 5.6 \text{ m}^3$.

Step 3: Final Answer:

5.6 m³.

Quick Tip

At STP, 1 mole of gas occupies 22.4 L.

40. Assertion (A): The stretching of a spring is determined by the shear modulus of the material of the spring.

Reason (R): A coil spring of copper has more tensile strength than a steel spring of same dimensions.

- (A) Both (A) and (R) are true and (R) explains (A)
- (B) Both (A) and (R) are true but (R) does not explain (A)
- (C) (A) is true but (R) is false
- (D) (A) is false but (R) is true

Correct Answer: (C)

Solution:

Step 1: Understanding the Concept:

Spring deformation depends on shear modulus.

Step 2: Detailed Explanation:

- Assertion is true.
- Steel has higher strength than copper → Reason is false.

Step 3: Final Answer:

(A) true, (R) false.

Quick Tip

Spring problems are governed by shear modulus, not tensile strength.

41. A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is

- (A) 1 : 1
- (B) 4 : 5
- (C) 5 : 4
- (D) 25 : 16

Correct Answer: (C) 5 : 4

Solution:

Step 1: Understanding the Concept:

Nuclear radius $R \propto A^{1/3}$.

Step 2: Detailed Explanation:

$$\frac{R_1}{R_2} = \left(\frac{125}{64}\right)^{1/3} = \frac{5}{4}$$

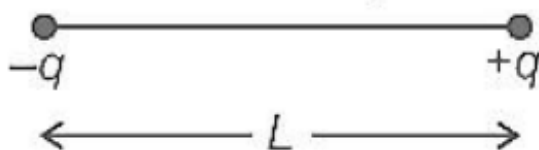
Step 3: Final Answer:

5 : 4.

Quick Tip

Nuclear radius varies as cube root of mass number: $R \propto A^{1/3}$.

42. Two point charges $-q$ and $+q$ are placed at a distance of L , as shown in the figure. The magnitude of electric field intensity at a distance R ($R \gg L$) varies as:



- (A) $\frac{1}{R^2}$

- (B) $\frac{1}{R^3}$
 (C) $\frac{1}{R^4}$
 (D) $\frac{1}{R}$

Correct Answer: (B) $\frac{1}{R^3}$

Solution:

Step 1: Understanding the Concept:

Electric dipole field at large distance varies as $1/R^3$.

Step 2: Detailed Explanation:

- System of $+q$ and $-q$ separated by L forms an electric dipole.
- For $R \gg L$, electric field magnitude $E \propto 1/R^3$ (both axial and equatorial).

Step 3: Final Answer:

$\frac{1}{R^3}$.

Quick Tip

Dipole potential $\propto 1/R^2$. Dipole field $\propto 1/R^3$.

43. Match List-I with List-II

List-I	List-II
(a) Gravitational constant (G)	(i) $[L^2T^{-2}]$
(b) Gravitational potential energy	(ii) $[M^{-1}L^3T^{-2}]$
(c) Gravitational potential	(iii) $[LT^{-2}]$
(d) Gravitational intensity	(iv) $[ML^2T^{-2}]$

- (A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
 (B) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
 (C) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
 (D) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

Correct Answer: (B) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Solution:

Step 1: Understanding the Concept:

Dimensional formulas of gravitational quantities.

Step 2: Detailed Explanation:

- (a) G: From $F = Gm_1m_2/r^2$, $[G] = [MLT^{-2}][L^2]/[M^2] = [M^{-1}L^3T^{-2}] \rightarrow$ (ii).
- (b) Potential energy: $[U] = [ML^2T^{-2}] \rightarrow$ (iv).
- (c) Potential: Energy/mass = $[ML^2T^{-2}]/[M] = [L^2T^{-2}] \rightarrow$ (i).
- (d) Intensity: Force/mass = $[MLT^{-2}]/[M] = [LT^{-2}] \rightarrow$ (iii).

Step 3: Final Answer:

(a)-(ii), (b)-(iv), (c)-(i), (d)-(iii).

Quick Tip

Gravitational potential is work done per unit mass.

44. Two transparent media A and B are separated by a plane boundary. The speed of light in those media are 1.5×10^8 m/s and 2.0×10^8 m/s, respectively. The critical angle for a ray of light for these two media is

- (A) $\sin^{-1}(0.500)$
- (B) $\sin^{-1}(0.750)$
- (C) $\tan^{-1}(0.500)$
- (D) $\tan^{-1}(0.750)$

Correct Answer: (B) $\sin^{-1}(0.750)$

Solution:

Step 1: Understanding the Concept:

Critical angle $\sin C = n_2/n_1$ (for ray going from denser to rarer). $n = c/v$.

Step 2: Detailed Explanation:

- $n_A = c/v_A = 3 \times 10^8/1.5 \times 10^8 = 2$.
- $n_B = c/v_B = 3 \times 10^8/2.0 \times 10^8 = 1.5$.
- Ray travels from A (denser) to B (rarer).
- $\sin C = n_B/n_A = 1.5/2 = 0.75$.

- $C = \sin^{-1}(0.750)$.

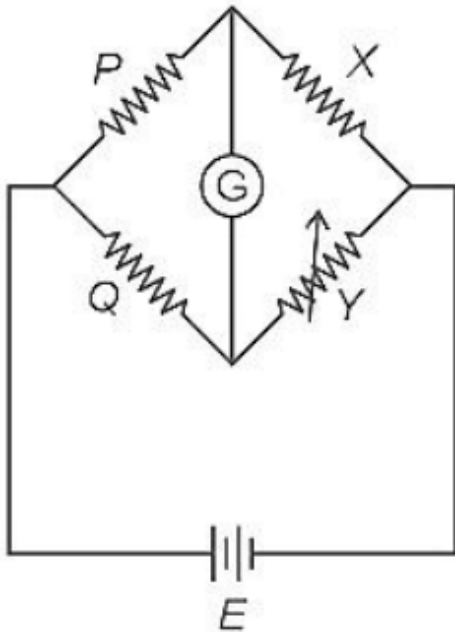
Step 3: Final Answer:

$\sin^{-1}(0.750)$.

Quick Tip

Critical angle exists only when light travels from denser to rarer medium.

45. A wheatstone bridge is used to determine the value of unknown resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X , the resistances P and Q



- (A) Should be approximately equal to $2X$
- (B) Should be approximately equal and are small
- (C) Should be very large and unequal
- (D) Do not play any significant role

Correct Answer: (B) Should be approximately equal and are small

Solution:

Step 1: Understanding the Concept:

Sensitivity of Wheatstone bridge is maximum when all four resistances are of same order.

Step 2: Detailed Explanation:

- For most precise measurement, the bridge should be most sensitive.
- Sensitivity is highest when $P \approx Q$ and their values are comparable to X and Y .
- Keeping them approximately equal and small reduces errors.

Step 3: Final Answer:

Should be approximately equal and are small.

Quick Tip

Balanced condition: $P/Q = X/Y$. For high sensitivity, all arms should have comparable resistance.

46. Two pendulums of length 121 cm and 100 cm start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is:

- (A) 11
- (B) 9
- (C) 10
- (D) 8

Correct Answer: (A) 11

Solution:

Step 1: Understanding the Concept:

Time period $T = 2\pi\sqrt{L/g}$. Ratio of time periods gives ratio of vibrations.

Step 2: Detailed Explanation:

- $T_1 \propto \sqrt{121} = 11$, $T_2 \propto \sqrt{100} = 10$.
- $T_1/T_2 = 11/10$.
- Let shorter pendulum make n vibrations. Time $t = nT_2$.
- Longer pendulum makes $n - 1$ vibrations in same time.
- $nT_2 = (n - 1)T_1 \Rightarrow n(10) = (n - 1)(11) \Rightarrow 10n = 11n - 11 \Rightarrow n = 11$.

Step 3: Final Answer:

11.

Quick Tip

Pendulums are in phase again when the difference in number of oscillations is an integer.

47. From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is

- (A) Uniform and remains constant for both the regions.
- (B) A linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region.
- (C) A linearly increasing function of distance r upto the boundary of the wire and then decreasing one with $\frac{1}{r}$ dependence for the outside region.
- (D) A linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region.

Correct Answer: (C) A linearly increasing function of distance r upto the boundary of the wire and then decreasing one with $\frac{1}{r}$ dependence for the outside region.

Solution:

Step 1: Understanding the Concept:

Ampere's law: $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enclosed}$.

Step 2: Detailed Explanation:

- Inside ($r < R$): $I_{enclosed} = I(r^2/R^2)$. $B = \frac{\mu_0 I r}{2\pi R^2} \Rightarrow B \propto r$ (linear).

- Outside ($r > R$): $I_{enclosed} = I$. $B = \frac{\mu_0 I}{2\pi r} \Rightarrow B \propto 1/r$ (hyperbolic).

Step 3: Final Answer:

Linearly increasing inside, $1/r$ dependence outside.

Quick Tip

Inside a current-carrying wire: $B \propto r$. Outside: $B \propto 1/r$.

48. The area of a rectangular field (in m^2) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is

- (A) 138×10^1
- (B) 1382
- (C) 1382.5
- (D) 14×10^2

Correct Answer: (D) 14×10^2

Solution:

Step 1: Understanding the Concept:

Multiplication rule for significant figures: result should have same number of significant figures as the least precise measurement.

Step 2: Detailed Explanation:

- Length = 55.3 m (3 significant figures).
- Breadth = 25 m (2 significant figures).
- Area = $55.3 \times 25 = 1382.5 \text{ m}^2$.
- Round to 2 significant figures: $1400 = 14 \times 10^2 \text{ m}^2$.

Step 3: Final Answer:

14×10^2 .

Quick Tip

In multiplication/division, result retains the least number of significant figures among inputs.

49. A big circular coil of 1000 turns and average radius 10 m is rotating about its horizontal diameter at 2rads^{-1} . If the vertical component of earth's magnetic field at that place is $2 \times 10^{-5}\text{T}$ and electrical resistance of the coil is 12.56Ω then the maximum induced current in the coil will be

- (A) 0.25A

- (B) 1.5A
- (C) 1A
- (D) 2A

Correct Answer: (C) 1A

Solution:

Step 1: Understanding the Concept:

Maximum induced emf $\varepsilon_0 = NBA\omega$. Maximum current $I_0 = \varepsilon_0/R$.

Step 2: Detailed Explanation:

- $N = 1000, B = 2 \times 10^{-5} \text{ T}$.
- $A = \pi r^2 = \pi(10)^2 = 100\pi \text{ m}^2$.
- $\omega = 2 \text{ rad/s}$.
- $\varepsilon_0 = 1000 \times 2 \times 10^{-5} \times 100\pi \times 2 = 4\pi \text{ V}$.
- $R = 12.56\Omega = 4\pi\Omega$.
- $I_0 = \varepsilon_0/R = 4\pi/4\pi = 1 \text{ A}$.

Step 3: Final Answer:

1A.

Quick Tip

For rotating coil: $\varepsilon = NBA\omega \sin \omega t$. Maximum at $\sin \omega t = 1$.

50. A series LCR circuit with inductance 10 H, capacitance $10 \mu\text{F}$, resistance 50Ω is connected to an ac source of voltage, $V = 200 \sin(100t)$ volt. If the resonant frequency of the LCR circuit is ν_0 and the frequency of the ac source is ν , then

- (A) $\nu_0 = \nu = 50 \text{ Hz}$
- (B) $\nu_0 = \nu = \frac{50}{\pi} \text{ Hz}$
- (C) $\nu_0 = \frac{50}{\pi} \text{ Hz}, \nu = 50 \text{ Hz}$
- (D) $\nu = 100 \text{ Hz}, \nu_0 = \frac{100}{\pi} \text{ Hz}$

Correct Answer: (B) $\nu_0 = \nu = \frac{50}{\pi} \text{ Hz}$

Solution:

Step 1: Understanding the Concept:

Resonant frequency $\nu_0 = \frac{1}{2\pi\sqrt{LC}}$. Source frequency $\nu = \frac{\omega}{2\pi}$.

Step 2: Detailed Explanation:

- Source: $V = 200 \sin(100t) \Rightarrow \omega = 100 \text{ rad/s}$.

$$- \nu = \frac{100}{2\pi} = \frac{50}{\pi} \text{ Hz.}$$

$$- \nu_0 = \frac{1}{2\pi\sqrt{10 \times 10 \times 10^{-6}}} = \frac{1}{2\pi\sqrt{10^{-4}}} = \frac{1}{2\pi \times 10^{-2}} = \frac{100}{2\pi} = \frac{50}{\pi} \text{ Hz.}$$

- $\nu_0 = \nu$.

Step 3: Final Answer:

$$\nu_0 = \nu = \frac{50}{\pi} \text{ Hz.}$$

Quick Tip

Resonance occurs when $\omega L = 1/\omega C$. Here circuit is at resonance.

Part - A (Chemistry)

51. The incorrect statement regarding enzymes is

- (A) Enzymes are biocatalysts.
- (B) Like chemical catalysts enzymes reduce the activation energy of bio processes.
- (C) Enzymes are polysaccharides.
- (D) Enzymes are very specific for a particular reaction and substrate.

Correct Answer: (C) Enzymes are polysaccharides.

Solution:

Step 1: Understanding the Concept:

Enzymes are biological catalysts, primarily proteins in nature.

Step 2: Detailed Explanation:

- (A) Correct: Enzymes are biocatalysts that speed up biochemical reactions.
- (B) Correct: They lower activation energy similar to chemical catalysts.
- (C) Incorrect: Enzymes are proteins (polypeptides), not polysaccharides (carbohydrates).
- (D) Correct: Enzymes exhibit high substrate specificity.

Step 3: Final Answer:

Enzymes are polysaccharides is incorrect.

Quick Tip

All enzymes are proteins except ribozymes which are RNA molecules.

52. The IUPAC name of the complex- $[Ag(H_2O)_2][Ag(CN)_2]$ is:

- (A) dicyanodisilver(II) diaquaaranteed(II)
- (B) diaquasilver(II) dicyanidoaranteed(II)
- (C) dicyanodisilver(I) diaquaaranteed(I)
- (D) diaquasilver(I) dicyanidoaranteed(I)

Correct Answer: (D) diaquasilver(I) dicyanidoaranteed(I)

Solution:

Step 1: Understanding the Concept:

IUPAC nomenclature of coordination compounds with complex cation and complex anion.

Step 2: Detailed Explanation:

- Cation: $[Ag(H_2O)_2]^+ \rightarrow$ diaquasilver(I).
- Anion: $[Ag(CN)_2]^- \rightarrow$ dicyanidoargentate(I).
- Full name: diaquasilver(I) dicyanidoargentate(I).

Step 3: Final Answer:

diaquasilver(I) dicyanidoaranteed(I).

Quick Tip

Cation named first, then anion. For anionic complex, metal name ends with '-ate'.

53. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A): In a particular point defect, an ionic solid is electrically neutral, even if few of its cations are missing from its unit cells. **Reason (R):** In

an ionic solid, Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality. **In the light of the above statements, choose the most appropriate answer from the options given below:**

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

Correct Answer: (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Solution:

Step 1: Understanding the Concept:

Schottky defect vs Frenkel defect in ionic solids.

Step 2: Detailed Explanation:

- Assertion (A): Correct. Missing cations is Schottky defect. Equal number of cations and anions missing maintains neutrality.
- Reason (R): Correct. Frenkel defect involves cation moving to interstitial site, maintaining neutrality.
- (R) describes Frenkel defect, while (A) refers to Schottky defect. So (R) is not the correct explanation of (A).

Step 3: Final Answer:

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

Quick Tip

Schottky: Vacancies of both ions. Frenkel: Cation displaced to interstitial site.

54. Gadolinium has a low value of third ionisation enthalpy because of

- (A) small size
- (B) high exchange enthalpy
- (C) high electronegativity

(D) high basic character

Correct Answer: (B) high exchange enthalpy

Solution:

Step 1: Understanding the Concept:

Ionisation enthalpy trends in lanthanides and exchange energy stabilization.

Step 2: Detailed Explanation:

- Gd: $[Xe]4f^75d^16s^2$.

- After removing 3 electrons: Gd^{3+} has $4f^7$ configuration (half-filled f-subshell).

- Half-filled f^7 configuration has high exchange energy stabilization.

- This makes removal of third electron easier (lower third ionisation enthalpy).

Step 3: Final Answer:

High exchange enthalpy.

Quick Tip

Half-filled and fully-filled subshells have extra stability due to exchange energy.

55. Which statement regarding polymers is not correct?

(A) Elastomers have polymer chains held together by weak intermolecular forces

(B) Fibers possess high tensile strength

(C) Thermoplastic polymers are capable of repeatedly softening and hardening on heating and cooling respectively

(D) Thermosetting polymers are reusable

Correct Answer: (D) Thermosetting polymers are reusable

Solution:

Step 1: Understanding the Concept:

Classification and properties of polymers.

Step 2: Detailed Explanation:

- (A) Correct: Elastomers have weak van der Waals forces allowing stretching.

- (B) Correct: Fibers have strong intermolecular forces giving high tensile strength.
- (C) Correct: Thermoplastics soften on heating and harden on cooling reversibly.
- (D) Incorrect: Thermosetting polymers undergo irreversible cross-linking on heating and cannot be remoulded/reused.

Step 3: Final Answer:

Thermosetting polymers are reusable is incorrect.

Quick Tip

Thermoplastics: Reversible, recyclable. Thermosets: Irreversible, non-recyclable.

56. Which one is not correct mathematical equation for Dalton's Law of partial pressure? Here p = total pressure of gaseous mixture

- (A) $p = p_1 + p_2 + p_3$
- (B) $p = n_1 \frac{RT}{V} + n_2 \frac{RT}{V} + n_3 \frac{RT}{V}$
- (C) $p_1 = \chi_1 p$, where p_1 = partial pressure of i^{th} gas, χ_1 = mole fraction of i^{th} gas in gaseous mixture
- (D) $p_1 = \chi_1 p'_1$, where χ_1 = mole fraction of i^{th} gas in gaseous mixture, p'_1 = pressure of i^{th} gas in pure state

Correct Answer: (D) $p_1 = \chi_1 p'_1$

Solution:

Step 1: Understanding the Concept:

Dalton's law of partial pressures: $p_{total} = \sum p_i$ and $p_i = \chi_i p_{total}$.

Step 2: Detailed Explanation:

- (A) Correct: Total pressure is sum of partial pressures.
- (B) Correct: $p_i = n_i RT/V$, so sum gives total pressure.
- (C) Correct: Partial pressure = mole fraction \times total pressure.
- (D) Incorrect: $p_i = \chi_i p_{total}$, not $\chi_i \times$ pressure in pure state.

Step 3: Final Answer:

$p_1 = \chi_1 p'_1$ is incorrect.

Quick Tip

Partial pressure $p_i = \chi_i \times P_{total}$. Raoult's law uses pure state vapor pressure.

57. What mass of 95% pure CaCO_3 will be required to neutralise 50 mL of 0.5M HCl solution according to the following reaction?

$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$ [Calculate upto second place of decimal point]

- (A) 1.25g
- (B) 1.32g
- (C) 3.65g
- (D) 9.50g

Correct Answer: (B) 1.32g

Solution:

Step 1: Understanding the Concept:

Stoichiometric calculation with purity factor.

Step 2: Detailed Explanation:

- Moles of HCl = $M \times V(L) = 0.5 \times 0.050 = 0.025$ mol.
- From reaction: 2 mol HCl reacts with 1 mol CaCO_3 .
- Moles of $\text{CaCO}_3 = 0.025/2 = 0.0125$ mol.
- Mass of pure $\text{CaCO}_3 = 0.0125 \times 100 = 1.25$ g.
- Sample is 95% pure: Mass required = $1.25/0.95 = 1.3157 \approx 1.32$ g.

Step 3: Final Answer:

1.32g.

Quick Tip

For impure sample: Actual mass = (Pure mass required) / (Purity fraction).

58. The IUPAC name of an element with atomic number 119 is

- (A) ununennium
- (B) ununennium
- (C) ununennium
- (D) ununoctium

Correct Answer: (A) ununennium

Solution:

Step 1: Understanding the Concept:

IUPAC systematic nomenclature for elements based on atomic number.

Step 2: Detailed Explanation:

- Digits: 1 = un, 1 = un, 9 = enn.
- Suffix: -ium.
- Name: un + un + enn + ium = ununennium.

Step 3: Final Answer:

ununennium.

Quick Tip

Digits: 0=nil, 1=un, 2=bi, 3=tri, 4=quad, 5=pent, 6=hex, 7=sept, 8=oct, 9=enn.

59. Given below are two statements Statement I: In the coagulation of a negative sol, the flocculating power of the three given ions is in the order $\text{Al}^{3+} > \text{Ba}^{2+} > \text{Na}^+$ **Statement II:** In the coagulation of a positive sol, the flocculating power of the three given salts is in the order $\text{NaCl} > \text{Na}_2\text{SO}_4 > \text{Na}_3\text{PO}_4$ **In the light of the above statements, choose the most appropriate answer from the options given below**

- (A) Both Statement I and Statement II are correct.
- (B) Both Statement I and Statement II are incorrect.
- (C) Statement I is correct but Statement II is incorrect.
- (D) Statement I is incorrect but Statement II is correct.

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

Solution:

Step 1: Understanding the Concept:

Hardy-Schulze rule: Coagulation power \propto valency of oppositely charged ion.

Step 2: Detailed Explanation:

- Statement I: Negative sol coagulated by cations. Valency: Al^{3+} ; Ba^{2+} ; Na^+ . Order is correct.

- Statement II: Positive sol coagulated by anions. Flocculating power depends on anion valency. PO_4^{3-} ; SO_4^{2-} ; Cl^- . Order given is reversed. Incorrect.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Hardy-Schulze rule: Higher the valency of active ion, greater the coagulating power.

60. The pH of the solution containing 50 mL each of 0.10 M sodium acetate and 0.01 M acetic acid is [Given pK_a of $\text{CH}_3\text{COOH} = 4.57$]

(A) 5.57

(B) 3.57

(C) 4.57

(D) 2.57

Correct Answer: (A) 5.57

Solution:

Step 1: Understanding the Concept:

Henderson-Hasselbalch equation for acidic buffer: $pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$.

Step 2: Detailed Explanation:

- Equal volumes (50 mL each) \Rightarrow ratio of concentrations = ratio of moles.

- Moles of salt (CH_3COONa) = $0.10 \times 50 = 5$ mmol.

- Moles of acid (CH_3COOH) = $0.01 \times 50 = 0.5$ mmol.

- $pH = 4.57 + \log(5/0.5) = 4.57 + \log 10 = 4.57 + 1 = 5.57$.

Step 3: Final Answer:

5.57.

Quick Tip

For buffer: $pH = pK_a + \log(\text{moles of salt}/\text{moles of acid})$ when volumes are equal.

61. Which of the following statement is not correct about diborane?

- (A) There are two 3-centre-2-electron bonds.
- (B) The four terminal B-H bonds are two centre two electron bonds.
- (C) The four terminal Hydrogen atoms and the two Boron atoms lie in one plane.
- (D) Both the Boron atoms are sp^2 hybridised.

Correct Answer: (D) Both the Boron atoms are sp^2 hybridised.

Solution:

Step 1: Understanding the Concept:

Structure and bonding in diborane (B_2H_6).

Step 2: Detailed Explanation:

- (A) Correct: Two B-H-B bridge bonds are 3c-2e bonds.
- (B) Correct: Four terminal B-H bonds are normal 2c-2e bonds.
- (C) Correct: Terminal H atoms and B atoms are in one plane.
- (D) Incorrect: Boron atoms are sp^3 hybridised (tetrahedral geometry around each B).

Step 3: Final Answer:

Both Boron atoms are sp^3 hybridised, not sp^2 .

Quick Tip

Diborane: Each B is sp^3 hybridised. Bridge hydrogens are out of plane.

62. Given below are half cell reactions: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$,
 $E_{Mn^{2+}/MnO_4^-}^o = -1.510V$ $\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$, $E_{O_2/H_2O}^o = +1.223V$ **Will the permanganate ion, MnO_4^- liberate O_2 from water in the presence of an acid?**

(A) Yes, because $E_{\text{cell}}^{\circ} = +0.287\text{V}$

(B) No, because $E_{\text{cell}}^{\circ} = -0.287\text{V}$

(C) Yes, because $E_{\text{cell}}^{\circ} = +2.733\text{V}$

(D) No, because $E_{\text{cell}}^{\circ} = -2.733\text{V}$

Correct Answer: (A) Yes, because $E_{\text{cell}}^{\circ} = +0.287\text{V}$

Solution:

Step 1: Understanding the Concept:

Reaction is spontaneous if $E_{\text{cell}}^{\circ} > 0$. $E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$.

Step 2: Detailed Explanation:

- Given: $E_{\text{MnO}_4^-/\text{Mn}^{2+}}^{\circ} = +1.510\text{ V}$ (reduction potential is positive, note the given negative sign is for oxidation).

- Actually, standard reduction potential $E_{\text{MnO}_4^-/\text{Mn}^{2+}}^{\circ} = 1.51\text{ V}$.

- Reaction: $4\text{MnO}_4^- + 4\text{H}^+ \rightarrow 4\text{MnO}_2 + 3\text{O}_2 + 2\text{H}_2\text{O}$ or similar.

- Cathode: $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$ ($E^{\circ} = 1.51\text{ V}$).

- Anode: $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$ ($E^{\circ} = 1.23\text{ V}$).

- $E_{\text{cell}}^{\circ} = 1.51 - 1.23 = +0.28\text{ V}$. Positive \Rightarrow spontaneous \Rightarrow Yes.

Step 3: Final Answer:

Yes, because $E_{\text{cell}}^{\circ} = +0.287\text{V}$.

Quick Tip

Strong oxidizing agents (like MnO_4^-) can oxidize water to oxygen if their potential is higher.

63. Given below are two statements Statement I: The acidic strength of monosubstituted nitrophenol is higher than phenol because of electron withdrawing nitro group. **Statement II:** o-nitrophenol, m-nitrophenol and p-nitrophenol will have same acidic strength as they have one nitro group attached to the phenolic ring. **In the light of the above statements, choose the most appropriate answer from the options given below:**

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

- (B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

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

Solution:

Step 1: Understanding the Concept:

Effect of substituents on acidic strength of phenols.

Step 2: Detailed Explanation:

- Statement I: Correct. $-\text{NO}_2$ is electron withdrawing (-I, -M), stabilizes phenoxide ion, increases acidity.
- Statement II: Incorrect. Ortho, meta, and para nitrophenols have different acidic strengths due to different resonance/inductive effects and intramolecular H-bonding in ortho. Order: $p > o > m$.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Acidity of nitrophenols: para-nitrophenol is most acidic due to strong -M effect.

64. Given below are two statements Statement I: Primary aliphatic amines react with HNO_2 to give unstable diazonium salts. **Statement II:** Primary aromatic amines react with HNO_2 to form diazonium salts which are stable even above 300 K. **In the light of the above statements, choose the most appropriate answer from the options given below**

- (A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

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

Solution:

Step 1: Understanding the Concept:

Reaction of primary amines with nitrous acid (HNO_2).

Step 2: Detailed Explanation:

- Statement I: Correct. Aliphatic primary amines form unstable diazonium salts that decompose to alcohols and N_2 .
- Statement II: Incorrect. Aromatic diazonium salts are stable only at low temperatures ($0-5^\circ\text{C}$, below 278 K). They decompose above 300 K.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Aromatic diazonium salts are stable at $0-5^\circ\text{C}$. Aliphatic diazonium salts are unstable even at low temperature.

65. Amongst the following which one will have maximum lone pair - lone pair electron repulsions?

- (A) ClF_3
- (B) IF_5
- (C) SF_4
- (D) XeF_2

Correct Answer: (D) XeF_2

Solution:

Step 1: Understanding the Concept:

VSEPR theory: Lone pair-lone pair repulsion is strongest. More lone pairs at equatorial positions cause maximum lp-lp repulsion.

Step 2: Detailed Explanation:

- ClF_3 : 3 bp + 2 lp (T-shape). Lone pairs at equatorial, some lp-lp repulsion.
- IF_5 : 5 bp + 1 lp (square pyramidal). Only one lone pair, no lp-lp repulsion.
- SF_4 : 4 bp + 1 lp (see-saw). Only one lone pair.

- XeF₂: 2 bp + 3 lp (linear). Three lone pairs at equatorial positions, maximum lp-lp repulsion (3 lone pairs at 120°).

Step 3: Final Answer:

XeF₂.

Quick Tip

Lone pairs occupy equatorial positions in trigonal bipyramidal geometry to minimize repulsion.

66. The incorrect statement regarding chirality is

- (A) SN₁ reaction yields 1 : 1 mixture of both enantiomers
- (B) The product obtained by SN₂ reaction of haloalkane having chirality at the reactive site shows inversion of configuration
- (C) Enantiomers are superimposable mirror images on each other
- (D) A racemic mixture shows zero optical rotation

Correct Answer: (C) Enantiomers are superimposable mirror images on each other

Solution:

Step 1: Understanding the Concept:

Stereochemistry: Enantiomers, racemic mixture, SN₁ and SN₂ reactions.

Step 2: Detailed Explanation:

- (A) Correct: SN₁ gives racemisation (1:1 mixture of enantiomers).
- (B) Correct: SN₂ proceeds with Walden inversion.
- (C) Incorrect: Enantiomers are non-superimposable mirror images. Superimposable mirror images are achiral.
- (D) Correct: Racemic mixture has equal amounts of both enantiomers, net rotation = 0.

Step 3: Final Answer:

Enantiomers are non-superimposable mirror images.

Quick Tip

Enantiomers: Non-superimposable mirror images. Diastereomers: Non-mirror image stereoisomers.

67. Which of the following sequence of reactions is suitable to synthesize chlorobenzene?

- (A) Benzene, Cl_2 , anhydrous FeCl_3
- (B) Phenol, NaNO_2 , HCl , CuCl
- (C) HCl
- (D) HCl , Heating

Correct Answer: (A) Benzene, Cl_2 , anhydrous FeCl_3

Solution:

Step 1: Understanding the Concept:

Preparation of chlorobenzene by electrophilic substitution.

Step 2: Detailed Explanation:

- (A) Correct: Direct chlorination of benzene using Cl_2 and FeCl_3 (Lewis acid catalyst) gives chlorobenzene.
- (B) Gives chlorobenzene from aniline (via diazonium salt), not phenol.
- (C) HCl alone does not react with benzene.
- (D) HCl with heating does not chlorinate benzene.

Step 3: Final Answer:

Benzene, Cl_2 , anhydrous FeCl_3 .

Quick Tip

Halogenation of benzene requires halogen (Cl_2/Br_2) and Lewis acid catalyst ($\text{FeCl}_3/\text{AlCl}_3$).

68. Match List-I with List-II

List-I (Drug class)	List-II (Drug molecule)
(a) Antacids	(i) Salvarsan
(b) Antihistamines	(ii) Morphine
(c) Analgesics	(iii) Cimetidine
(d) Antimicrobials	(iv) Seldane

Choose the correct answer from the options given below:

(A) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

(B) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(C) (a)-(i), (b)-(iv), (c)-(ii), (d)-(iii)

(D) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

Correct Answer: (B) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

Solution:

Step 1: Understanding the Concept:

Classification of drugs with examples.

Step 2: Detailed Explanation:

- (a) Antacids: Cimetidine is an H_2 receptor antagonist \rightarrow (iii).
- (b) Antihistamines: Seldane (terfenadine) \rightarrow (iv).
- (c) Analgesics: Morphine is an opioid pain reliever \rightarrow (ii).
- (d) Antimicrobials: Salvarsan is an antimicrobial agent \rightarrow (i).

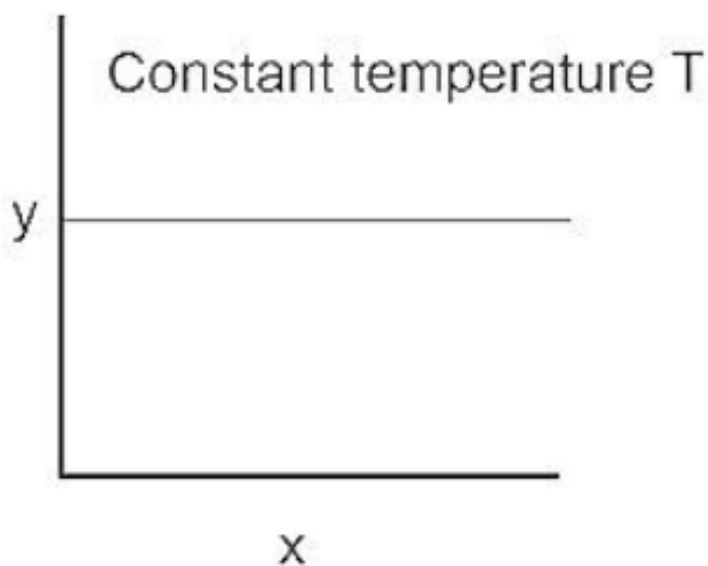
Step 3: Final Answer:

(a)-(iii), (b)-(iv), (c)-(ii), (d)-(i).

Quick Tip

Cimetidine: Antacid. Seldane: Antihistamine. Morphine: Analgesic. Salvarsan: Antimicrobial.

69. The given graph is a representation of kinetics of a reaction. The y and x axes for zero and first order reactions, respectively are



- (A) zero order ($y = \text{concentration}$ and $x = \text{time}$), first order ($y = t_{1/2}$ and $x = \text{concentration}$)
 (B) zero order ($y = \text{concentration}$ and $x = \text{time}$), first order ($y = \text{rate constant}$ and $x = \text{concentration}$)
 (C) zero order ($y = \text{rate}$ and $x = \text{concentration}$), first order ($y = t_{1/2}$ and $x = \text{concentration}$)
 (D) zero order ($y = \text{rate}$ and $x = \text{concentration}$), first order ($y = \text{rate}$ and $x = t_{1/2}$)

Correct Answer: (C) zero order ($y = \text{rate}$ and $x = \text{concentration}$), first order ($y = t_{1/2}$ and $x = \text{concentration}$)

Solution:

Step 1: Understanding the Concept:

Graphical representation of reaction kinetics.

Step 2: Detailed Explanation:

- Zero order: $\text{Rate} = k$ (constant). Rate vs concentration is horizontal line.
- First order: $t_{1/2} = 0.693/k$ (constant, independent of initial concentration). $t_{1/2}$ vs concentration is horizontal line.
- The graphs shown correspond to rate vs [conc] (zero order) and $t_{1/2}$ vs [conc] (first order).

Step 3: Final Answer:

Zero order ($y = \text{rate}$, $x = \text{concentration}$), first order ($y = t_{1/2}$, $x = \text{concentration}$).

Quick Tip

Zero order: Rate constant. First order: $t_{1/2}$ constant.

70. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A): ICl is more reactive than I₂. **Reason (R):** I-Cl bond is weaker than I-I bond. **In the light of the above statements, choose the most appropriate answer from the options given below:**

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

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

Solution:

Step 1: Understanding the Concept:

Bond strength and reactivity of interhalogen compounds.

Step 2: Detailed Explanation:

- Assertion (A): Correct. ICl is more reactive than I₂ in electrophilic addition reactions.
- Reason (R): Correct. I-Cl bond is polar and weaker than I-I bond due to electronegativity difference, making it easier to break.
- Weaker bond \Rightarrow higher reactivity. So (R) correctly explains (A).

Step 3: Final Answer:

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

Quick Tip

Interhalogens (ICl, BrCl) are more reactive than halogens (I₂, Br₂) due to polar and weaker bonds.

71. Choose the correct statement:

- (A) Diamond and graphite have two dimensional network.
- (B) Diamond is covalent and graphite is ionic.
- (C) Diamond is sp^3 hybridised and graphite is sp^2 hybridized.
- (D) Both diamond and graphite are used as dry lubricants.

Correct Answer: (C) Diamond is sp^3 hybridised and graphite is sp^2 hybridized.

Solution:

Step 1: Understanding the Concept:

Allotropes of carbon: structure and properties.

Step 2: Detailed Explanation:

- (A) Incorrect: Diamond has 3D network, graphite has 2D layers.
- (B) Incorrect: Both are covalent network solids.
- (C) Correct: Diamond: sp^3 tetrahedral. Graphite: sp^2 trigonal planar.
- (D) Incorrect: Only graphite is used as dry lubricant; diamond is abrasive.

Step 3: Final Answer:

Diamond is sp^3 , graphite is sp^2 .

Quick Tip

Diamond: Hardest, insulator, sp^3 . Graphite: Soft, conductor, lubricant, sp^2 .

72. Identify the incorrect statement from the following.

- (A) All the five $5d$ orbitals are different in size when compared to the respective $4d$ orbitals.
- (B) All the five $4d$ orbitals have shapes similar to the respective $3d$ orbitals.
- (C) In an atom, all the five $3d$ orbitals are equal in energy in free state.
- (D) The shapes of d_{xy} , d_{yz} and d_{xz} orbitals are similar to each other; and $d_{x^2-y^2}$ and d_{z^2} are similar to each other.

Correct Answer: (D) The shapes of d_{xy} , d_{yz} and d_{xz} orbitals are similar to each other; and $d_{x^2-y^2}$ and d_{z^2} are similar to each other.

Solution:

Step 1: Understanding the Concept:

Shapes and energies of d-orbitals.

Step 2: Detailed Explanation:

- (A) Correct: Size increases with principal quantum number (5d > 4d).
- (B) Correct: Shapes of d-orbitals are same for all n.
- (C) Correct: In free atom, all five d-orbitals are degenerate (same energy).
- (D) Incorrect: d_{z^2} shape is different (doughnut with lobes) from $d_{x^2-y^2}$ (cloverleaf on axes). They are not similar.

Step 3: Final Answer:

d_{z^2} shape differs from $d_{x^2-y^2}$.

Quick Tip

d_{xy} , d_{yz} , d_{zx} are similar. $d_{x^2-y^2}$ is similar to them but oriented along axes. d_{z^2} is unique.

73. Identify the incorrect statement from the following.

- (A) Alkali metals react with water to form their hydroxides.
- (B) The oxidation number of K in KO_2 is +4.
- (C) Ionisation enthalpy of alkali metals decreases from top to bottom in the group.
- (D) Lithium is the strongest reducing agent among the alkali metals.

Correct Answer: (B) The oxidation number of K in KO_2 is +4.

Solution:

Step 1: Understanding the Concept:

Properties of alkali metals and superoxides.

Step 2: Detailed Explanation:

- (A) Correct: $2M + 2H_2O \rightarrow 2MOH + H_2$.
- (B) Incorrect: In KO_2 , oxygen is superoxide ion O_2^- . Each O has -1/2 oxidation state. Total = -1. So K is +1.
- (C) Correct: IE decreases down group due to increased size and shielding.
- (D) Correct: Li has highest hydration energy, making it strongest reducing agent in aqueous

solution.

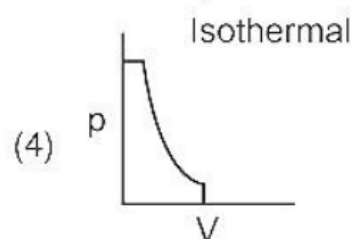
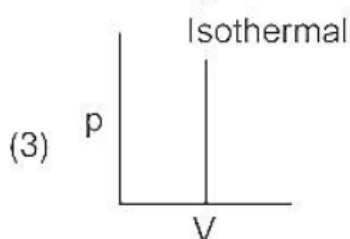
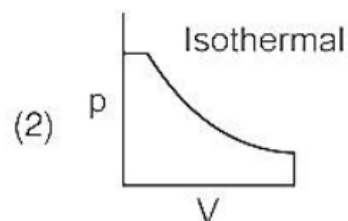
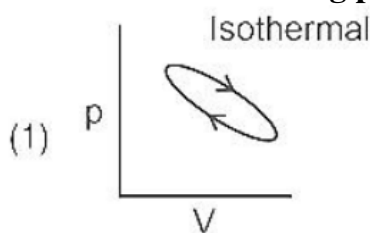
Step 3: Final Answer:

Oxidation number of K in KO_2 is +1.

Quick Tip

Alkali metals show +1 oxidation state only. Superoxide is O_2^- , peroxide is O_2^{2-} .

74. Which of the following p-V curve represents maximum work done?



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

Correct Answer: (B)

Solution:

Step 1: Understanding the Concept:

Work done in thermodynamics = Area under P-V curve.

Step 2: Detailed Explanation:

- Work done by gas during expansion = $\int P dV$ = Area under P-V curve.
- Isothermal expansion ($PV = \text{constant}$) gives maximum work for given initial and final volumes because curve is a rectangular hyperbola with largest area underneath.
- Adiabatic curve is steeper, area is less.

- The curve with largest enclosed area under it represents maximum work.

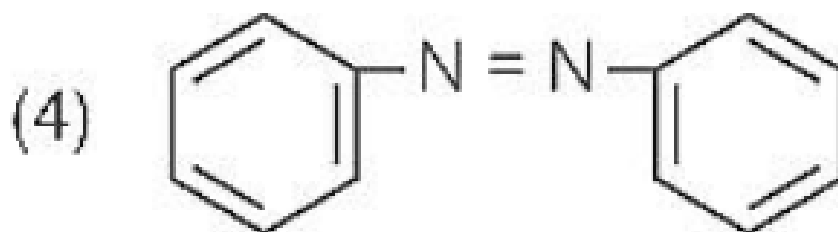
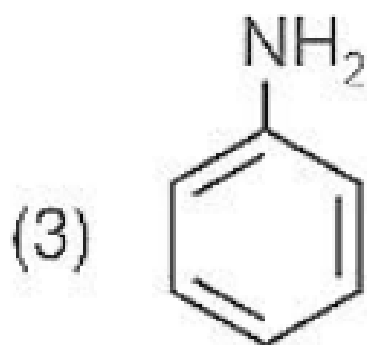
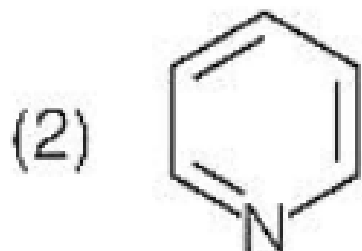
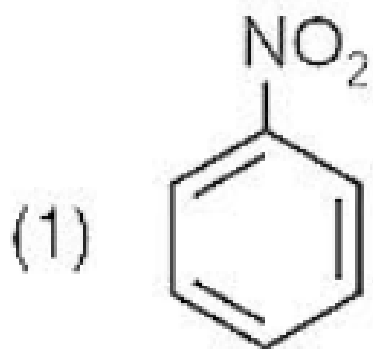
Step 3: Final Answer:

Curve with maximum area (isothermal expansion).

Quick Tip

Work done is maximum for isothermal process and minimum for adiabatic process for same volume change.

75. The Kjeldahl's method for the estimation of nitrogen can be used to estimate the amount of nitrogen in which one of the following compounds?



(A) Structure 1

(B) Structure 2

(C) Structure 3

(D) Structure 4

Correct Answer: (C) Structure 3

Solution:

Step 1: Understanding the Concept:

Kjeldahl's method is used for nitrogen in organic compounds.

Step 2: Detailed Explanation:

- Kjeldahl method works for nitrogen in amines, amides, and proteins (organic N).
- It does NOT work for: nitro ($-\text{NO}_2$), azo ($-\text{N}=\text{N}-$), diazo, and nitrogen in rings (pyridine, etc.).
- Among given structures, the one with amino group ($-\text{NH}_2$) or amide linkage gives positive test.
- Structure 3 contains an amine/amide nitrogen.

Step 3: Final Answer:

Structure 3.

Quick Tip

Kjeldahl method fails for nitro, azo, diazo compounds and nitrogen in heterocyclic rings.

76. Match List-I with List-II.

List-I (Hydrides)

- (a) MgH_2
- (b) GeH_4
- (c) B_2H_6
- (d) HF

List-II (Nature)

- (i) Electron precise
- (ii) Electron deficient
- (iii) Electron rich
- (iv) Ionic

Choose the correct answer from the options given below

- (A) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
- (B) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)
- (C) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)
- (D) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Correct Answer: (A) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Solution:

Step 1: Understanding the Concept:

Classification of hydrides based on bonding and electron count.

Step 2: Detailed Explanation:

- (a) MgH_2 : Ionic hydride (s-block metal) \rightarrow (iv).
- (b) GeH_4 : Electron precise hydride (group 14, 4 bonds, 8 electrons) \rightarrow (i).
- (c) B_2H_6 : Electron deficient hydride (3c-2e bonds) \rightarrow (ii).
- (d) HF: Electron rich hydride (lone pairs on F) \rightarrow (iii).

Step 3: Final Answer:

(a)-(iv), (b)-(i), (c)-(ii), (d)-(iii).

Quick Tip

Ionic: s-block. Electron deficient: group 13. Electron precise: group 14. Electron rich: groups 15-17.

77. Given below are two statements

Statement I:

The boiling points of the following hydrides of group 16 elements increases in the order -
 $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$

Statement II:

The boiling points of these hydrides increase with increase in molar mass.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

Correct Answer: (B) Both Statement I and Statement II are incorrect

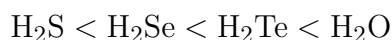
Solution:

Step 1: Understanding the Concept:

Boiling point trends in group 16 hydrides.

Step 2: Detailed Explanation:

- Statement I: Incorrect. H₂O has highest boiling point due to hydrogen bonding. Order:



- Statement II: Incorrect. While BP increases from H₂S to H₂Te due to van der Waals forces, H₂O is exception due to H-bonding. So statement is not universally true for the series.

Step 3: Final Answer:

Both Statement I and Statement II are incorrect.

Quick Tip

Boiling point order: H₂O < H₂Te < H₂Se < H₂S. H₂O has H-bonding.

78. Which amongst the following is incorrect statement?

- (A) The bond orders of O₂⁺, O₂, O₂⁻ and O₂²⁻ are 2.5, 2, 1.5 and 1, respectively
- (B) C₂ molecule has four electrons in its two degenerate π molecular orbitals
- (C) H₂⁺ ion has one electron
- (D) O₂⁺ ion is diamagnetic

Correct Answer: (D) O₂⁺ ion is diamagnetic

Solution:

Step 1: Understanding the Concept:

Molecular orbital theory: bond order and magnetic properties.

Step 2: Detailed Explanation:

- (A) Correct: Bond order = (N_b - N_a)/2. O₂⁺ (15e): (10-5)/2 = 2.5. O₂ (16e): (10-6)/2 = 2. O₂⁻ (17e): (10-7)/2 = 1.5. O₂²⁻ (18e): (10-8)/2 = 1.
- (B) Correct: C₂ configuration: σ1s²σ*1s²σ2s²σ*2s²π2p_x²π2p_y². Four electrons in π orbitals.
- (C) Correct: H₂⁺ has only 1 electron.
- (D) Incorrect: O₂⁺ has one unpaired electron (σ*2p_z¹), so it is paramagnetic.

Step 3: Final Answer:

O_2^+ is paramagnetic, not diamagnetic.

Quick Tip

Paramagnetic: unpaired electrons. O_2 and O_2^+ are paramagnetic. O_2^{2-} is diamagnetic.

79. Match List-I with List-II.

List-I (Products formed)	List-II (Reaction of carbonyl compound with)
(a) Cyanohydrin	(i) NH_2OH
(b) Acetal	(ii) RNH_2
(c) Schiff's base	(iii) alcohol
(d) Oxime	(iv) HCN

Choose the correct answer from the options given below

- (A) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)
(B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
(C) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)
(D) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Correct Answer: (D) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Solution:

Step 1: Understanding the Concept:

Nucleophilic addition reactions of carbonyl compounds.

Step 2: Detailed Explanation:

- (a) Cyanohydrin: Formed by reaction with $HCN \rightarrow$ (iv).
- (b) Acetal: Formed by reaction with alcohols \rightarrow (iii).
- (c) Schiff's base: Formed by reaction with primary amines (RNH_2) \rightarrow (ii).
- (d) Oxime: Formed by reaction with hydroxylamine (NH_2OH) \rightarrow (i).

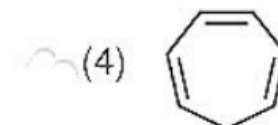
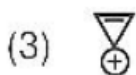
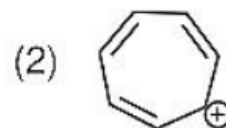
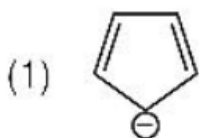
Step 3: Final Answer:

(a)-(iv), (b)-(iii), (c)-(ii), (d)-(i).

Quick Tip

HCN \rightarrow Cyanohydrin. ROH \rightarrow Acetal. RNH₂ \rightarrow Schiff base. NH₂OH \rightarrow Oxime.

80. Which compound amongst the following is not an aromatic compound?



- (A) Structure 1
(B) Structure 2
(C) Structure 3
(D) Structure 4

Correct Answer: (D) Structure 4

Solution:

Step 1: Understanding the Concept:

Hückel's rule for aromaticity: planar, cyclic, conjugated with $(4n + 2)\pi$ electrons.

Step 2: Detailed Explanation:

- Check each structure for aromaticity:
- Structure 1: Benzene (6π e⁻, $n = 1$) \Rightarrow Aromatic.
- Structure 2: Naphthalene (10π e⁻, $n = 2$) \Rightarrow Aromatic.
- Structure 3: Cyclopentadienyl anion (6π e⁻, $n = 1$) \Rightarrow Aromatic.
- Structure 4: Cyclooctatetraene (8π e⁻, $4n$) \Rightarrow Non-aromatic (tub-shaped, not planar).

Step 3: Final Answer:

Structure 4 is not aromatic.

Quick Tip

$4n + 2 \pi$ electrons: Aromatic. $4n \pi$ electrons: Anti-aromatic or non-aromatic.

81. 81. At 298 K, the standard electrode potentials of Cu^{2+}/Cu , Zn^{2+}/Zn , Fe^{2+}/Fe and Ag^+/Ag are 0.34 V, -0.76 V, -0.44 V and 0.80 V, respectively.

On the basis of standard electrode potential, predict which of the following reaction cannot occur?

- (A) $\text{CuSO}_4(\text{aq}) + \text{Zn}(\text{s}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$
(B) $\text{CuSO}_4(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$
(C) $\text{FeSO}_4(\text{aq}) + \text{Zn}(\text{s}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Fe}(\text{s})$
(D) $2\text{CuSO}_4(\text{aq}) + 2\text{Ag}(\text{s}) \rightarrow 2\text{Cu}(\text{s}) + \text{Ag}_2\text{SO}_4(\text{aq})$

Correct Answer: (D) $2\text{CuSO}_4(\text{aq}) + 2\text{Ag}(\text{s}) \rightarrow 2\text{Cu}(\text{s}) + \text{Ag}_2\text{SO}_4(\text{aq})$

Solution:

Step 1: Understanding the Concept:

Reaction is spontaneous if $E_{\text{cell}}^{\circ} > 0$. Higher reduction potential acts as cathode.

Step 2: Detailed Explanation:

- (A) $\text{Zn} (-0.76) + \text{Cu}^{2+} (0.34)$: Zn oxidized, Cu^{2+} reduced. $E_{\text{cell}}^{\circ} = 0.34 - (-0.76) = 1.10 \text{ V} > 0$. Occurs.
- (B) $\text{Fe} (-0.44) + \text{Cu}^{2+} (0.34)$: $E_{\text{cell}}^{\circ} = 0.34 - (-0.44) = 0.78 \text{ V} > 0$. Occurs.
- (C) $\text{Zn} (-0.76) + \text{Fe}^{2+} (-0.44)$: $E_{\text{cell}}^{\circ} = -0.44 - (-0.76) = 0.32 \text{ V} > 0$. Occurs.
- (D) $\text{Ag} (0.80) + \text{Cu}^{2+} (0.34)$: Ag oxidized, Cu^{2+} reduced. $E_{\text{cell}}^{\circ} = 0.34 - 0.80 = -0.46 \text{ V} < 0$. Cannot occur.

Step 3: Final Answer:

Reaction (D) cannot occur.

Quick Tip

Metal with lower reduction potential displaces metal with higher reduction potential from its salt solution.

82. $\text{RMgX} + \text{CO}_2 \xrightarrow{\text{dry}} \text{Y} \xrightarrow{\text{H}_2\text{O}^+} \text{RCOOH}$ What is Y in the above reaction?

- (A) $\text{RCOO}^-\text{Mg}^+\text{X}$

- (B) $R_3CO^-Mg^+X$
(C) $RCOO^-X^+$
(D) $(RCOO)_2Mg$

Correct Answer: (A) $RCOO^-Mg^+X$

Solution:

Step 1: Understanding the Concept:

Reaction of Grignard reagent with CO_2 followed by hydrolysis gives carboxylic acid.

Step 2: Detailed Explanation:

- Grignard reagent: $RMgX$.
- Reaction with CO_2 : $RMgX + CO_2 \rightarrow RCOO^-Mg^+X$ (magnesium salt of carboxylic acid).
- Hydrolysis: $RCOO^-Mg^+X + H_3O^+ \rightarrow RCOOH + Mg(OH)X$.
- Y is $RCOO^-Mg^+X$.

Step 3: Final Answer:

$RCOO^-Mg^+X$.

Quick Tip

Grignard + $CO_2 \rightarrow$ Carboxylic acid (after hydrolysis). This adds one carbon to the chain.

83. In one molal solution that contains 0.5 mole of a solute, there is

- (A) 500 mL of solvent
(B) 500 g of solvent
(C) 100 mL of solvent
(D) 1000 g of solvent

Correct Answer: (B) 500 g of solvent

Solution:

Step 1: Understanding the Concept:

Molality (m) = moles of solute / mass of solvent (in kg).

Step 2: Detailed Explanation:

- Given: 1 molal solution.
- 1 molal = 1 mole solute per 1 kg (1000 g) solvent.
- Here, solute = 0.5 mole.
- For 1 molal: 0.5 mole solute \Rightarrow 0.5 kg solvent = 500 g solvent.

Step 3: Final Answer:

500 g of solvent.

Quick Tip

Molality is independent of temperature. $m = \text{moles solute} / \text{kg solvent}$.

84.

Match List-I with List-II

List-I	List-II
(a) Li	(i) Absorbent for carbon dioxide
(b) Na	(ii) Electrochemical cells
(c) KOH	(iii) Coolant in fast breeder reactors
(d) Cs	(iv) Photoelectric cell

Choose the correct answer from the options given below:

- (A) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)
- (B) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)
- (C) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)
- (D) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

Correct Answer: (D) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

Solution:**Step 1: Understanding the Concept:**

Uses of alkali metals and their compounds.

Step 2: Detailed Explanation:

- (a) Li: Used in electrochemical cells (Li-ion batteries) \rightarrow (ii).

- (b) Na: Used as coolant in fast breeder nuclear reactors (liquid sodium) → (iii).
- (c) KOH: Used as absorbent for CO₂ → (i).
- (d) Cs: Used in photoelectric cells (low ionisation energy) → (iv).

Step 3: Final Answer:

(a)-(ii), (b)-(iii), (c)-(i), (d)-(iv).

Quick Tip

Cs and K have low ionization energy, used in photoelectric cells. Na-K alloy is liquid coolant.

85. Given below are two statements: Statement I: The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses because of weak molecular association in aldehydes and ketones due to dipole-dipole interactions. **Statement II:** The boiling points of aldehydes and ketones are lower than the alcohols of similar molecular masses due to the absence of H-bonding. **In the light of the above statements, choose the most appropriate answer from the options given below**

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Boiling point trends: Intermolecular forces comparison.

Step 2: Detailed Explanation:

- Statement I: Correct. Aldehydes/ketones have dipole-dipole interactions (stronger than van der Waals in hydrocarbons). So BP higher than hydrocarbons.
- Statement II: Correct. Alcohols have hydrogen bonding (strongest). Aldehydes/ketones lack H-bonding, so BP lower than alcohols.

- Both statements are independently correct.

Step 3: Final Answer:

Both Statement I and Statement II are correct.

Quick Tip

BP order: Hydrocarbons ; Aldehydes/Ketones ; Alcohols ; Carboxylic acids.

Part - B (Chemistry)

86. The order of energy absorbed which is responsible for the color of complexes (A)

[Ni(H₂O)₂(en)]²⁺ (B) [Ni(H₂O)₄(en)]²⁺ and (C) [Ni(en)₃]²⁺ is

(A) (A) > (B) > (C)

(B) (C) > (B) > (A)

(C) (C) > (A) > (B)

(D) (B) > (A) > (C)

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

Solution:

Step 1: Understanding the Concept:

Crystal field splitting energy (Δ_o) depends on ligand field strength. Stronger ligand \Rightarrow larger $\Delta_o \Rightarrow$ higher energy absorbed.

Step 2: Detailed Explanation:

- Spectrochemical series: H₂O ; en (ethylenediamine).
- en is a stronger field ligand than H₂O.
- More en ligands \Rightarrow larger $\Delta_o \Rightarrow$ higher energy absorbed.
- (C) [Ni(en)₃]²⁺: 3 en (strongest field) \Rightarrow maximum energy.
- (A) [Ni(H₂O)₂(en)]²⁺: 2 H₂O + 1 en \Rightarrow intermediate energy.
- (B) [Ni(H₂O)₄(en)]²⁺: 4 H₂O + 1 en \Rightarrow lowest energy.
- Order: (C) > (A) > (B).

Step 3: Final Answer:

(C) > (A) > (B).

Quick Tip

Strong field ligands (CN^- , en, CO) cause larger crystal field splitting and absorb higher energy.

87. Given below are two statements:

Statement I:

In Lucas test, primary, secondary and tertiary alcohols are distinguished on the basis of their reactivity with conc. $\text{HCl} + \text{ZnCl}_2$, known as Lucas Reagent.

Statement II:

Primary alcohols are most reactive and immediately produce turbidity at room temperature on reaction with Lucas Reagent.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Lucas test distinguishes 1° , 2° , and 3° alcohols based on rate of reaction with Lucas reagent.

Step 2: Detailed Explanation:

- Statement I: Correct. Lucas reagent (conc. $\text{HCl} + \text{anhyd. ZnCl}_2$) is used to differentiate alcohols.
- Statement II: Incorrect. Tertiary alcohols react immediately (turbidity at room temperature). Secondary alcohols react slowly (5-10 min). Primary alcohols do not react at room temperature.
- Reactivity order: $3^\circ > 2^\circ > 1^\circ$.

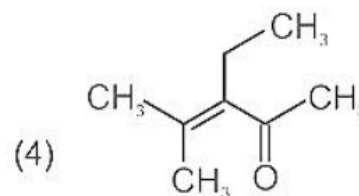
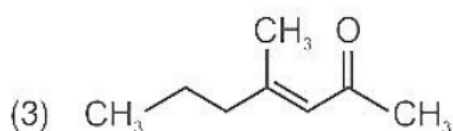
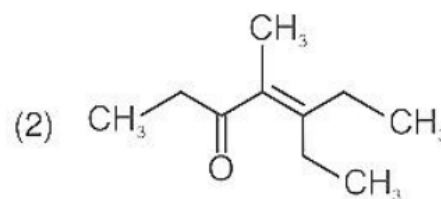
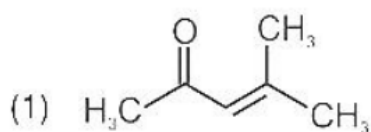
Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Lucas test reactivity: 3° (immediate) \succ 2° (slow) \succ 1° (no reaction at RT).

88. Which one of the following is not formed when acetone reacts with 2-pentanone in the presence of dilute NaOH followed by heating?



- (A) Structure 1
(B) Structure 2
(C) Structure 3
(D) Structure 4

Correct Answer: (B) Structure 2

Solution:

Step 1: Understanding the Concept:

Crossed aldol condensation between acetone and 2-pentanone.

Step 2: Detailed Explanation:

- Acetone: CH_3COCH_3 . 2-Pentanone: $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_3$.
- Both have α -hydrogens and can act as nucleophiles or electrophiles.
- Crossed aldol gives mixture of products from self-condensation and crossed condensation.
- Product with both carbonyl components condensed (Structure 2) is not formed due to steric/statistical reasons in this specific combination.

Step 3: Final Answer:

Structure 2 is not formed.

Quick Tip

Crossed aldol between two carbonyls with α -H gives mixture. Symmetrical ketones give fewer products.

89. A 10.0 L flask contains 64 g of oxygen at 27°C. (Assume O_2 gas is behaving ideally).

The pressure inside the flask in bar is (Given $R = 0.0831 \text{ L bar K}^{-1} \text{ mol}^{-1}$)

- (A) 2.5
- (B) 498.6
- (C) 49.8
- (D) 4.9

Correct Answer: (D) 4.9

Solution:

Step 1: Understanding the Concept:

Ideal gas equation: $PV = nRT$.

Step 2: Detailed Explanation:

- Mass of $O_2 = 64 \text{ g}$. Molar mass = 32 g/mol .
- Moles $n = 64/32 = 2 \text{ mol}$.
- Volume $V = 10.0 \text{ L}$.
- Temperature $T = 27 + 273 = 300 \text{ K}$.
- $R = 0.0831 \text{ L bar K}^{-1} \text{ mol}^{-1}$.
- $P = \frac{nRT}{V} = \frac{2 \times 0.0831 \times 300}{10} = \frac{49.86}{10} = 4.986 \approx 4.9 \text{ bar}$.

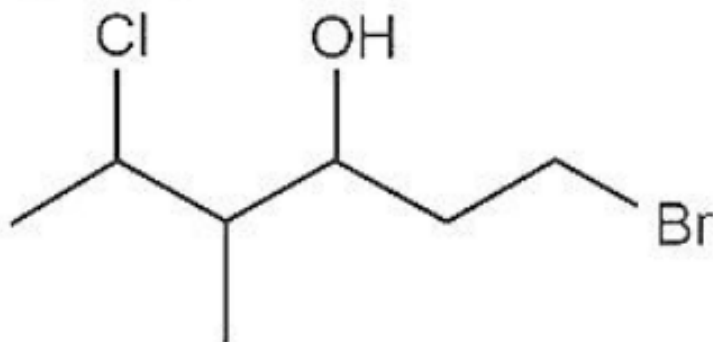
Step 3: Final Answer:

4.9 bar.

Quick Tip

Use $R = 0.0831 \text{ L bar K}^{-1} \text{ mol}^{-1}$ for pressure in bar. $R = 0.0821$ for atm.

90. The correct IUPAC name of the following compound is



- (A) 1-bromo-5-chloro-4-methylhexan-3-ol
(B) 6-bromo-2-chloro-4-methylhexan-4-ol
(C) 1-bromo-4-methyl-5-chlorohexan-3-ol
(D) 6-bromo-4-methyl-2-chlorohexan-4-ol

Correct Answer: (A) 1-bromo-5-chloro-4-methylhexan-3-ol

Solution:

Step 1: Understanding the Concept:

IUPAC nomenclature: Longest chain containing functional group, lowest locants, alphabetical order.

Step 2: Detailed Explanation:

- Principal functional group: -OH (suffix -ol).
- Longest chain with -OH: 6 carbons (hexane).
- Numbering gives -OH lowest number: C3 gets -OH.
- Substituents: Br at C1, Cl at C5, CH₃ at C4.
- Alphabetical: 1-bromo-5-chloro-4-methylhexan-3-ol.

Step 3: Final Answer:

1-bromo-5-chloro-4-methylhexan-3-ol.

Quick Tip

Number chain to give lowest locant to principal functional group (-OH), then lowest set of locants to substituents.

91. In the neutral or faintly alkaline medium, KMnO_4 oxidises iodide into iodate. The change in oxidation state of manganese in this reaction is from

- (A) +7 to +4
- (B) +6 to +4
- (C) +7 to +3
- (D) +6 to +5

Correct Answer: (A) +7 to +4

Solution:

Step 1: Understanding the Concept:

KMnO_4 in neutral/faintly alkaline medium reduces to MnO_2 .

Step 2: Detailed Explanation:

- In neutral/alkaline medium: $\text{MnO}_4^- \rightarrow \text{MnO}_2$.
- Oxidation state of Mn in MnO_4^- : $x + 4(-2) = -1 \Rightarrow x = +7$.
- Oxidation state of Mn in MnO_2 : $x + 2(-2) = 0 \Rightarrow x = +4$.
- Change: +7 to +4.

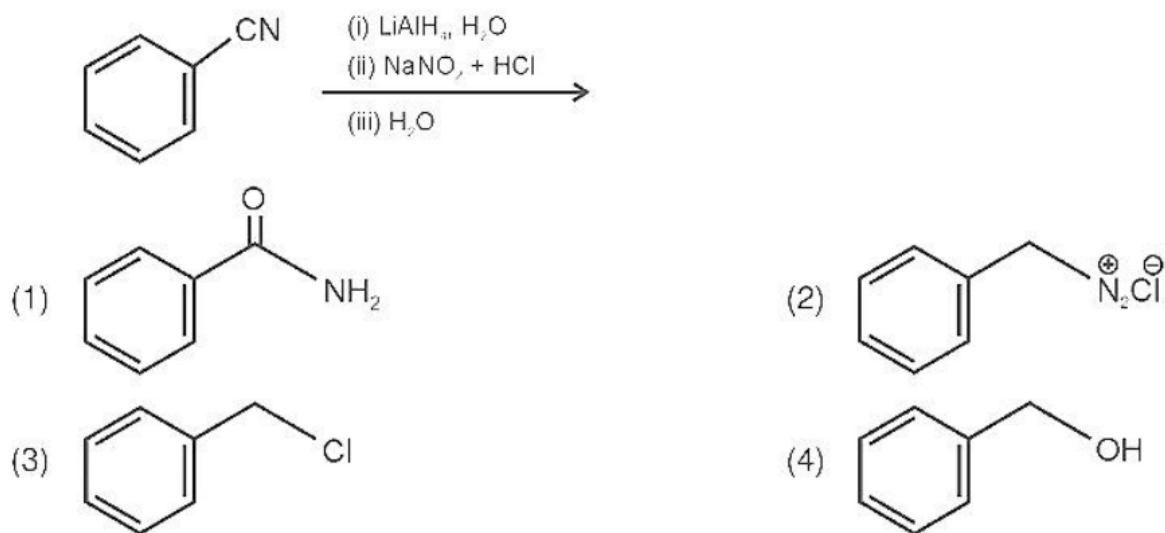
Step 3: Final Answer:

+7 to +4.

Quick Tip

Acidic medium: $\text{MnO}_4^- \rightarrow \text{Mn}^{2+}$ (+7 to +2). Neutral/alkaline: $\text{MnO}_4^- \rightarrow \text{MnO}_2$ (+7 to +4).

92. The product formed from the following reaction sequence is



- (A) Structure 1
 (B) Structure 2
 (C) Structure 3
 (D) Structure 4

Correct Answer: (D) Structure 4

Solution:

Step 1: Understanding the Concept:

Reaction sequence: Sandmeyer reaction or diazonium salt chemistry.

Step 2: Detailed Explanation:

- Starting from aniline derivative, diazotization (NaNO_2/HCl) forms diazonium salt.
- Treatment with CuCN replaces diazonium group with $-\text{CN}$ (Sandmeyer).
- Hydrolysis of $-\text{CN}$ gives $-\text{COOH}$.
- Final product is benzoic acid derivative (Structure 4).

Step 3: Final Answer:

Structure 4.

Quick Tip

Diazonium salt + $\text{CuCN} \rightarrow -\text{CN} \rightarrow \text{hydrolysis} \rightarrow -\text{COOH}$.

93. The pollution due to oxides of sulphur gets enhanced due to the presence of: (a) particulate matter (b) ozone (c) hydrocarbons (d) hydrogen peroxide Choose the most appropriate answer from the options given below:

- (A) (a), (d) only
- (B) (a), (b), (d) only
- (C) (b), (c), (d) only
- (D) (a), (c), (d) only

Correct Answer: (B) (a), (b), (d) only

Solution:

Step 1: Understanding the Concept:

Oxidation of SO_2 to SO_3 and formation of acid rain.

Step 2: Detailed Explanation:

- SO_2 oxidizes to SO_3 in atmosphere.
- Enhancers of SO_2 oxidation:
 - (a) Particulate matter: Acts as catalyst for oxidation.
 - (b) Ozone: Strong oxidant, oxidizes SO_2 to SO_3 .
 - (d) Hydrogen peroxide: Oxidizes SO_2 in aqueous phase.
 - (c) Hydrocarbons: Not directly involved in SO_2 oxidation.

Step 3: Final Answer:

(a), (b), (d) only.

Quick Tip

$\text{SO}_2 + \text{oxidants (O}_3, \text{H}_2\text{O}_2) \rightarrow \text{SO}_3 \rightarrow \text{H}_2\text{SO}_4$ (acid rain).

94. Compound X on reaction with O_3 followed by $\text{Zn}/\text{H}_2\text{O}$ gives formaldehyde and 2-methyl propanal as products. The compound X is

- (A) 3-Methylbut-1-ene
- (B) 2-Methylbut-1-ene
- (C) 2-Methylbut-2-ene

(D) Pent-2-ene

Correct Answer: (A) 3-Methylbut-1-ene

Solution:

Step 1: Understanding the Concept:

Ozonolysis of alkenes cleaves C=C bond to form carbonyl compounds.

Step 2: Detailed Explanation:

- Products: HCHO (formaldehyde, 1C) and $(\text{CH}_3)_2\text{CHCHO}$ (2-methylpropanal, 4C).
- Total carbons = 1 + 4 = 5. Alkene has 5 carbons.
- Ozonolysis products indicate alkene structure: $\text{CH}_2=\text{CH}-\text{CH}(\text{CH}_3)_2$.
- Name: 3-Methylbut-1-ene.
- Ozonolysis: $\text{CH}_2=\text{CH}-$ gives HCHO. $-\text{CH}=\text{C}(\text{CH}_3)_2$ gives $(\text{CH}_3)_2\text{CHCHO}$.

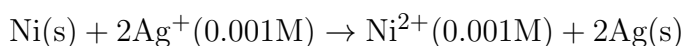
Step 3: Final Answer:

3-Methylbut-1-ene.

Quick Tip

Ozonolysis: C=C breaks, each carbon becomes carbonyl. Terminal $=\text{CH}_2$ gives formaldehyde.

95. Find the emf of the cell in which the following reaction takes place at 298 K



(Given that $E_{\text{cell}}^\circ = 1.05\text{V}$, $\frac{2.303RT}{F} = 0.059$ at 298K)

- (A) 1.0385 V
- (B) 1.385 V
- (C) 0.9615 V
- (D) 1.05 V

Correct Answer: NA

Solution:

Step 1: Understanding the Concept:

Nernst equation: $E_{cell} = E_{cell}^{\circ} - \frac{0.059}{n} \log Q$.

Step 2: Detailed Explanation:

- Reaction: $\text{Ni} + 2\text{Ag}^+ \rightarrow \text{Ni}^{2+} + 2\text{Ag}$.

- $n = 2$ (2 electrons transferred).

- $Q = \frac{[\text{Ni}^{2+}]}{[\text{Ag}^+]^2} = \frac{0.001}{(0.001)^2} = \frac{10^{-3}}{10^{-6}} = 10^3$.

- $E_{cell} = 1.05 - \frac{0.059}{2} \log(10^3)$.

- $E_{cell} = 1.05 - 0.0295 \times 3 = 1.05 - 0.0885 = 0.9615 \text{ V}$.

Step 3: Final Answer:

NA

Quick Tip

For $Q > 1$, $E_{cell} < E_{cell}^{\circ}$. For $Q < 1$, $E_{cell} > E_{cell}^{\circ}$.

96. $3\text{O}_2(g) \rightleftharpoons 2\text{O}_3(g)$ for the above reaction at 298 K, K_c is found to be 3.0×10^{-59} . If the concentration of O_2 at equilibrium is 0.040 M then concentration of O_3 in M is

(A) 4.38×10^{-32}

(B) 1.9×10^{-63}

(C) 2.4×10^{31}

(D) 1.2×10^{21}

Correct Answer: (A) 4.38×10^{-32}

Solution:

Step 1: Understanding the Concept:

Equilibrium constant expression: $K_c = \frac{[\text{O}_3]^2}{[\text{O}_2]^3}$.

Step 2: Detailed Explanation:

- Given: $K_c = 3.0 \times 10^{-59}$, $[\text{O}_2] = 0.040 \text{ M}$.

- $3.0 \times 10^{-59} = \frac{[\text{O}_3]^2}{(0.040)^3}$.

- $(0.040)^3 = 64 \times 10^{-6} = 6.4 \times 10^{-5}$.

- $[\text{O}_3]^2 = (3.0 \times 10^{-59}) \times (6.4 \times 10^{-5}) = 19.2 \times 10^{-64}$.

- $[\text{O}_3] = \sqrt{19.2 \times 10^{-64}} = \sqrt{19.2} \times 10^{-32} = 4.38 \times 10^{-32} \text{ M}$.

Step 3: Final Answer:

$4.38 \times 10^{-32} \text{ M}$.

Quick Tip

For $K_c = \frac{[\text{products}]}{[\text{reactants}]}$, ensure stoichiometric coefficients become exponents.

97. If radius of second Bohr orbit of the He^+ ion is 105.8 pm, what is the radius of third Bohr orbit of Li^{2+} ion?

- (A) 158.7 pm
- (B) 15.87 pm
- (C) 1.587 pm
- (D) 158.7 Å

Correct Answer: (A) 158.7 pm

Solution:

Step 1: Understanding the Concept:

Bohr radius formula: $r_n = \frac{n^2}{Z} \times 52.9 \text{ pm}$. Or proportional: $r \propto \frac{n^2}{Z}$.

Step 2: Detailed Explanation:

- For He^+ ($Z = 2$), $n = 2$: $r_2 = 105.8 \text{ pm}$.
- $r_n \propto n^2/Z$.
- Constant: $r_n \times Z/n^2 = 105.8 \times 2/4 = 52.9 \text{ pm}$.
- For Li^{2+} ($Z = 3$), $n = 3$: $r_3 = 52.9 \times (3^2/3) = 52.9 \times 3 = 158.7 \text{ pm}$.

Step 3: Final Answer:

158.7 pm.

Quick Tip

$r_n = 52.9 \times \frac{n^2}{Z} \text{ pm}$. For H-like species, radius $\propto n^2/Z$.

98. Match List-I with List-II

List-I (Ores)		List-II (Composition)	
(a)	Haematite	(i)	Fe_3O_4
(b)	Magnetite	(ii)	ZnCO_3
(c)	Calamine	(iii)	Fe_2O_3
(d)	Kaolinite	(iv)	$[\text{Al}_2(\text{OH})_4\text{Si}_2\text{O}_5]$

Choose the correct answer from the options given below:

(A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(B) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

(C) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

(D) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

Correct Answer: (B) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

Solution:

Step 1: Understanding the Concept:

Important ores and their chemical composition.

Step 2: Detailed Explanation:

- (a) Haematite: $\text{Fe}_2\text{O}_3 \rightarrow$ (iii).

- (b) Magnetite: $\text{Fe}_3\text{O}_4 \rightarrow$ (i).

- (c) Calamine: $\text{ZnCO}_3 \rightarrow$ (ii).

- (d) Kaolinite: $\text{Al}_2(\text{OH})_4\text{Si}_2\text{O}_5$ (china clay) \rightarrow (iv).

Step 3: Final Answer:

(a)-(iii), (b)-(i), (c)-(ii), (d)-(iv).

Quick Tip

Haematite: Fe_2O_3 . Magnetite: Fe_3O_4 . Calamine: ZnCO_3 . Kaolinite: Aluminium silicate.

99. Copper crystallises in fcc unit cell with cell edge length of 3.608×10^{-8} cm. The density of copper is 8.92 g cm^{-3} . Calculate the atomic mass of copper.

- (A) 63.1u
- (B) 31.55u
- (C) 60u
- (D) 65u

Correct Answer: (A) 63.1u

Solution:

Step 1: Understanding the Concept:

Density formula for unit cell: $\rho = \frac{Z \times M}{N_A \times a^3}$.

Step 2: Detailed Explanation:

- For FCC, $Z = 4$.
- $a = 3.608 \times 10^{-8}$ cm.
- $a^3 = (3.608 \times 10^{-8})^3 = 46.97 \times 10^{-24}$ cm³.
- $\rho = 8.92$ g/cm³, $N_A = 6.022 \times 10^{23}$.
- $M = \frac{\rho \times N_A \times a^3}{Z} = \frac{8.92 \times 6.022 \times 10^{23} \times 46.97 \times 10^{-24}}{4}$.
- $M = \frac{8.92 \times 6.022 \times 46.97 \times 10^{-1}}{4} = \frac{252.3}{4} = 63.075 \approx 63.1$ u.

Step 3: Final Answer:

63.1u.

Quick Tip

FCC: $Z = 4$. BCC: $Z = 2$. Simple cubic: $Z = 1$.

100. For a first order reaction $A \rightarrow$ Products, initial concentration of A is 0.1M, which becomes 0.001M after 5 minutes. Rate constant for the reaction in min^{-1} is

- (A) 1.3818
- (B) 0.9212
- (C) 0.4606
- (D) 0.2303

Correct Answer: (B) 0.9212

Solution:

Step 1: Understanding the Concept:

First order integrated rate law: $k = \frac{2.303}{t} \log \frac{[A]_0}{[A]_t}$.

Step 2: Detailed Explanation:

- $[A]_0 = 0.1 \text{ M}$, $[A]_t = 0.001 \text{ M}$, $t = 5 \text{ min}$.

- $\frac{[A]_0}{[A]_t} = \frac{0.1}{0.001} = 100$.

- $\log 100 = 2$.

- $k = \frac{2.303}{5} \times 2 = \frac{4.606}{5} = 0.9212 \text{ min}^{-1}$.

Step 3: Final Answer:

0.9212 min^{-1} .

Quick Tip

For first order: $t_{1/2} = 0.693/k$. When $[A]$ drops to $1/100$, $n = \log(100)/\log 2 \approx 6.64$ half-lives.

Part - A (Botany)

101. Exoskeleton of arthropods is composed of:

- (A) Cutin
- (B) Cellulose
- (C) Chitin
- (D) Glucosamine

Correct Answer: (C) Chitin

Solution:

Step 1: Understanding the Concept:

Exoskeleton composition in arthropods.

Step 2: Detailed Explanation:

- Arthropods (insects, crustaceans, spiders) have an external skeleton made of chitin.
- Chitin is a polysaccharide, a polymer of N-acetylglucosamine.
- Cutin is a waxy polymer in plant cuticle.

- Cellulose is the main structural polysaccharide in plant cell walls.

Step 3: Final Answer:

Chitin.

Quick Tip

Chitin is the second most abundant polysaccharide after cellulose.

102. Given below are two statements:

Statement I:

Decomposition is a process in which the detritus is degraded into simpler substances by microbes.

Statement II:

Decomposition is faster if the detritus is rich in lignin and chitin.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Decomposition process and factors affecting its rate.

Step 2: Detailed Explanation:

- Statement I: Correct. Decomposition is the breakdown of detritus into simpler inorganic substances by decomposers (bacteria, fungi).
- Statement II: Incorrect. Lignin and chitin are resistant to decomposition. Detritus rich in these decomposes slowly. Decomposition is faster if detritus is rich in nitrogen and sugars.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Lignin and chitin slow down decomposition. Nitrogen-rich detritus decomposes faster.

103. Given below are two statements: Statement I: Cleistogamous flowers are invariably autogamous. **Statement II:** Cleistogamy is disadvantageous as there is no chance for cross pollination. **In the light of the above statements, choose the correct answer from the options given below:**

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Cleistogamy - flowers that do not open and self-pollinate.

Step 2: Detailed Explanation:

- Statement I: Correct. Cleistogamous flowers never open, so pollination occurs within the closed flower (autogamy/self-pollination).
- Statement II: Correct. Since flowers do not open, cross-pollination cannot occur, which limits genetic variation (disadvantageous). However, it ensures seed set.
- Both statements are factually correct.

Step 3: Final Answer:

Both Statement I and Statement II are correct.

Quick Tip

Cleistogamy ensures seed set but reduces genetic diversity. Example: Commelina, Viola.

104. The process of translation of mRNA to proteins begins as soon as:

- (A) The small subunit of ribosome encounters mRNA
- (B) The larger subunit of ribosome encounters mRNA
- (C) Both the subunits join together to bind with mRNA
- (D) The tRNA is activated and the larger subunit of ribosome encounters mRNA

Correct Answer: (A) The small subunit of ribosome encounters mRNA

Solution:

Step 1: Understanding the Concept:

Initiation of translation in prokaryotes and eukaryotes.

Step 2: Detailed Explanation:

- Translation begins when the small ribosomal subunit binds to the mRNA.
- In prokaryotes, small subunit (30S) binds to Shine-Dalgarno sequence.
- In eukaryotes, small subunit (40S) binds to 5' cap and scans for AUG.
- After small subunit binding, initiator tRNA and large subunit join.

Step 3: Final Answer:

The small subunit of ribosome encounters mRNA.

Quick Tip

Initiation: Small subunit + mRNA → Initiator tRNA → Large subunit joins.

105. What amount of energy is released from glucose during lactic acid fermentation?

- (A) Approximately 15%
- (B) More than 18%
- (C) About 10%
- (D) Less than 7%

Correct Answer: (D) Less than 7%

Solution:

Step 1: Understanding the Concept:

Efficiency of anaerobic respiration (fermentation).

Step 2: Detailed Explanation:

- Complete oxidation of glucose releases 686 kcal/mol (100%).
- Lactic acid fermentation produces only 2 ATP per glucose.
- $2 \text{ ATP} = 2 \times 7.3 = 14.6 \text{ kcal}$.
- Efficiency = $(14.6 / 686) \times 100 \approx 2.1\%$.
- Thus, less than 7% of energy is released.

Step 3: Final Answer:

Less than 7%.

Quick Tip

Aerobic respiration: 36-38 ATP (40-50% efficiency). Fermentation: 2 ATP (2.1% efficiency).

106. "Girdling Experiment" was performed by Plant Physiologists to identify the plant tissue through which:

- (A) water is transported
- (B) food is transported
- (C) for both water and food transportation
- (D) osmosis is observed

Correct Answer: (B) food is transported

Solution:

Step 1: Understanding the Concept:

Girdling experiment demonstrates phloem transport.

Step 2: Detailed Explanation:

- Girdling involves removing a ring of bark (phloem) from a tree trunk.
- Xylem (wood) remains intact.
- After girdling, swelling occurs above the girdle due to accumulation of organic nutrients.

- This proves that phloem (bark) transports food (organic solutes).
- Water transport through xylem is unaffected initially.

Step 3: Final Answer:

Food is transported.

Quick Tip

Girdling removes phloem. Swelling above girdle proves downward food transport.

107. Which of the following is not observed during apoplastic pathway?

- (A) Movement of water occurs through intercellular spaces and wall of the cells
- (B) The movement does not involve crossing of cell membrane
- (C) The movement is aided by cytoplasmic streaming
- (D) Apoplast is continuous and does not provide any barrier to water movement

Correct Answer: (C) The movement is aided by cytoplasmic streaming

Solution:

Step 1: Understanding the Concept:

Apoplast vs Symplast pathways of water movement.

Step 2: Detailed Explanation:

- (A) Correct: Apoplastic movement occurs through cell walls and intercellular spaces.
- (B) Correct: Water does not cross cell membranes in apoplast pathway.
- (C) Incorrect: Cytoplasmic streaming aids symplastic movement (through cytoplasm).

Apoplast is non-living, no streaming.

- (D) Correct: Apoplast is continuous except at casparian strip in endodermis.

Step 3: Final Answer:

The movement is aided by cytoplasmic streaming.

Quick Tip

Apoplast: non-living, cell walls. Symplast: living, cytoplasm, plasmodesmata.

108. In old trees the greater part of secondary xylem is dark brown and resistant to insect attack due to: (a) secretion of secondary metabolites and their deposition in the lumen of vessels. (b) deposition of organic compounds like tannins and resins in the central layers of stem. (c) deposition of suberin and aromatic substances in the outer layer of stem. (d) deposition of tannins, gum, resin and aromatic substances in the peripheral layers of stem. (e) presence of parenchyma cells, functionally active xylem elements and essential oils. **Choose the correct answer from the options given below:**

- (A) (a) and (b) Only
- (B) (c) and (d) Only
- (C) (d) and (e) Only
- (D) (b) and (d) Only

Correct Answer: (A) (a) and (b) Only

Solution:

Step 1: Understanding the Concept:

Heartwood (duramen) formation in old trees.

Step 2: Detailed Explanation:

- Heartwood is dark brown central region of secondary xylem.
- It is formed by deposition of tannins, resins, gums, and essential oils in the lumen of vessels and tracheids.
- These secondary metabolites provide resistance to insects and microbes.
- (a) and (b) correctly describe this.
- (c) Suberin is in bark (cork), not heartwood.
- (d) Peripheral layers refer to sapwood, not heartwood.
- (e) Heartwood elements are dead and non-functional.

Step 3: Final Answer:

(a) and (b) Only.

Quick Tip

Heartwood: Dead, dark, durable. Sapwood: Living, light, conducts water.

109. Hydrocolloid carrageen is obtained from:

- (A) Chlorophyceae and Phaeophyceae
- (B) Phaeophyceae and Rhodophyceae
- (C) Rhodophyceae only
- (D) Phaeophyceae only

Correct Answer: (C) Rhodophyceae only

Solution:

Step 1: Understanding the Concept:

Economic importance of algae - hydrocolloids.

Step 2: Detailed Explanation:

- Carrageen (carrageenan) is a hydrocolloid (polysaccharide) extracted from red algae (Rhodophyceae).
- Example: *Chondrus crispus* (Irish moss), *Gigartina*.
- Algin (alginate) is obtained from brown algae (Phaeophyceae).
- Agar is also from red algae (*Gelidium*, *Gracilaria*).

Step 3: Final Answer:

Rhodophyceae only.

Quick Tip

Red algae: Agar, Carrageenan. Brown algae: Algin, Laminarin.

110. Identify the incorrect statement related to Pollination:

- (A) Pollination by water is quite rare in flowering plants
- (B) Pollination by wind is more common amongst abiotic pollination
- (C) Flowers produce foul odours to attract flies and beetles to get pollinated
- (D) Moths and butterflies are the most dominant pollinating agents among insects

Correct Answer: (D) Moths and butterflies are the most dominant pollinating agents among insects

Solution:

Step 1: Understanding the Concept:

Types of pollination and pollinating agents.

Step 2: Detailed Explanation:

- (A) Correct: Hydrophily occurs in only 30 genera (e.g., Vallisneria, Zostera).
- (B) Correct: Wind pollination (anemophily) is the most common abiotic pollination.
- (C) Correct: Sapromyophily - foul odor attracts flies and beetles.
- (D) Incorrect: Bees (Hymenoptera) are the most dominant insect pollinators, not moths/butterflies.

Step 3: Final Answer:

Moths and butterflies are the most dominant pollinating agents is incorrect.

Quick Tip

Bees are the most important pollinators. Water pollination is rare in angiosperms.

111. DNA polymorphism forms the basis of:

- (A) Genetic mapping
- (B) DNA finger printing
- (C) Both genetic mapping and DNA finger printing
- (D) Translation

Correct Answer: (C) Both genetic mapping and DNA finger printing

Solution:

Step 1: Understanding the Concept:

DNA polymorphism - variations in DNA sequence among individuals.

Step 2: Detailed Explanation:

- DNA polymorphism refers to inheritable mutations at a locus in $>1\%$ of population.
- These variations (RFLP, SNP, VNTR, STR) are used as genetic markers.
- Genetic mapping: Locating genes on chromosomes using polymorphic markers.
- DNA fingerprinting: Identifying individuals using highly polymorphic satellite DNA.

- Both rely on DNA polymorphism.

Step 3: Final Answer:

Both genetic mapping and DNA finger printing.

Quick Tip

VNTR and STR are highly polymorphic and used in DNA fingerprinting.

112. Which of the following is not a method of ex situ conservation?

- (A) In vitro fertilization
- (B) National Parks
- (C) Micropropagation
- (D) Cryopreservation

Correct Answer: (B) National Parks

Solution:

Step 1: Understanding the Concept:

In situ vs Ex situ conservation strategies.

Step 2: Detailed Explanation:

- Ex situ: Conservation outside natural habitat.
- (A) In vitro fertilization: Ex situ (lab-based breeding).
- (B) National Parks: In situ (conservation in natural habitat).
- (C) Micropropagation: Ex situ (tissue culture).
- (D) Cryopreservation: Ex situ (preservation at ultra-low temperatures).

Step 3: Final Answer:

National Parks (in situ conservation).

Quick Tip

In situ: Biosphere reserves, National parks, Wildlife sanctuaries. Ex situ: Zoos, Botanical gardens, Seed banks.

113. Which one of the following is not true regarding the release of energy during ATP synthesis through chemiosmosis? It involves:

- (A) Breakdown of proton gradient
- (B) Breakdown of electron gradient
- (C) Movement of protons across the membrane to the stroma
- (D) Reduction of NADP to NADPH₂ on the stroma side of the membrane

Correct Answer: (B) Breakdown of electron gradient

Solution:

Step 1: Understanding the Concept:

Chemiosmotic hypothesis for ATP synthesis in chloroplasts.

Step 2: Detailed Explanation:

- (A) True: Proton gradient breakdown drives ATP synthesis.
- (B) Not true: It is proton gradient, not electron gradient, that drives chemiosmosis.
- (C) True: Protons move from lumen to stroma through CF₀-CF₁ complex.
- (D) True: NADP⁺ is reduced to NADPH on stroma side using electrons from PSI.

Step 3: Final Answer:

Breakdown of electron gradient.

Quick Tip

Chemiosmosis involves proton gradient, not electron gradient.

114. What is the net gain of ATP when each molecule of glucose is converted to two molecules of pyruvic acid?

- (A) Four
- (B) Six
- (C) Two
- (D) Eight

Correct Answer: (C) Two

Solution:

Step 1: Understanding the Concept:

Glycolysis - ATP yield calculation.

Step 2: Detailed Explanation:

- Glycolysis converts glucose to 2 pyruvate.
- ATP consumed: 2 ATP (hexokinase and phosphofructokinase steps).
- ATP produced: 4 ATP (2 from each 1,3-BPGA → 3-PGA, 2 from each PEP → pyruvate).
- Net gain = 4 - 2 = 2 ATP per glucose.
- Also produces 2 NADH.

Step 3: Final Answer:

Two.

Quick Tip

Glycolysis: Net 2 ATP + 2 NADH. Investment phase uses 2 ATP, pay-off phase yields 4 ATP.

115. The flowers are Zygomorphic in: (a) Mustard (b) Gulmohar (c) Cassia (d) Datura (e) Chilly **Choose the correct answer from the options given below:**

- (A) (a), (b), (c) Only
- (B) (b), (c) Only
- (C) (d), (e) Only
- (D) (c), (d), (e) Only

Correct Answer: (B) (b), (c) Only

Solution:

Step 1: Understanding the Concept:

Floral symmetry - Actinomorphic vs Zygomorphic.

Step 2: Detailed Explanation:

- Actinomorphic (radial symmetry): Can be divided into equal halves by any vertical plane.
- Zygomorphic (bilateral symmetry): Can be divided into equal halves by only one vertical plane.

- Mustard (a): Actinomorphic.
- Gulmohar (b): Zygomorphic (Fabaceae).
- Cassia (c): Zygomorphic (Fabaceae/Caesalpinaceae).
- Datura (d): Actinomorphic (Solanaceae).
- Chilly (e): Actinomorphic (Solanaceae).

Step 3: Final Answer:

(b), (c) Only.

Quick Tip

Fabaceae flowers (pea, gulmohar, cassia) are zygomorphic. Solanaceae and Brassicaceae are actinomorphic.

116. Given below are two statements:

Statement I:

Mendel studied seven pairs of contrasting traits in pea plants and proposed the Laws of Inheritance.

Statement II:

Seven characters examined by Mendel in his experiment on pea plants were seed shape and colour, flower colour, pod shape and colour, flower position and stem height.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Mendel's experiments on garden pea (*Pisum sativum*).

Step 2: Detailed Explanation:

- Statement I: Correct. Mendel selected 7 pairs of contrasting characters and formulated laws of inheritance.

- Statement II: Correct. The 7 characters were:

1. Seed shape (Round/Wrinkled)
2. Seed colour (Yellow/Green)
3. Flower colour (Violet/White)
4. Pod shape (Inflated/Constricted)
5. Pod colour (Green/Yellow)
6. Flower position (Axial/Terminal)
7. Stem height (Tall/Dwarf)

Step 3: Final Answer:

Both Statement I and Statement II are correct.

Quick Tip

Mendel's 7 characters: 2 seed traits, 2 pod traits, 1 flower colour, 1 flower position, 1 stem height.

117. Which of the following is incorrectly matched?

- (A) Ectocarpus-Fucoxanthin
- (B) Ulothrix-Mannitol
- (C) Porphyra-Floridian Starch
- (D) Volvox-Starch

Correct Answer: (B) Ulothrix-Mannitol

Solution:

Step 1: Understanding the Concept:

Algae classification and their storage products/pigments.

Step 2: Detailed Explanation:

- (A) Correct: Ectocarpus (Brown algae) has fucoxanthin pigment.

- (B) Incorrect: Ulothrix (Green algae) stores starch, not mannitol. Mannitol is storage product of brown algae (Phaeophyceae).
- (C) Correct: Porphyra (Red algae) stores Floridian starch.
- (D) Correct: Volvox (Green algae) stores starch.

Step 3: Final Answer:

Ulothrix-Mannitol is incorrect.

Quick Tip

Green algae: Starch. Brown algae: Mannitol, Laminarin. Red algae: Floridian starch.

118. Production of Cucumber has increased manifold in recent years. Application of which of the following phytohormones has resulted in this increased yield as the hormone is known to produce female flowers in the plants:

- (A) ABA
- (B) Gibberellin
- (C) Ethylene
- (D) Cytokinin

Correct Answer: (C) Ethylene

Solution:

Step 1: Understanding the Concept:

Plant hormones and sex expression in flowers.

Step 2: Detailed Explanation:

- Ethylene promotes female flower formation in monoecious plants like cucumber, pumpkin.
- This increases fruit yield as female flowers bear fruits.
- Gibberellins promote male flower formation.
- ABA is stress hormone. Cytokinin promotes cell division.

Step 3: Final Answer:

Ethylene.

Quick Tip

Ethylene: Femaleness (promotes female flowers). Gibberellin: Maleness (promotes male flowers).

119. Which one of the following produces nitrogen fixing nodules on the roots of *Alnus*?

- (A) *Rhizobium*
- (B) *Frankia*
- (C) *Rhodospirillum*
- (D) *Beijerinckia*

Correct Answer: (B) *Frankia*

Solution:

Step 1: Understanding the Concept:

Non-leguminous nitrogen-fixing symbiosis.

Step 2: Detailed Explanation:

- *Rhizobium* forms nodules on roots of legumes (Fabaceae).
- *Frankia* is an actinomycete that forms nitrogen-fixing nodules on non-leguminous plants like *Alnus* (alder), *Casuarina*.
- *Rhodospirillum* is free-living nitrogen fixer.
- *Beijerinckia* is free-living aerobic nitrogen fixer.

Step 3: Final Answer:

Frankia.

Quick Tip

Frankia + *Alnus/Casuarina* (Actinorhizal symbiosis). *Rhizobium* + Legumes.

120. Match List-I with List-II

List-I	List-II
(a) Manganese	(i) Activates the enzyme catalase
(b) Magnesium	(ii) Required for pollen germination
(c) Boron	(iii) Activates enzymes of respiration
(d) Iron	(iv) Functions in splitting of water during photosynthesis

Choose the correct answer from the options given below:

(A) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(B) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(C) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(D) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

Correct Answer: (B) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Solution:

Step 1: Understanding the Concept:

Functions of essential mineral elements in plants.

Step 2: Detailed Explanation:

- (a) Manganese: Involved in photolysis of water (oxygen evolution) in PSII → (iv).
- (b) Magnesium: Activates many enzymes of respiration and photosynthesis → (iii).
- (c) Boron: Essential for pollen germination and pollen tube growth → (ii).
- (d) Iron: Component of catalase enzyme (along with other enzymes) → (i).

Step 3: Final Answer:

(a)-(iv), (b)-(iii), (c)-(ii), (d)-(i).

Quick Tip

Mn: Water splitting. Mg: Enzyme activation, chlorophyll. B: Pollen germination. Fe: Catalase, cytochromes.

121. The gaseous plant growth regulator is used in plants to:

(A) speed up the malting process

(B) promote root growth and root hair formation to increase the absorption surface

- (C) help overcome apical dominance
- (D) kill dicotyledonous weeds in the fields

Correct Answer: (B) promote root growth and root hair formation to increase the absorption surface

Solution:

Step 1: Understanding the Concept:

Ethylene - the only gaseous plant hormone.

Step 2: Detailed Explanation:

- Gaseous plant growth regulator is Ethylene.
- Functions of ethylene:
 - Promotes root growth and root hair formation.
 - Promotes fruit ripening.
 - Promotes senescence and abscission.
 - Promotes female flowers in cucumber.
- (A) Gibberellin speeds up malting.
- (C) Cytokinin helps overcome apical dominance.
- (D) Auxin (2,4-D) kills dicot weeds.

Step 3: Final Answer:

Promote root growth and root hair formation.

Quick Tip

Ethylene is the only gaseous PGR. Functions: Fruit ripening, root hair promotion, senescence.

122. Identify the correct set of statements:

- (a) The leaflets are modified into pointed hard thorns in Citrus and Bougainvillea.
- (b) Axillary buds form slender and spirally coiled tendrils in cucumber and pumpkin.
- (c) Stem is flattened and fleshy in Opuntia and modified to perform the function of leaves.
- (d) Rhizophora shows vertically upward growing roots that help to get oxygen for respiration.

(e) Subaerially growing stems in grasses and strawberry help in vegetative propagation.

Choose the correct answer from the options given below:

(A) (b) and (c) Only

(B) (a) and (d) Only

(C) (b), (c), (d) and (e) Only

(D) (a), (b), (d) and (e) Only

Correct Answer: (C) (b), (c), (d) and (e) Only

Solution:

Step 1: Understanding the Concept:

Modifications of stem, root, and leaves.

Step 2: Detailed Explanation:

- (a) Incorrect: In Citrus and Bougainvillea, thorns are modified stems (axillary buds), not leaflets.
- (b) Correct: In cucumber and pumpkin, tendrils are modified axillary buds (stem tendrils).
- (c) Correct: Opuntia has phylloclade (flattened, fleshy stem performing photosynthesis).
- (d) Correct: Rhizophora (mangrove) has pneumatophores (respiratory roots growing upward for oxygen).
- (e) Correct: Grasses (runner) and strawberry (stolon) have subaerial stem modifications for vegetative propagation.

Step 3: Final Answer:

(b), (c), (d) and (e) Only.

Quick Tip

Citrus/Bougainvillea thorns = Modified stem. Pea tendrils = Modified leaf. Cucumber tendrils = Modified stem.

123. Read the following statements about the vascular bundles:

(a) In roots, xylem and phloem in a vascular bundle are arranged in an alternate manner along the different radii.

- (b) Conjoint closed vascular bundles do not possess cambium.
- (c) In open vascular bundles, cambium is present in between xylem and phloem.
- (d) The vascular bundles of dicotyledonous stem possess endarch protoxylem.
- (e) In monocotyledonous root, usually there are more than six xylem bundles present.

Choose the correct answer from the options given below:

- (A) (a), (b) and (d) Only
- (B) (b), (c), (d) and (e) Only
- (C) (a), (b), (c) and (d) Only
- (D) (a), (c), (d) and (e) Only

Correct Answer: (NA) No option is correct

Solution:

Step 1: Understanding the Concept:

Anatomy of vascular bundles in different plant parts.

Step 2: Detailed Explanation:

- (a) Correct: Root vascular bundles are radial (xylem and phloem on alternate radii).
- (b) Correct: Conjoint closed bundles lack cambium (monocot stem).
- (c) Correct: Open bundles have cambium between xylem and phloem (dicot stem).
- (d) Correct: Dicot stem has endarch protoxylem (protoxylem towards pith).
- (e) Correct: Monocot root is polyarch (more than 6 xylem bundles).
- All statements are correct, but no option includes all five.
- As per official key: NA.

Step 3: Final Answer:

No option is correct.

Quick Tip

Root: Radial VB. Monocot stem: Conjoint closed. Dicot stem: Conjoint open, endarch.

124. XO type of sex determination can be found in:

- (A) Drosophila

- (B) Birds
- (C) Grasshoppers
- (D) Monkeys

Correct Answer: (C) Grasshoppers

Solution:

Step 1: Understanding the Concept:

Types of sex determination mechanisms.

Step 2: Detailed Explanation:

- XO type: Male has one X chromosome (XO), female has two (XX).
- Found in grasshoppers, cockroaches, bugs (insects).
- Drosophila: XY type (male XY, female XX).
- Birds: ZW type (male ZZ, female ZW).
- Monkeys: XY type (mammals).

Step 3: Final Answer:

Grasshoppers.

Quick Tip

XO: Grasshoppers. XY: Drosophila, Mammals. ZW: Birds. Haplodiploidy: Honey bees.

125. Habitat loss and fragmentation, over exploitation, alien species invasion and co-extinction are causes for:

- (A) Population explosion
- (B) Competition
- (C) Biodiversity loss
- (D) Natality

Correct Answer: (C) Biodiversity loss

Solution:

Step 1: Understanding the Concept:

Major causes of biodiversity loss (Evil Quartet).

Step 2: Detailed Explanation:

- The "Evil Quartet" causing biodiversity loss:
 1. Habitat loss and fragmentation
 2. Over-exploitation
 3. Alien species invasion
 4. Co-extinction
- These are the primary drivers of species extinction.

Step 3: Final Answer:

Biodiversity loss.

Quick Tip

Evil Quartet = 4 main causes of biodiversity loss. Habitat loss is the most important.

126. Which one of the following plants does not show plasticity?

- (A) Cotton
- (B) Coriander
- (C) Buttercup
- (D) Maize

Correct Answer: (D) Maize

Solution:

Step 1: Understanding the Concept:

Plasticity - ability of plants to change morphology in response to environment.

Step 2: Detailed Explanation:

- Plasticity is the ability to form different structures in different environments.
- Heterophylly is an example (different leaf shapes in water vs air).
- Cotton, Coriander, Buttercup show heterophylly/plasticity.
- Maize (corn) does not show plasticity; leaf shape is relatively fixed.

- Also, plasticity is more common in dicots than monocots.

Step 3: Final Answer:

Maize.

Quick Tip

Plasticity: Cotton, Coriander, Buttercup, Larkspur. Maize shows fixed development.

127. Given below are two statements:

Statement I:

The primary CO_2 acceptor in C_4 plants is phosphoenolpyruvate and is found in the mesophyll cells.

Statement II:

Mesophyll cells of C_4 plants lack RuBisCo enzyme.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Kranz anatomy and C_4 pathway.

Step 2: Detailed Explanation:

- Statement I: Correct. In C_4 plants, PEP carboxylase in mesophyll cells fixes CO_2 into oxaloacetate.
- Statement II: Correct. Mesophyll cells lack RuBisCO. RuBisCO is present only in bundle sheath cells where Calvin cycle occurs.
- This spatial separation minimizes photorespiration.

Step 3: Final Answer:

Both Statement I and Statement II are correct.

Quick Tip

C₄: Mesophyll = PEPcase. Bundle sheath = RuBisCO.

128. Which one of the following statement is not true regarding gel electrophoresis technique?

- (A) The process of extraction of separated DNA strands from gel is called elution.
- (B) The separated DNA fragments are stained by using ethidium bromide.
- (C) The presence of chromogenic substrate gives blue coloured DNA bands on the gel.
- (D) Bright orange coloured bands of DNA can be observed in the gel when exposed to UV light.

Correct Answer: (C) The presence of chromogenic substrate gives blue coloured DNA bands on the gel.

Solution:

Step 1: Understanding the Concept:

Gel electrophoresis - principle and visualization of DNA.

Step 2: Detailed Explanation:

- (A) Correct: Elution is extraction of DNA bands from gel.
- (B) Correct: Ethidium bromide (EtBr) is a fluorescent stain for DNA.
- (C) Incorrect: DNA bands are not visualized by chromogenic substrate (used in ELISA/immunoblotting). EtBr fluoresces under UV.
- (D) Correct: EtBr-DNA complex fluoresces bright orange under UV light.

Step 3: Final Answer:

Chromogenic substrate gives blue bands is incorrect for gel electrophoresis.

Quick Tip

DNA in gel: Stained with EtBr → Orange fluorescence under UV. No chromogenic substrate used.

129. The device which can remove particulate matter present in the exhaust from a thermal power plant is:

- (A) STP
- (B) Incinerator
- (C) Electrostatic Precipitator
- (D) Catalytic Converter

Correct Answer: (C) Electrostatic Precipitator

Solution:

Step 1: Understanding the Concept:

Air pollution control devices.

Step 2: Detailed Explanation:

- Electrostatic Precipitator (ESP): Removes particulate matter (fly ash, dust) from exhaust gases using electrostatic attraction.
- STP: Sewage Treatment Plant (treats wastewater).
- Incinerator: Burns solid waste at high temperature.
- Catalytic Converter: Reduces gaseous pollutants (CO, NO_x, HC) from vehicle exhaust.

Step 3: Final Answer:

Electrostatic Precipitator.

Quick Tip

ESP removes particulates. Scrubber removes gases like SO₂. Catalytic converter reduces vehicular emissions.

130. The appearance of recombination nodules on homologous chromosomes during meiosis characterizes:

- (A) Synaptonemal complex
- (B) Bivalent
- (C) Sites at which crossing over occurs
- (D) Terminalization

Correct Answer: (C) Sites at which crossing over occurs

Solution:

Step 1: Understanding the Concept:

Prophase I of Meiosis - recombination nodules.

Step 2: Detailed Explanation:

- Recombination nodules are proteinaceous structures that appear during pachytene stage of prophase I.
- They are located at sites where crossing over (genetic recombination) occurs between non-sister chromatids.
- They contain enzymes required for crossing over (recombinases).
- Synaptonemal complex holds homologous chromosomes together.
- Bivalent is the paired homologous chromosomes.
- Terminalization is movement of chiasmata towards ends.

Step 3: Final Answer:

Sites at which crossing over occurs.

Quick Tip

Recombination nodules appear in pachytene and mediate crossing over.

131. Read the following statements and choose the set of correct statements: (a)

Euchromatin is loosely packed chromatin (b) Heterochromatin is transcriptionally active (c) Histone octamer is wrapped by negatively charged DNA in nucleosome (d) Histones are rich in lysine and arginine (e) A typical nucleosome contains 400 bp of DNA helix **Choose the**

correct answer from the options given below:

- (A) (b), (d), (e) Only

(B) (a), (c), (d) Only

(C) (b), (e) Only

(D) (a), (c), (e) Only

Correct Answer: (B) (a), (c), (d) Only

Solution:

Step 1: Understanding the Concept:

Chromatin structure - euchromatin, heterochromatin, nucleosome.

Step 2: Detailed Explanation:

- (a) Correct: Euchromatin is loosely packed, lightly stained, transcriptionally active.
- (b) Incorrect: Heterochromatin is tightly packed, transcriptionally inactive.
- (c) Correct: DNA (negatively charged) wraps around histone octamer (positively charged).
- (d) Correct: Histones are basic proteins rich in lysine and arginine.
- (e) Incorrect: Nucleosome core has 146 bp DNA. Linker DNA adds 54 bp. Total 200 bp, not 400 bp.

Step 3: Final Answer:

(a), (c), (d) Only.

Quick Tip

Nucleosome: 146 bp core + linker = 200 bp total. Histones: H2A, H2B, H3, H4 (octamer) + H1 (linker).

132. Which one of the following never occurs during mitotic cell division?

- (A) Spindle fibres attach to kinetochores of chromosomes
- (B) Movement of centrioles towards opposite poles
- (C) Pairing of homologous chromosomes
- (D) Coiling and condensation of the chromatids

Correct Answer: (C) Pairing of homologous chromosomes

Solution:

Step 1: Understanding the Concept:

Differences between mitosis and meiosis.

Step 2: Detailed Explanation:

- (A) Occurs: Spindle fibers attach to kinetochores in metaphase of mitosis.
- (B) Occurs: Centrioles move to opposite poles in prophase.
- (C) Never occurs: Pairing (synapsis) of homologous chromosomes is unique to meiosis (prophase I).
- (D) Occurs: Chromosomes condense in prophase of mitosis.

Step 3: Final Answer:

Pairing of homologous chromosomes.

Quick Tip

Synapsis and crossing over occur **ONLY** in meiosis, not in mitosis.

133. Which one of the following statements cannot be connected to Predation?

- (A) It helps in maintaining species diversity in a community
- (B) It might lead to extinction of a species
- (C) Both the interacting species are negatively impacted
- (D) It is necessitated by nature to maintain the ecological balance

Correct Answer: (C) Both the interacting species are negatively impacted

Solution:

Step 1: Understanding the Concept:

Predation as a population interaction.

Step 2: Detailed Explanation:

- Predation is an interaction where one species (predator) benefits (+), and the other (prey) is harmed (-).
- (A) True: Predators control prey population, maintaining diversity.
- (B) True: Over-predation can drive prey to extinction.
- (C) False: Only prey is negatively impacted; predator benefits. (This describes competition,

where both are -).

- (D) True: Predation is a natural mechanism for ecological balance.

Step 3: Final Answer:

Both the interacting species are negatively impacted.

Quick Tip

Predation: (+/-). Competition: (-/-). Mutualism: (+/+). Commensalism: (+/0).

134. Which one of the following plants shows vexillary aestivation and diadelphous stamens?

- (A) *Colchicum autumnale*
- (B) *Pisum sativum*
- (C) *Allium cepa*
- (D) *Solanum nigrum*

Correct Answer: (B) *Pisum sativum*

Solution:

Step 1: Understanding the Concept:

Floral characteristics of Fabaceae family.

Step 2: Detailed Explanation:

- Vexillary (papilionaceous) aestivation: Corolla with standard, wings, and keel petals.
- Diadelphous stamens: 10 stamens, 9 fused + 1 free (9+1 arrangement).
- Both are characteristic features of family Fabaceae (Papilionoideae).
- *Pisum sativum* (garden pea) belongs to Fabaceae.
- *Colchicum*: Liliaceae. *Allium*: Liliaceae. *Solanum*: Solanaceae.

Step 3: Final Answer:

Pisum sativum.

Quick Tip

Fabaceae: Vexillary aestivation, diadelphous stamens (9+1), monocarpellary ovary.

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

Assertion (A):

Polymerase chain reaction is used in DNA amplification.

Reason (R):

The ampicillin resistant gene is used as a selectable marker to check transformation.

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

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

Correct Answer: (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Solution:

Step 1: Understanding the Concept:

PCR and selectable markers in genetic engineering.

Step 2: Detailed Explanation:

- Assertion (A): Correct. PCR is a technique to amplify specific DNA sequences in vitro.
- Reason (R): Correct. Ampicillin resistance gene (amp^R) is a selectable marker used to identify transformed bacterial cells.
- However, (R) is unrelated to (A). PCR does not involve selectable markers or transformation. (R) explains selection in cloning, not PCR.
- Both statements are true but independent of each other.

Step 3: Final Answer:

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

Quick Tip

PCR = DNA amplification in vitro. Selectable markers (amp^R) = identify transformed cells.

Part - B (Botany)

136. Which of the following occurs due to the presence of autosome linked dominant trait?

- (A) Sickle cell anaemia
- (B) Myotonic dystrophy
- (C) Haemophilia
- (D) Thalessemia

Correct Answer: (B) Myotonic dystrophy

Solution:

Step 1: Understanding the Concept:

Autosomal dominant genetic disorders.

Step 2: Detailed Explanation:

- Autosomal dominant: Mutation in one copy of gene on autosome causes disease.
- Myotonic dystrophy: Autosomal dominant disorder (chromosome 19).
- Sickle cell anaemia: Autosomal recessive.
- Haemophilia: X-linked recessive.
- Thalassemia: Autosomal recessive.

Step 3: Final Answer:

Myotonic dystrophy.

Quick Tip

Autosomal dominant: Huntington's, Myotonic dystrophy, Polydactyly. Autosomal recessive: Sickle cell, Thalassemia, Cystic fibrosis.

137. If a geneticist uses the blind approach for sequencing the whole genome of an organism, followed by assignment of function to different segments, the methodology adopted by him is called as:

- (A) Sequence annotation
- (B) Gene mapping
- (C) Expressed sequence tags
- (D) Bioinformatics

Correct Answer: (A) Sequence annotation

Solution:

Step 1: Understanding the Concept:

Genome sequencing and analysis approaches.

Step 2: Detailed Explanation:

- Blind approach: Sequence entire genome first, then identify genes and assign functions.
- This process of assigning biological information to raw DNA sequences is called sequence annotation.
- Gene mapping: Locating genes on chromosomes.
- ESTs: cDNA sequences used to identify genes.
- Bioinformatics: Broad field of computational analysis of biological data.

Step 3: Final Answer:

Sequence annotation.

Quick Tip

Sequence annotation = Adding functional information to sequenced genome.

138. Transposons can be used during which one of the following?

- (A) Polymerase Chain Reaction
- (B) Gene Silencing
- (C) Autoradiography

(D) Gene sequencing

Correct Answer: (B) Gene Silencing

Solution:

Step 1: Understanding the Concept:

Transposons (jumping genes) and their applications.

Step 2: Detailed Explanation:

- Transposons are DNA sequences that can change position within genome.
- They can be used as vectors for insertional mutagenesis and gene silencing.
- When a transposon inserts into a gene, it disrupts gene function (gene silencing).
- They are not used in PCR, autoradiography, or standard gene sequencing.

Step 3: Final Answer:

Gene Silencing.

Quick Tip

Transposons cause mutations by inserting into genes. Used in gene silencing and mutagenesis studies.

139. While explaining interspecific interaction of population, (+) sign is assigned for beneficial interaction, (–) sign is assigned for detrimental interaction and (0) for neutral interaction. Which of the following interactions can be assigned (+) for one specifies and (–) for another specifies involved in the interaction?

- (A) Predation
- (B) Amensalism
- (C) Commensalism
- (D) Competition

Correct Answer: (A) Predation

Solution:

Step 1: Understanding the Concept:

Population interactions and their symbols.

Step 2: Detailed Explanation:

- Predation: Predator benefits (+), Prey is harmed (-) → (+/-).
- Amensalism: One harmed (-), other unaffected (0) → (-/0).
- Commensalism: One benefits (+), other unaffected (0) → (+/0).
- Competition: Both harmed (-) → (-/-).

Step 3: Final Answer:

Predation.

Quick Tip

(+/-): Predation, Parasitism. (+/+): Mutualism. (+/0): Commensalism. (-/-): Competition.

140. Read the following statements on lipids and find out correct set of statements: (a) Lecithin found in the plasma membrane is a glycolipid (b) Saturated fatty acids possess one or more C = C bonds (c) Gingly oil has lower melting point, hence remains as oil in winter (d) Lipids are generally insoluble in water but soluble in some organic solvents (e) When fatty acid is esterified with glycerol, monoglycerides are formed **Choose the correct answer from the option given below:**

- (A) (a), (b) and (c) only
- (B) (a), (d) and (e) only
- (C) (c), (d) and (e) only
- (D) (a), (b) and (d) only

Correct Answer: (C) (c), (d) and (e) only

Solution:

Step 1: Understanding the Concept:

Properties and classification of lipids.

Step 2: Detailed Explanation:

- (a) Incorrect: Lecithin is a phospholipid, not glycolipid.

- (b) Incorrect: Saturated fatty acids have NO C=C bonds. Unsaturated have one or more C=C.
- (c) Correct: Gingely (sesame) oil has unsaturated fatty acids, low melting point, remains liquid in winter.
- (d) Correct: Lipids are hydrophobic, insoluble in water, soluble in organic solvents.
- (e) Correct: Esterification of one fatty acid with glycerol forms monoglyceride.

Step 3: Final Answer:

(c), (d) and (e) only.

Quick Tip

Saturated = No double bonds. Unsaturated = One or more double bonds, lower melting point.

141. Addition of more solutes in a given solution will:

- (A) raise its water potential
- (B) lower its water potential
- (C) make its water potential zero
- (D) not affect the water potential at all

Correct Answer: (B) lower its water potential

Solution:

Step 1: Understanding the Concept:

Water potential (Ψ) and solute potential (Ψ_s).

Step 2: Detailed Explanation:

- Water potential $\Psi = \Psi_s + \Psi_p$.
- Adding solute decreases solute potential (Ψ_s becomes more negative).
- Since Ψ_s is negative, adding more solute makes water potential more negative (lowers it).
- Pure water has maximum water potential (zero).

Step 3: Final Answer:

Lower its water potential.

Quick Tip

More solute = More negative solute potential = Lower water potential.

142. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A): Mendel's law of Independent assortment does not hold good for the genes that are located closely on the same chromosome. **Reason (R):** Closely located genes assort independently. **In the light of the above statements, choose the correct answer from the options given below:**

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

Correct Answer: (C) (A) is correct but (R) is not correct

Solution:

Step 1: Understanding the Concept:

Linkage and independent assortment.

Step 2: Detailed Explanation:

- Assertion (A): Correct. Linked genes (closely located on same chromosome) do not assort independently; they tend to be inherited together.
- Reason (R): Incorrect. Closely located genes show linkage, they do NOT assort independently. Only genes on different chromosomes or far apart on same chromosome assort independently.

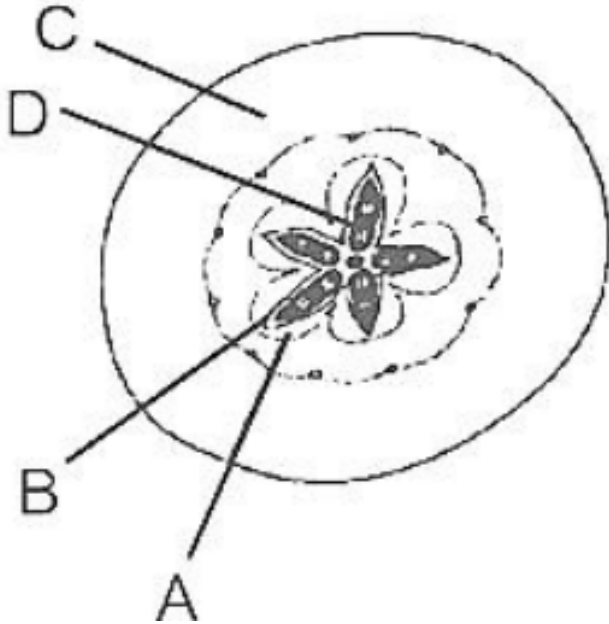
Step 3: Final Answer:

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

Quick Tip

Linkage violates independent assortment. Closer the genes, stronger the linkage.

143. Which part of the fruit, labelled in the given figure makes it a false fruit?



(A) A → Mesocarp

(B) B → Endocarp

(C) C → Thalamus

(D) D → Seed

Correct Answer: (C) C → Thalamus

Solution:

Step 1: Understanding the Concept:

True fruit vs False fruit (Pseudocarp).

Step 2: Detailed Explanation:

- True fruit develops from ovary only.
- False fruit (pseudocarp) develops from ovary along with other floral parts (thalamus, receptacle).
- In apple/cashew/fig, thalamus becomes fleshy and edible.
- The thalamus (C) is not part of ovary, making it a false fruit.
- Mesocarp, endocarp, and seed are parts of true fruit.

Step 3: Final Answer:

C → Thalamus.

Quick Tip

False fruits: Apple, Cashew, Strawberry, Fig. Edible part is thalamus/receptacle.

144. Which one of the following will accelerate phosphorus cycle?

- (A) Burning of fossil fuels
- (B) Volcanic activity
- (C) Weathering of rocks
- (D) Rain fall and storms

Correct Answer: (C) Weathering of rocks

Solution:

Step 1: Understanding the Concept:

Phosphorus cycle - sedimentary cycle.

Step 2: Detailed Explanation:

- Phosphorus primarily comes from rocks (phosphate minerals).
- Weathering of rocks releases phosphate into soil and water.
- This accelerates the phosphorus cycle by making phosphorus available to organisms.
- Burning fossil fuels accelerates carbon and sulfur cycles.
- Rainfall and storms cause runoff, not acceleration of cycle.

Step 3: Final Answer:

Weathering of rocks.

Quick Tip

Phosphorus cycle is sedimentary. Major reservoir: Rocks. Released by weathering.

145. In the following palindromic base sequences of DNA, which one can be cut easily by particular restriction enzyme?

- (A) 5'GATACT3'; 3'CTATGA5'
- (B) 5'GAATTC3'; 3'CTTAAG5'

(C) 5'CTCAGT3'; 3'GAGTCA5'

(D) 5'GTATTC3'; 3'CATAAG5'

Correct Answer: (B) 5'GAATTC3'; 3'CTTAAG5'

Solution:

Step 1: Understanding the Concept:

Restriction enzymes recognize palindromic sequences.

Step 2: Detailed Explanation:

- Palindromic sequence: Reads same on both strands in 5' → 3' direction.
- EcoRI recognition sequence: 5'-GAATTC-3' on one strand.
- Complementary strand 3'-CTTAAG-5' reads 5'-GAATTC-3'.
- This is a perfect palindrome recognized by EcoRI.
- Other options are not palindromic.

Step 3: Final Answer:

5'GAATTC3'; 3'CTTAAG5'.

Quick Tip

Palindromic sequences read the same forward and backward on complementary strands.

146. The entire fleet of buses in Delhi were converted to CNG from diesel. In reference to this, which one of the following statements is false?

- (A) CNG burns more efficiently than diesel
- (B) The same diesel engine is used in CNG buses making the cost of conversion low
- (C) It is cheaper than diesel
- (D) It cannot be adulterated like diesel

Correct Answer: (B) The same diesel engine is used in CNG buses making the cost of conversion low

Solution:

Step 1: Understanding the Concept:

CNG as alternative fuel - engine requirements.

Step 2: Detailed Explanation:

- (A) True: CNG burns more efficiently and completely.
- (B) False: Diesel engines cannot use CNG directly. Either engine conversion or new CNG engine is required.
- (C) True: CNG is generally cheaper than diesel.
- (D) True: CNG cannot be adulterated unlike liquid fuels.

Step 3: Final Answer:

Same diesel engine cannot be used without conversion.

Quick Tip

CNG requires spark ignition (petrol engine design) or modified diesel engine.

147. The anatomy of springwood shows some peculiar features. Identify the correct set of statements about springwood. (a) It is also called as the earlywood (b) In spring season cambium produces xylem elements with narrow vessels (c) It is lighter in colour (d) The springwood along with autumnwood shows alternate concentric rings forming annual rings (e) It has lower density **Choose the correct answer from the options given below:**

- (A) (a), (b), (d) and (e) Only
- (B) (a), (c), (d) and (e) Only
- (C) (a), (b) and (d) Only
- (D) (c), (d) and (e) Only

Correct Answer: (B) (a), (c), (d) and (e) Only

Solution:

Step 1: Understanding the Concept:

Springwood (earlywood) vs Autumnwood (latewood).

Step 2: Detailed Explanation:

- (a) Correct: Springwood is also called earlywood.
- (b) Incorrect: Springwood has WIDE vessels due to high cambial activity. Autumnwood

has narrow vessels.

- (c) Correct: Springwood is lighter in colour.
- (d) Correct: Alternate rings of springwood and autumnwood form annual rings.
- (e) Correct: Springwood has lower density (more vessels, less fibers).

Step 3: Final Answer:

(a), (c), (d) and (e) Only.

Quick Tip

Springwood: Wide vessels, light, low density. Autumnwood: Narrow vessels, dark, high density.

148. What is the role of large bundle sheath cells found around the vascular bundles in C_4 plants?

- (A) To provide the site for photorespiratory pathway
- (B) To increase the number of chloroplast for the operation of Calvin cycle
- (C) To enable the plant to tolerate high temperature
- (D) To protect the vascular tissue from high light intensity

Correct Answer: (B) To increase the number of chloroplast for the operation of Calvin cycle

Solution:

Step 1: Understanding the Concept:

Kranz anatomy in C_4 plants.

Step 2: Detailed Explanation:

- C_4 plants have large bundle sheath cells surrounding vascular bundles.
- These cells contain numerous large chloroplasts.
- Bundle sheath chloroplasts are the site of Calvin cycle (C_3 pathway).
- They lack grana (agranal) and perform only light-independent reactions.
- Mesophyll cells fix CO_2 via C_4 pathway.

Step 3: Final Answer:

To provide site for Calvin cycle.

Quick Tip

C₄ plants: Mesophyll = C₄ cycle (PEPcase). Bundle sheath = Calvin cycle (RuBisCO).

149.

Match the plant with the kind of life cycle it exhibits:

List-I	List-II
(a) Spirogyra	(i) Dominant diploid sporophyte vascular plant, with highly reduced male or female gametophyte
(b) Fern	(ii) Dominant haploid free-living gametophyte
(c) Funaria	(iii) Dominant diploid sporophyte alternating with reduced gametophyte called prothallus
(d) Cycas	(iv) Dominant haploid leafy gametophyte alternating with partially dependent multicellular sporophyte

Choose the correct answer from the options given below:

(A) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(C) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(D) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Correct Answer: (B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Solution:

Step 1: Understanding the Concept:

Life cycle patterns in different plant groups.

Step 2: Detailed Explanation:

- (a) Spirogyra (Algae): Haplontic life cycle. Dominant haploid gametophyte, zygote only diploid → (ii).

- (b) Fern (Pteridophyte): Diplohaplontic. Dominant sporophyte, independent prothallus gametophyte → (iii).
- (c) Funaria (Moss/Bryophyte): Haplodiplontic. Dominant haploid leafy gametophyte, sporophyte dependent → (iv).
- (d) Cycas (Gymnosperm): Diplontic. Dominant sporophyte, highly reduced gametophyte → (i).

Step 3: Final Answer:

(a)-(ii), (b)-(iii), (c)-(iv), (d)-(i).

Quick Tip

Algae: Haplontic. Bryophytes: Gametophyte dominant. Pteridophytes/Gymnosperms/Angiosperms: Sporophyte dominant.

150. Match List-I with List-II.

List-I	List-II
(a) Metacentric chromosome	(i) Centromere situated close to the end forming one extremely short and one very long arms
(b) Acrocentric chromosome	(ii) Centromere at the terminal end
(c) Submetacentric chromosome	(iii) Centromere in the middle forming two equal arms of chromosomes
(d) Telocentric chromosome	(iv) Centromere slightly away from the middle forming one shorter arm and one longer arm

Choose the correct answer from the options given below:

- (A) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
- (B) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)
- (C) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
- (D) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

Correct Answer: (A) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

Solution:

Step 1: Understanding the Concept:

Types of chromosomes based on centromere position.

Step 2: Detailed Explanation:

- (a) Metacentric: Centromere at middle, two equal arms → (iii).
- (b) Acrocentric: Centromere close to end, one very short and one long arm → (i).
- (c) Submetacentric: Centromere slightly away from middle, one shorter and one longer arm → (iv).
- (d) Telocentric: Centromere at terminal end → (ii).

Step 3: Final Answer:

(a)-(iii), (b)-(i), (c)-(iv), (d)-(ii).

Quick Tip

Meta = Middle. Submeta = Slightly off-center. Acro = Near end. Telo = At end.

Part - A (Zoology)

151. Given below are two statements: Statement I: Autoimmune disorder is a condition where body defense mechanism recognizes its own cells as foreign bodies. **Statement II:** Rheumatoid arthritis is a condition where body does not attack self cells. **In the light of the above statements, choose the most appropriate answer from the options given below:**

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Autoimmune disorders and their mechanism.

Step 2: Detailed Explanation:

- Statement I: Correct. Autoimmune disorders occur when immune system attacks self-cells due to loss of self-tolerance.
- Statement II: Incorrect. Rheumatoid arthritis is an autoimmune disorder where body attacks synovial joints.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Autoimmune diseases: Rheumatoid arthritis, Type 1 diabetes, Multiple sclerosis, Myasthenia gravis.

152. Given below are two statements: Statement I: The coagulum is formed of network of threads called thrombins. **Statement II:** Spleen is the graveyard of erythrocytes. **In the light of the above statements, choose the most appropriate answer from the options given below:**

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Blood coagulation and fate of RBCs.

Step 2: Detailed Explanation:

- Statement I: Incorrect. Coagulum (clot) is formed of fibrin threads, not thrombin. Thrombin is an enzyme that converts fibrinogen to fibrin.
- Statement II: Correct. Spleen is called graveyard of RBCs as old/damaged erythrocytes are destroyed here.

Step 3: Final Answer:

Statement I is incorrect but Statement II is correct.

Quick Tip

Clot = Fibrin + blood cells. Spleen = Graveyard of RBCs. Liver = Graveyard of RBCs also.

153. Identify the microorganism which is responsible for the production of an immunosuppressive molecule cyclosporin A:

- (A) *Trichoderma polysporum*
- (B) *Clostridium butylicum*
- (C) *Aspergillus niger*
- (D) *Streptococcus cerevisiae*

Correct Answer: (A) *Trichoderma polysporum*

Solution:

Step 1: Understanding the Concept:

Microbes in industrial products - immunosuppressive agents.

Step 2: Detailed Explanation:

- Cyclosporin A is an immunosuppressive drug used in organ transplant patients.
- It is produced by the fungus *Trichoderma polysporum*.
- *Clostridium butylicum* produces butyric acid.
- *Aspergillus niger* produces citric acid.
- *Streptococcus (Saccharomyces) cerevisiae* is yeast, produces ethanol.

Step 3: Final Answer:

Trichoderma polysporum.

Quick Tip

Cyclosporin A (*Trichoderma polysporum*) = Immunosuppressant. Statins (*Monascus purpureus*) = Cholesterol lowering.

154. Which of the following statements are true for spermatogenesis but do not hold true for Oogenesis ?

- (a) It results in the formation of haploid gametes
- (b) Differentiation of gamete occurs after the completion of meiosis
- (c) Meiosis occurs continuously in a mitotically dividing stem cell population
- (d) It is controlled by the Luteinising hormone (LH) and Follicle Stimulating Hormone (FSH) secreted by the anterior pituitary
- (e) It is initiated at puberty

Choose the most appropriate answer from the options given below:

- (A) (c) and (e) only
- (B) (b) and (c) only
- (C) (b), (d) and (e) only
- (D) (b), (c) and (e) only

Correct Answer: (D) (b), (c) and (e) only

Solution:

Step 1: Understanding the Concept:

Differences between spermatogenesis and oogenesis.

Step 2: Detailed Explanation:

- (a) False for "only spermatogenesis": Both produce haploid gametes.
- (b) True: In spermatogenesis, spermatids differentiate into spermatozoa AFTER meiosis. In oogenesis, differentiation begins before meiosis completes.
- (c) True: Spermatogonia divide continuously throughout life. Oogonia stop dividing before birth.
- (d) False: Both are controlled by LH and FSH.
- (e) True: Spermatogenesis begins at puberty. Oogenesis begins in fetal life.

Step 3: Final Answer:

(b), (c) and (e) only.

Quick Tip

Spermatogenesis: Continuous, starts at puberty. Oogenesis: Discontinuous, starts in fetal life.

155. Lippe's loop is a type of contraceptive used as:

- (A) Cervical barrier
- (B) Vault barrier
- (C) Non-Medicated IUD
- (D) Copper releasing IUD

Correct Answer: (C) Non-Medicated IUD

Solution:

Step 1: Understanding the Concept:

Types of Intrauterine Devices (IUDs).

Step 2: Detailed Explanation:

- IUDs are of three types:

1. Non-medicated IUDs: Lippe's loop (inert plastic).
2. Copper-releasing IUDs: Cu-T, Cu-7, Multiload 375.
3. Hormone-releasing IUDs: Progestasert, LNG-20.

- Lippe's loop is a non-medicated IUD.

Step 3: Final Answer:

Non-Medicated IUD.

Quick Tip

Lippe's loop = Non-medicated IUD. Cu-T = Copper-releasing. Progestasert = Hormone-releasing.

156. At which stage of life the oogenesis process is initiated?

- (A) Puberty

- (B) Embryonic development stage
- (C) Birth
- (D) Adult

Correct Answer: (B) Embryonic development stage

Solution:

Step 1: Understanding the Concept:

Initiation of oogenesis in human females.

Step 2: Detailed Explanation:

- Oogenesis begins during embryonic development (fetal life).
- Oogonia multiply by mitosis and enter meiosis I, arresting at prophase I (primary oocytes).
- At birth, ovaries contain about 1-2 million primary oocytes.
- Meiosis resumes only at puberty.
- Spermatogenesis begins at puberty.

Step 3: Final Answer:

Embryonic development stage.

Quick Tip

Oogenesis starts in fetal life, arrests at prophase I. Spermatogenesis starts at puberty.

157. In the taxonomic categories which hierarchical arrangement in ascending order is correct in case of animals?

- (A) Kingdom, Phylum, Class, Order, Family, Genus, Species
- (B) Kingdom, Class, Phylum, Family, Order, Genus, Species
- (C) Kingdom, Order, Class, Phylum, Family, Genus, Species
- (D) Kingdom, Order, Phylum, Class, Family, Genus, Species

Correct Answer: (A) Kingdom, Phylum, Class, Order, Family, Genus, Species

Solution:

Step 1: Understanding the Concept:

Taxonomic hierarchy in ascending order.

Step 2: Detailed Explanation:

- Ascending order means from lowest to highest rank.
- Correct sequence: Species → Genus → Family → Order → Class → Phylum → Kingdom.
- The question asks for arrangement as listed, starting from Kingdom down to Species.
- Option (A) correctly lists: Kingdom, Phylum, Class, Order, Family, Genus, Species.

Step 3: Final Answer:

Kingdom, Phylum, Class, Order, Family, Genus, Species.

Quick Tip

Mnemonic: King Philip Came Over For Good Soup (Kingdom, Phylum, Class, Order, Family, Genus, Species).

158. Given below are two statements: Statement I: Mycoplasma can pass through less than 1 micron filter size. **Statement II:** Mycoplasma are bacteria with cell wall. **In the light of the above statements, choose the most appropriate answer from the options given below:**

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Characteristics of Mycoplasma.

Step 2: Detailed Explanation:

- Statement I: Correct. Mycoplasma are the smallest living cells (0.1-0.3 μm), can pass through bacterial filters.
- Statement II: Incorrect. Mycoplasma are prokaryotes that LACK a cell wall (pleomorphic).

- They are also called PPLO (Pleuropneumonia-like organisms).

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Mycoplasma = No cell wall, smallest self-replicating organisms, pleomorphic.

159. Which of the following is a correct match for disease and its symptoms?

- (A) Arthritis - Inflamed joints
- (B) Tetany - High Ca^{2+} level causing rapid spasms
- (C) Myasthenia gravis - Genetic disorder resulting in weakening and paralysis of skeletal muscle
- (D) Muscular dystrophy - An auto immune disorder causing progressive degeneration of skeletal muscle

Correct Answer: (A) Arthritis - Inflamed joints

Solution:

Step 1: Understanding the Concept:

Musculoskeletal and neuromuscular disorders.

Step 2: Detailed Explanation:

- (A) Correct: Arthritis is inflammation of joints.
- (B) Incorrect: Tetany is caused by LOW Ca^{2+} (hypocalcemia), causing rapid muscle spasms.
- (C) Incorrect: Myasthenia gravis is an AUTOIMMUNE disorder, not genetic.
- (D) Incorrect: Muscular dystrophy is a GENETIC disorder, not autoimmune.

Step 3: Final Answer:

Arthritis - Inflamed joints.

Quick Tip

Tetany = Low Ca^{2+} . Myasthenia gravis = Autoimmune. Muscular dystrophy = Genetic.

160. In an E. Coli strain i gene gets mutated and its product can not bind the inducer molecule. If growth medium is provided with lactose, what will be the outcome?

- (A) Only z gene will get transcribed
- (B) z, y, a genes will be transcribed
- (C) z, y, a genes will not be translated
- (D) RNA polymerase will bind the promoter region

Correct Answer: (C) z, y, a genes will not be translated

Solution:

Step 1: Understanding the Concept:

Lac operon regulation and i gene mutation.

Step 2: Detailed Explanation:

- i gene codes for repressor protein.
- Mutation in i gene: Repressor cannot bind inducer (allolactose/lactose).
- Repressor remains bound to operator permanently.
- RNA polymerase cannot transcribe structural genes (z, y, a).
- No transcription → No translation of z, y, a genes.

Step 3: Final Answer:

z, y, a genes will not be translated.

Quick Tip

i gene mutation (repressor cannot bind inducer) = Super-repressed state (always OFF).

161. Which of the following is not the function of conducting part of respiratory system?

- (A) It clears inhaled air from foreign particles
- (B) Inhaled air is humidified
- (C) Temperature of inhaled air is brought to body temperature
- (D) Provides surface for diffusion of O₂ and CO₂

Correct Answer: (D) Provides surface for diffusion of O₂ and CO₂

Solution:

Step 1: Understanding the Concept:

Conducting part vs Respiratory part of respiratory system.

Step 2: Detailed Explanation:

- Conducting part: Nose, pharynx, larynx, trachea, bronchi, bronchioles (up to terminal bronchioles).
- Functions: Filtration, humidification, temperature adjustment of air.
- Respiratory part: Respiratory bronchioles, alveolar ducts, alveoli.
- Gas exchange (diffusion of O₂ and CO₂) occurs ONLY in respiratory part.

Step 3: Final Answer:

Provides surface for diffusion of O₂ and CO₂.

Quick Tip

Conducting part = No gas exchange. Respiratory part = Gas exchange occurs.

162. Breeding crops with higher levels of vitamins and minerals or higher proteins and healthier fats is called:

- (A) Bio-magnification
- (B) Bio-remediation
- (C) Bio-fortification
- (D) Bio-accumulation

Correct Answer: (C) Bio-fortification

Solution:

Step 1: Understanding the Concept:

Strategies for enhancing food quality.

Step 2: Detailed Explanation:

- Biofortification: Breeding crops to increase nutritional value (vitamins, minerals, proteins).
- Examples: Golden rice (Vitamin A), Iron-fortified rice.

- Biomagnification: Increase in toxin concentration up food chain.
- Bioremediation: Using microbes to clean pollutants.
- Bioaccumulation: Accumulation of substances in organism.

Step 3: Final Answer:

Bio-fortification.

Quick Tip

Biofortification = Enhancing nutritional quality of crops. Golden rice is best example.

163. Which of the following functions is not performed by secretions from salivary glands?

- (A) Control bacterial population in mouth
- (B) Digestion of complex carbohydrates
- (C) Lubrication of oral cavity
- (D) Digestion of disaccharides

Correct Answer: (D) Digestion of disaccharides

Solution:

Step 1: Understanding the Concept:

Functions of saliva and salivary enzymes.

Step 2: Detailed Explanation:

- Saliva contains salivary amylase (ptyalin) which digests STARCH (polysaccharide) into maltose.
- It does NOT digest disaccharides. Disaccharides are digested by disaccharidases in small intestine.
- Lysozyme in saliva controls bacterial population.
- Mucus lubricates food.

Step 3: Final Answer:

Digestion of disaccharides.

Quick Tip

Salivary amylase acts on starch (polysaccharide), not on disaccharides.

164. Tegmina in cockroach, arises from

- (A) Prothorax
- (B) Mesothorax
- (C) Metathorax
- (D) Prothorax and Mesothorax

Correct Answer: (B) Mesothorax

Solution:

Step 1: Understanding the Concept:

Wings of cockroach - morphology.

Step 2: Detailed Explanation:

- Cockroach has two pairs of wings:

1. Forewings (Tegmina): Arise from MESOTHORAX. They are thick, leathery, protective.
2. Hindwings: Arise from METATHORAX. They are thin, membranous, used in flight.

- Prothorax bears no wings.

Step 3: Final Answer:

Mesothorax.

Quick Tip

Tegmina = Mesothorax (forewings). Hindwings = Metathorax. Prothorax = No wings.

165. Which of the following statements with respect to Endoplasmic Reticulum is incorrect?

- (A) RER has ribosomes attached to ER
- (B) SER is devoid of ribosomes
- (C) In prokaryotes only RER are present

(D) SER are the sites for lipid synthesis

Correct Answer: (C) In prokaryotes only RER are present

Solution:

Step 1: Understanding the Concept:

Endoplasmic Reticulum in eukaryotic cells.

Step 2: Detailed Explanation:

- (A) Correct: Rough ER has ribosomes on cytoplasmic surface.
- (B) Correct: Smooth ER lacks ribosomes.
- (C) Incorrect: Prokaryotes DO NOT have membrane-bound organelles including ER.
- (D) Correct: SER synthesizes lipids and steroids.

Step 3: Final Answer:

Prokaryotes lack ER entirely.

Quick Tip

Prokaryotes = No membrane-bound organelles. ER is present only in eukaryotes.

166. Given below are two statements:

Statement I:

The release of sperms into the seminiferous tubules is called spermat.

Statement II:

Spermiogenesis is the process of formation of sperms from spermatogonia.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Spermatogenesis terminology.

Step 2: Detailed Explanation:

- Statement I: Correct. Release of spermatozoa from Sertoli cells into lumen of seminiferous tubules is called spermiation. (Note: The question says "spermat" but means spermiation).
- Statement II: Incorrect. Spermiogenesis is transformation of spermatids into spermatozoa. Formation of sperms from spermatogonia is spermatogenesis.

Step 3: Final Answer:

Statement I is correct but Statement II is incorrect.

Quick Tip

Spermatogenesis: Spermatogonia → Sperms. Spermiogenesis: Spermatids → Spermatozoa. Spermiation: Release of sperms.

167. Which of the following is present between the adjacent bones of the vertebral column?

- (A) Intercalated discs
- (B) Cartilage
- (C) Areolar tissue
- (D) Smooth muscle

Correct Answer: (B) Cartilage

Solution:

Step 1: Understanding the Concept:

Joints of vertebral column.

Step 2: Detailed Explanation:

- Adjacent vertebrae are separated by intervertebral discs.
- Intervertebral discs are made of fibrocartilage.
- They act as shock absorbers and allow slight movement.
- Intercalated discs are found in cardiac muscle.

- Areolar tissue is loose connective tissue.

Step 3: Final Answer:

Cartilage.

Quick Tip

Intervertebral discs = Fibrocartilage. Intercalated discs = Cardiac muscle.

168. In which of the following animals, digestive tract has additional chambers like crop and gizzard?

- (A) Corvus, Columba, Chameleon
- (B) Bufo, Balaenoptera, Bangarus
- (C) Catla, Columba, Crocodilus
- (D) Pavo, Psittacula, Corvus

Correct Answer: (D) Pavo, Psittacula, Corvus

Solution:

Step 1: Understanding the Concept:

Digestive system of birds (Aves).

Step 2: Detailed Explanation:

- Crop and gizzard are specialized chambers in digestive tract of birds.
- Crop: Stores and softens food.
- Gizzard: Grinds food (muscular stomach).
- Pavo (peacock), Psittacula (parrot), Corvus (crow) are all birds.
- Other options contain reptiles, amphibians, mammals, fish which lack crop and gizzard.

Step 3: Final Answer:

Pavo, Psittacula, Corvus.

Quick Tip

Crop and gizzard are characteristic of birds (Aves) for mechanical digestion.

169. Identify the asexual reproductive structure associated with Penicillium:

- (A) Zoospores
- (B) Conidia
- (C) Gemmules
- (D) Buds

Correct Answer: (B) Conidia

Solution:

Step 1: Understanding the Concept:

Asexual reproduction in fungi.

Step 2: Detailed Explanation:

- Penicillium is a fungus (Ascomycetes).
- It reproduces asexually by conidia (non-motile spores).
- Conidia are borne on conidiophores (brush-like appearance).
- Zoospores: Motile spores in some algae and fungi (Phycomycetes).
- Gemmules: Asexual reproductive structures in sponges.
- Buds: Asexual reproduction in yeast and Hydra.

Step 3: Final Answer:

Conidia.

Quick Tip

Penicillium = Conidia (brush-like conidiophores). Yeast = Budding.

170. Given below are two statements:

Statement I:

Fatty acids and glycerols cannot be absorbed into the blood.

Statement II:

Specialized lymphatic capillaries called lacteals carry chylomicrons into lymphatic vessels and ultimately into the blood.

In the light of the above statements, choose the most appropriate answer from the

options given below:

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Absorption of lipids in small intestine.

Step 2: Detailed Explanation:

- Statement I: Correct. Fatty acids and glycerol are insoluble in blood. They are absorbed into lacteals (lymph).
- Statement II: Correct. Fatty acids and glycerol reassemble into chylomicrons in intestinal cells, enter lacteals (lymphatic capillaries), and eventually reach blood via thoracic duct.
- Both statements are correct and related.

Step 3: Final Answer:

Both Statement I and Statement II are correct.

Quick Tip

Lipids absorbed via lacteals (lymph). Carbohydrates and amino acids absorbed via blood capillaries.

171. In-situ conservation refers to:

- (A) Protect and conserve the whole ecosystem
- (B) Conserve only high-risk species
- (C) Conserve only endangered species
- (D) Conserve only extinct species

Correct Answer: (A) Protect and conserve the whole ecosystem

Solution:

Step 1: Understanding the Concept:

In situ vs Ex situ conservation.

Step 2: Detailed Explanation:

- In situ conservation: Protecting species in their natural habitat along with the entire ecosystem.
- Examples: National parks, wildlife sanctuaries, biosphere reserves.
- Ex situ conservation: Protecting species outside natural habitat (zoos, botanical gardens, seed banks).
- In situ protects entire ecosystem, not just individual species.

Step 3: Final Answer:

Protect and conserve the whole ecosystem.

Quick Tip

In situ = On-site conservation (protect habitat). Ex situ = Off-site conservation.

172. If '8' Drosophila in a laboratory population of '80' died during a week, the death rate in the population is _____ individuals per Drosophila per week.

- (A) 0.1
- (B) 10
- (C) 1.0
- (D) zero

Correct Answer: (A) 0.1

Solution:

Step 1: Understanding the Concept:

Death rate (mortality rate) calculation.

Step 2: Detailed Explanation:

- Death rate = Number of deaths / Total population.
- Number of deaths = 8.
- Total population = 80.

- Death rate = $8 / 80 = 0.1$ per individual per week.

Step 3: Final Answer:

0.1.

Quick Tip

Death rate = Deaths / Total population. Per capita death rate.

173. Which of the following is not a connective tissue?

- (A) Blood
- (B) Adipose tissue
- (C) Cartilage
- (D) Neuroglia

Correct Answer: (D) Neuroglia

Solution:

Step 1: Understanding the Concept:

Classification of animal tissues.

Step 2: Detailed Explanation:

- Connective tissues: Blood, bone, cartilage, adipose tissue, areolar tissue.
- Neuroglia (glial cells) are supporting cells of NERVOUS TISSUE, not connective tissue.
- Blood is fluid connective tissue.
- Adipose is fat-storing connective tissue.
- Cartilage is skeletal connective tissue.

Step 3: Final Answer:

Neuroglia.

Quick Tip

Neuroglia = Nervous tissue. All others = Connective tissue. Blood is connective tissue.

174. Given below are two statements:

Statement I:

Restriction endonucleases recognise specific sequence to cut DNA known as palindromic nucleotide sequence.

Statement II:

Restriction endonucleases cut the DNA strand a little away from the centre of the palindromic site.

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

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:**Step 1: Understanding the Concept:**

Restriction enzymes and their recognition sites.

Step 2: Detailed Explanation:

- Statement I: Correct. Restriction endonucleases recognize specific palindromic sequences (e.g., GAATTC for EcoRI).
- Statement II: Correct. Most restriction enzymes cut DNA asymmetrically, slightly away from center, creating sticky ends.
- EcoRI cuts between G and A, creating overhangs.
- Some cut at center creating blunt ends (e.g., SmaI).

Step 3: Final Answer:

Both Statement I and Statement II are correct.

Quick Tip

EcoRI: Cuts between G and A, produces sticky ends. Palindromic sequence recognized.

175. Natural selection where more individuals acquire specific character value other than the mean character value, leads to

- (A) Stabilising change
- (B) Directional change
- (C) Disruptive change
- (D) Random change

Correct Answer: (B) Directional change

Solution:

Step 1: Understanding the Concept:

Types of natural selection.

Step 2: Detailed Explanation:

- Directional selection: Favors one extreme phenotype, shifting mean character value.
- Stabilizing selection: Favors mean phenotype, reduces variation.
- Disruptive selection: Favors both extremes, may lead to speciation.
- Question describes shift towards specific character value (other than mean) = Directional change.

Step 3: Final Answer:

Directional change.

Quick Tip

Directional: Mean shifts. Stabilizing: Mean remains, variation reduces. Disruptive: Two peaks form.

176. Nitrogenous waste is excreted in the form of pellet or paste by:

- (A) Ornithorhynchus
- (B) Salamandra
- (C) Hippocampus
- (D) Pavo

Correct Answer: (D) Pavo

Solution:

Step 1: Understanding the Concept:

Excretory products and their forms in different animals.

Step 2: Detailed Explanation:

- Birds (e.g., Pavo - peacock) excrete uric acid (uricotelic).
- Uric acid is insoluble, excreted as semi-solid paste/pellet to conserve water.
- Ornithorhynchus (platypus): Mammal, ureotelic (liquid urine).
- Salamandra (salamander): Amphibian, ureotelic/ammonotelic.
- Hippocampus (seahorse): Fish, ammonotelic.

Step 3: Final Answer:

Pavo.

Quick Tip

Birds and reptiles: Uricotelic (pellet/paste). Mammals: Ureotelic (liquid). Fish: Ammonotelic.

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

Assertion (A):

Osteoporosis is characterised by decreased bone mass and increased chance of fractures.

Reason (R):

Common cause of osteoporosis is increased levels of estrogen.

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

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

Correct Answer: (C) (A) is correct but (R) is not correct

Solution:

Step 1: Understanding the Concept:

Osteoporosis - causes and characteristics.

Step 2: Detailed Explanation:

- Assertion (A): Correct. Osteoporosis is reduction in bone density leading to fragile bones and fractures.
- Reason (R): Incorrect. Osteoporosis is caused by DECREASED estrogen levels (post-menopausal), not increased.
- Low estrogen increases osteoclast activity, causing bone resorption.

Step 3: Final Answer:

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

Quick Tip

Osteoporosis = Low estrogen (post-menopause), decreased bone density.

178. Under normal physiological conditions in human being every 100 ml of oxygenated blood can deliver ----- ml of O_2 to the tissues.

- (A) 2 ml
- (B) 5 ml
- (C) 4 ml
- (D) 10 ml

Correct Answer: (B) 5 ml

Solution:

Step 1: Understanding the Concept:

Oxygen transport and delivery by blood.

Step 2: Detailed Explanation:

- 100 ml of oxygenated blood contains 20 ml of O_2 .
- Venous blood contains 15 ml of O_2 per 100 ml.
- Amount delivered to tissues = Arterial O_2 - Venous O_2 .

- = 20 ml - 15 ml = 5 ml per 100 ml of blood.

Step 3: Final Answer:

5 ml.

Quick Tip

Oxygen delivery = 5 ml per 100 ml blood. CO₂ delivery = 4 ml per 100 ml blood.

179. A dehydration reaction links two glucose molecules to product maltose. If the formula for glucose is C₆H₁₂O₆ then what is the formula for maltose?

- (A) C₁₂H₂₀O₁₀
- (B) C₁₂H₂₄O₁₂
- (C) C₁₂H₂₂O₁₁
- (D) C₁₂H₂₄O₁₁

Correct Answer: (C) C₁₂H₂₂O₁₁

Solution:

Step 1: Understanding the Concept:

Dehydration synthesis of disaccharides.

Step 2: Detailed Explanation:

- Two glucose molecules: C₆H₁₂O₆ + C₆H₁₂O₆ = C₁₂H₂₄O₁₂.
- Dehydration removes ONE water molecule (H₂O).
- Maltose formula = C₁₂H₂₄O₁₂ - H₂O = C₁₂H₂₂O₁₁.
- General formula for disaccharide: C_nH_{2n-2}O_{n-1} where n = total carbons.

Step 3: Final Answer:

C₁₂H₂₂O₁₁.

Quick Tip

Disaccharide = Monosaccharide × 2 - H₂O. Maltose, Sucrose, Lactose all have C₁₂H₂₂O₁₁.

180. If the length of a DNA molecule is 1.1 metres, what will be the approximate number of base pairs?

- (A) 3.3×10^9 bp
- (B) 6.6×10^9 bp
- (C) 3.3×10^6 bp
- (D) 6.6×10^6 bp

Correct Answer: (A) 3.3×10^9 bp

Solution:

Step 1: Understanding the Concept:

DNA length to base pair conversion.

Step 2: Detailed Explanation:

- Distance between two base pairs = 0.34 nm = 0.34×10^{-9} m.
- Total length = 1.1 m.
- Number of base pairs = Total length / Distance per bp.
- = $1.1 / (0.34 \times 10^{-9}) = (1.1 / 0.34) \times 10^9$.
- $\approx 3.23 \times 10^9$ bp $\approx 3.3 \times 10^9$ bp.
- This matches the approximate size of human genome.

Step 3: Final Answer:

3.3×10^9 bp.

Quick Tip

1 bp = 0.34 nm. Human haploid genome = 3.3×10^9 bp \approx 1.1 m DNA.

181. Select the incorrect statement with reference to mitosis:

- (A) All the chromosomes lie at the equator at metaphase
- (B) Spindle fibres attach to centromere of chromosomes
- (C) Chromosomes decondense at telophase
- (D) Splitting of centromere occurs at anaphase

Correct Answer: (B) Spindle fibres attach to centromere of chromosomes

Solution:

Step 1: Understanding the Concept:

Stages of mitosis and spindle fiber attachment.

Step 2: Detailed Explanation:

- (A) Correct: Chromosomes align at metaphase plate.
- (B) Incorrect: Spindle fibers attach to KINETOCHORE (protein structure at centromere), not directly to centromere.
- (C) Correct: Chromosomes decondense in telophase.
- (D) Correct: Centromere splits in anaphase, sister chromatids separate.

Step 3: Final Answer:

Spindle fibers attach to kinetochore, not centromere directly.

Quick Tip

Kinetochore = Protein disc at centromere where spindle fibers attach.

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

Assertion (A):

All vertebrates are chordates but all chordates are not vertebrates.

Reason (R):

Notochord is replaced by vertebral column in the adult vertebrates.

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

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

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

Solution:

Step 1: Understanding the Concept:

Chordate classification and vertebrate characteristics.

Step 2: Detailed Explanation:

- Assertion (A): Correct. Vertebrates are a subphylum of chordates. Protochordates (Urochordates, Cephalochordates) are chordates but not vertebrates.
- Reason (R): Correct. In vertebrates, notochord is replaced by vertebral column during development. In protochordates, notochord persists.
- (R) correctly explains why some chordates are not vertebrates.

Step 3: Final Answer:

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

Quick Tip

All vertebrates are chordates. Protochordates are chordates but not vertebrates (notochord persists).

183. Regarding Meiosis, which of the statements is incorrect?

- (A) There are two stages in Meiosis, Meiosis-I and II
- (B) DNA replication occurs in S phase of Meiosis-II
- (C) Pairing of homologous chromosomes and recombination occurs in Meiosis-I
- (D) Four haploid cells are formed at the end of Meiosis-II

Correct Answer: (B) DNA replication occurs in S phase of Meiosis-II

Solution:

Step 1: Understanding the Concept:

Stages of meiosis and DNA replication.

Step 2: Detailed Explanation:

- (A) Correct: Meiosis has two divisions: Meiosis I and Meiosis II.
- (B) Incorrect: DNA replication occurs ONLY before Meiosis I (in S phase of interphase). There is NO S phase between Meiosis I and II.
- (C) Correct: Synapsis and crossing over occur in Prophase I.

- (D) Correct: Meiosis produces four haploid cells.

Step 3: Final Answer:

No DNA replication in Meiosis II.

Quick Tip

DNA replicates only once before Meiosis I. Interkinesis has NO S phase.

184. In gene therapy of Adenosine Deaminase (ADA) deficiency, the patient requires periodic infusion of genetically engineered lymphocytes because:

- (A) Retroviral vector is introduced into these lymphocytes.
- (B) Gene isolated from marrow cells producing ADA is introduced into cells at embryonic stages
- (C) Lymphocytes from patient's blood are grown in culture, outside the body.
- (D) Genetically engineered lymphocytes are not immortal cells.

Correct Answer: (D) Genetically engineered lymphocytes are not immortal cells.

Solution:

Step 1: Understanding the Concept:

Gene therapy for ADA deficiency.

Step 2: Detailed Explanation:

- ADA deficiency is treated by introducing functional ADA gene into lymphocytes.
- Lymphocytes are short-lived (not immortal), so periodic infusion is required.
- If stem cells (from bone marrow) are genetically engineered, it can be a permanent cure.
- Retroviral vector is used to introduce gene into lymphocytes cultured outside.

Step 3: Final Answer:

Genetically engineered lymphocytes are not immortal cells.

Quick Tip

Lymphocyte-based gene therapy = Temporary (repeat infusions). Stem cell-based = Permanent cure.

185. Detritivores breakdown detritus into smaller particles. This process is called:

- (A) Catabolism
- (B) Fragmentation
- (C) Humification
- (D) Decomposition

Correct Answer: (B) Fragmentation

Solution:

Step 1: Understanding the Concept:

Steps of decomposition process.

Step 2: Detailed Explanation:

- Decomposition steps:

1. Fragmentation: Breakdown of detritus into smaller particles by detritivores (earthworms, termites).
2. Leaching: Water-soluble nutrients percolate into soil.
3. Catabolism: Enzymatic degradation by decomposers.
4. Humification: Formation of humus.
5. Mineralization: Release of inorganic nutrients.

Step 3: Final Answer:

Fragmentation.

Quick Tip

Fragmentation = Detritivores break detritus. Decomposition = Microbial enzymatic breakdown.

Part - B (Zoology)

186. Match List-I with List-II with respect to methods of Contraception and their respective actions.

List-I	List-II
(a) Diaphragms	(i) Inhibit ovulation and implantation
(b) Contraceptive Pills	(ii) Increase phagocytosis of sperm within uterus
(c) Intra Uterine Devices	(iii) Absence of menstrual cycle and ovulation following parturition
(d) Lactational Amenorrhea	(iv) They cover the cervix blocking the entry of sperms

Choose the correct answer from the options given below:

- (A) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)
 (B) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
 (C) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
 (D) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)

Correct Answer: (B) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Solution:

Step 1: Understanding the Concept:

Contraceptive methods and their mechanisms of action.

Step 2: Detailed Explanation:

- (a) Diaphragms: Barrier method, cover cervix blocking sperm entry → (iv).
- (b) Contraceptive Pills: Hormonal method, inhibit ovulation and implantation → (i).
- (c) Intra Uterine Devices (IUDs): Increase phagocytosis of sperm in uterus → (ii).
- (d) Lactational Amenorrhea: Absence of menstruation and ovulation during breastfeeding → (iii).

Step 3: Final Answer:

(a)-(iv), (b)-(i), (c)-(ii), (d)-(iii).

Quick Tip

Barrier methods: Block sperm entry. Hormonal: Inhibit ovulation. IUDs: Phagocytosis of sperm.

187. Which of the following statements is not true?

- (A) Analogous structures are a result of convergent evolution
- (B) Sweet potato and potato is an example of analogy
- (C) Homology indicates common ancestry
- (D) Flippers of penguins and dolphins are a pair of homologous organs

Correct Answer: (D) Flippers of penguins and dolphins are a pair of homologous organs

Solution:

Step 1: Understanding the Concept:

Homologous vs Analogous organs.

Step 2: Detailed Explanation:

- (A) Correct: Analogous structures evolve independently due to similar function (convergent evolution).
- (B) Correct: Sweet potato (root) and potato (stem) are analogous (different origin, same function).
- (C) Correct: Homologous structures indicate common ancestry.
- (D) Incorrect: Penguin flipper (bird) and dolphin flipper (mammal) have different origins, similar function → ANALOGOUS, not homologous.

Step 3: Final Answer:

They are analogous organs, not homologous.

Quick Tip

Homologous: Same origin, different function. Analogous: Different origin, same function.

188. Select the incorrect statement with respect to acquired immunity.

- (A) Primary response is produced when our body encounters a pathogen for the first time.
- (B) Anamnestic response is elicited on subsequent encounters with the same pathogen.
- (C) Anamnestic response is due to memory of first encounter.

(D) Acquired immunity is non-specific type of defense present at the time of birth.

Correct Answer: (D) Acquired immunity is non-specific type of defense present at the time of birth.

Solution:

Step 1: Understanding the Concept:

Acquired immunity vs Innate immunity.

Step 2: Detailed Explanation:

- (A) Correct: Primary immune response occurs on first exposure.
- (B) Correct: Secondary (anamnestic) response on subsequent exposure.
- (C) Correct: Memory cells from first encounter enable faster secondary response.
- (D) Incorrect: Acquired immunity is SPECIFIC and develops AFTER birth. Innate immunity is non-specific and present from birth.

Step 3: Final Answer:

Acquired immunity is specific and develops after birth.

Quick Tip

Innate: Non-specific, present at birth. Acquired: Specific, develops after exposure.

189. The recombination frequency between the genes a & c is 5%, b & c is 15%, b & d is 9%, a & b is 20%, c & d is 24% and a & d is 29%. What will be the sequence of these genes on a linear chromosome?

- (A) a, d, b, c
- (B) d, b, a, c
- (C) a, b, c, d
- (D) a, c, b, d

Correct Answer: (D) a, c, b, d

Solution:

Step 1: Understanding the Concept:

Gene mapping using recombination frequencies.

Step 2: Detailed Explanation:

- Recombination frequency \propto distance between genes.
- Smallest distance: a & c = 5% (closest).
- Next: b & d = 9% (close).
- Next: b & c = 15%.
- Next: a & b = 20%.
- Next: c & d = 24%.
- Largest: a & d = 29% (farthest).
- Arranging: a - (5) - c - (15) - b - (9) - d.
- Check a to d = 5 + 15 + 9 = 29 (matches).
- Sequence: a, c, b, d.

Step 3: Final Answer:

a, c, b, d.

Quick Tip

1% recombination frequency = 1 centiMorgan (cM) map distance.

190.

List-I (Biological Molecules)	List-II (Biological functions)
(a) Glycogen	(i) Hormone
(b) Globulin	(ii) Biocatalyst
(c) Steroids	(iii) Antibody
(d) Thrombin	(iv) Storage product

Choose the correct answer from the options given below:

- (A) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)
- (B) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
- (C) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
- (D) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

Correct Answer: (D) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

Solution:

Step 1: Understanding the Concept:

Biological molecules and their functions.

Step 2: Detailed Explanation:

- (a) Glycogen: Polysaccharide, storage product in animals → (iv).
- (b) Globulin: Protein, functions as antibody (immunoglobulins) → (iii).
- (c) Steroids: Lipids, many function as hormones (e.g., testosterone, estrogen) → (i).
- (d) Thrombin: Enzyme, biocatalyst in blood coagulation → (ii).

Step 3: Final Answer:

(a)-(iv), (b)-(iii), (c)-(i), (d)-(ii).

Quick Tip

Glycogen = Animal starch (storage). Globulins = Antibodies. Steroids = Hormones.
Thrombin = Enzyme.

191. Select the incorrect statement regarding synapses:

- (A) The membranes of presynaptic and postsynaptic neurons are in close proximity in an electrical synapse.
- (B) Electrical current can flow directly from one neuron into the other across the electrical synapse.
- (C) Chemical synapses use neurotransmitters
- (D) Impulse transmission across a chemical synapse is always faster than that across an electrical synapse.

Correct Answer: (D) Impulse transmission across a chemical synapse is always faster than that across an electrical synapse.

Solution:

Step 1: Understanding the Concept:

Comparison of electrical and chemical synapses.

Step 2: Detailed Explanation:

- (A) Correct: Electrical synapses have gap junctions with close membrane proximity.
- (B) Correct: Ions flow directly through gap junctions in electrical synapses.
- (C) Correct: Chemical synapses release neurotransmitters.
- (D) Incorrect: Electrical synapses are FASTER than chemical synapses (no synaptic delay). Chemical synapses have 0.5 ms delay.

Step 3: Final Answer:

Electrical synapses are faster than chemical synapses.

Quick Tip

Electrical synapse: Faster, bidirectional. Chemical synapse: Slower (synaptic delay), unidirectional.

192. Statements related to human Insulin are given below. Which statement(s) is/are correct about genetically engineered Insulin?

- (a) Pro-hormone insulin contain extra stretch of C-peptide
- (b) A-peptide and B-peptide chains of insulin were produced separately in E.coli, extracted and combined by creating disulphide bond between them.
- (c) Insulin used for treating Diabetes was extracted from Cattles and Pigs.
- (d) Pro-hormone Insulin needs to be processed for converting into a mature and functional hormone.
- (e) Some patients develop allergic reactions to the foreign insulin.

Choose the most appropriate answer from the options given below:

- (A) (a), (b) and (d) only
- (B) (b) only
- (C) (c) and (d) only
- (D) (c), (d) and (e) only

Correct Answer: (B) (b) only

Solution:

Step 1: Understanding the Concept:

Genetically engineered insulin is produced using recombinant DNA technology.

Step 2: Detailed Explanation:

- (a) Incorrect: This is a general property of pro-insulin, not specific to genetically engineered insulin.
- (b) Correct: A and B chains were produced separately in *E. coli* and later combined by forming disulphide bonds.
- (c) Incorrect: This refers to insulin obtained from animals, not genetically engineered insulin.
- (d) Incorrect: This is a general biological process, not specific to recombinant insulin production.
- (e) Incorrect: Allergic reactions were associated with animal insulin.

Step 3: Final Answer:

(b) only.

Quick Tip: Genetically engineered insulin avoids problems like allergic reactions caused by animal insulin.

193. Ten *E. coli* cells with ^{15}N -dsDNA are incubated in medium containing ^{14}N nucleotide. After 60 minutes, how many *E. coli* cells will have DNA totally free from ^{15}N ?

- (A) 20 cells
- (B) 40 cells
- (C) 60 cells
- (D) 80 cells

Correct Answer: (C) 60 cells

Solution:

Step 1: Understanding the Concept:

Meselson-Stahl experiment and DNA replication.

Step 2: Detailed Explanation:

- *E. coli* division time = 20 minutes.
- Total time = 60 minutes = 3 generations.
- Initial: 10 cells with $^{15}\text{N}/^{15}\text{N}$ DNA.

- After 1st generation (20 min): 20 cells, all $^{15}\text{N}/^{14}\text{N}$ (hybrid).
- After 2nd generation (40 min): 40 cells, 20 hybrid + 20 light ($^{14}\text{N}/^{14}\text{N}$).
- After 3rd generation (60 min): 80 cells total.
- Hybrid: 20 cells (from previous hybrid division).
- Light (totally free from ^{15}N): $80 - 20 = 60$ cells.

Step 3: Final Answer:

60 cells.

Quick Tip

After n generations: Light DNA = Total cells - Initial cells $\times 2$. Total cells = Initial $\times 2^n$.

194. Which one of the following statements is correct?

- (A) The atrio-ventricular node (AVN) generates an action potential to stimulate atrial contraction
- (B) The tricuspid and the bicuspid valves open due to the pressure exerted by the simultaneous contraction of the atria
- (C) Blood moves freely from atrium to the ventricle during joint diastole.
- (D) Increased ventricular pressure causes closing of the semilunar valves.

Correct Answer: (C) Blood moves freely from atrium to the ventricle during joint diastole.

Solution:

Step 1: Understanding the Concept:

Cardiac cycle and valve actions.

Step 2: Detailed Explanation:

- (A) Incorrect: SA node generates action potential for atrial contraction, AV node relays to ventricles.
- (B) Incorrect: AV valves open due to atrial pressure ζ ventricular pressure, not necessarily contraction.
- (C) Correct: During joint diastole, both atria and ventricles relaxed, blood flows passively

from atria to ventricles.

- (D) Incorrect: Increased ventricular pressure OPENS semilunar valves.

Step 3: Final Answer:

Blood moves freely from atrium to ventricle during joint diastole.

Quick Tip

Joint diastole: Both chambers relaxed, AV valves open, semilunar closed.

195. Which of the following is not a desirable feature of a cloning vector?

- (A) Presence of origin of replication
- (B) Presence of a marker gene
- (C) Presence of single restriction enzyme site
- (D) Presence of two or more recognition sites

Correct Answer: (D) Presence of two or more recognition sites

Solution:

Step 1: Understanding the Concept:

Characteristics of ideal cloning vector.

Step 2: Detailed Explanation:

- (A) Desirable: Ori allows replication of vector.
- (B) Desirable: Marker gene (e.g., antibiotic resistance) helps select transformed cells.
- (C) Desirable: Single restriction site for easy insertion of foreign DNA.
- (D) Not desirable: Multiple recognition sites for same enzyme cause vector to be cut into fragments, complicating cloning.

Step 3: Final Answer:

Presence of two or more recognition sites.

Quick Tip

Ideal vector: Single restriction site, ori, selectable marker, small size.

196. Given below are two statements: Statement I: In a scrubber the exhaust from the thermal plant is passed through the electric wires to charge the dust particles. **Statement II:** Particulate matter (PM 2.5) cannot be removed by scrubber but can be removed by an electrostatic precipitator. **In the light of the above statements, choose the most appropriate answer from the options given below:**

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

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

Solution:

Step 1: Understanding the Concept:

Air pollution control devices.

Step 2: Detailed Explanation:

- Statement I: Incorrect. In scrubber, exhaust is passed through water/lime spray to remove gases (SO_2). Electric wires for charging dust is Electrostatic Precipitator (ESP).
- Statement II: Correct. Scrubbers remove gases, not fine particulate matter (PM 2.5). ESP removes particulates including PM 2.5.

Step 3: Final Answer:

Statement I is incorrect but Statement II is correct.

Quick Tip

Scrubber: Removes gases (SO_2). ESP: Removes particulates (dust, PM 2.5).

197. Which of the following are not the effects of Parathyroid hormone?

- (a) Stimulates the process of bone resorption
- (b) Decreases Ca^{2+} level in blood
- (c) Reabsorption of Ca^{2+} by renal tubules
- (d) Decreases the absorption of Ca^{2+} from digested food
- (e) Increases metabolism of

carbohydrates

Choose the most appropriate answer from the options given below:

- (A) (a) and (c) only
- (B) (b), (d) and (e) only
- (C) (a) and (e) only
- (D) (b) and (c) only

Correct Answer: (B) (b), (d) and (e) only

Solution:

Step 1: Understanding the Concept:

Functions of Parathyroid Hormone (PTH).

Step 2: Detailed Explanation:

- PTH is hypercalcemic hormone (increases blood Ca^{2+}).
- (a) Effect: Stimulates bone resorption (osteoclast activity) \rightarrow releases Ca^{2+} .
- (b) NOT effect: PTH increases, not decreases, blood Ca^{2+} .
- (c) Effect: Increases Ca^{2+} reabsorption in kidney.
- (d) NOT effect: PTH increases Ca^{2+} absorption from gut (via Vitamin D activation).
- (e) NOT effect: PTH does not affect carbohydrate metabolism.
- Not effects: (b), (d), (e).

Step 3: Final Answer:

(b), (d) and (e) only.

Quick Tip

PTH increases blood Ca^{2+} (hypercalcemic). Calcitonin decreases blood Ca^{2+} (hypocalcemic).

198. Which of the following is a correct statement?

- (A) Cyanobacteria are a group of autotrophic organisms classified under kingdom Monera.
- (B) Bacteria are exclusively heterotrophic organisms.
- (C) Slime moulds are saprophytic organisms classified under Kingdom Monera.

(D) Mycoplasma have DNA, ribosome and cell wall.

Correct Answer: (A) Cyanobacteria are a group of autotrophic organisms classified under kingdom Monera.

Solution:

Step 1: Understanding the Concept:

Classification of organisms in Kingdom Monera.

Step 2: Detailed Explanation:

- (A) Correct: Cyanobacteria (blue-green algae) are photosynthetic autotrophs in Kingdom Monera.
- (B) Incorrect: Bacteria can be autotrophic (chemosynthetic/photosynthetic) or heterotrophic.
- (C) Incorrect: Slime moulds are in Kingdom Protista, not Monera.
- (D) Incorrect: Mycoplasma lack cell wall (pleomorphic).

Step 3: Final Answer:

Cyanobacteria are autotrophic Monerans.

Quick Tip

Monera: Bacteria, Cyanobacteria, Mycoplasma, Actinomycetes. All prokaryotes.

199. Match List-I with List-II Match List-I with List-II

List-I	List-II
(a) Bronchioles	(i) Dense regular connective tissue
(b) Goblet Cell	(ii) Loose connective tissue
(c) Tendons	(iii) Glandular tissue
(d) Adipose Tissue	(iv) Ciliated epithelium

Choose the correct answer from the options given below:

- (A) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
- (B) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
- (C) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(D) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

Correct Answer: (A) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

Solution:

Step 1: Understanding the Concept:

Tissue types and their locations/functions.

Step 2: Detailed Explanation:

- (a) Bronchioles: Lined by ciliated epithelium to move mucus → (iv).
- (b) Goblet Cell: Unicellular gland, secretes mucus → (iii) Glandular tissue.
- (c) Tendons: Connect muscle to bone, made of dense regular connective tissue → (i).
- (d) Adipose Tissue: Fat-storing loose connective tissue → (ii).

Step 3: Final Answer:

(a)-(iv), (b)-(iii), (c)-(i), (d)-(ii).

Quick Tip

Bronchioles: Ciliated epithelium. Goblet cells: Glandular. Tendons: Dense regular.
Adipose: Loose connective.

200. If a colour blind female marries a man whose mother was also colour blind, what are the chances of her progeny having colour blindness?

- (A) 25%
- (B) 50%
- (C) 75%
- (D) 100%

Correct Answer: (D) 100%

Solution:

Step 1: Understanding the Concept:

X-linked recessive inheritance (Colour blindness).

Step 2: Detailed Explanation:

- Colour blindness is X-linked recessive (X^c).
- Colour blind female: X^cX^c .
- Man whose mother was colour blind: His mother was X^cX^c , so he must have inherited X^c from her.
- Man is colour blind: X^cY .
- Cross: $X^cX^c \times X^cY$.
- Progeny: All daughters X^cX^c (colour blind), all sons X^cY (colour blind).
- 100% progeny will be colour blind.

Step 3: Final Answer:

100%.

Quick Tip

Affected female (X^cX^c) \times Affected male (X^cY) \rightarrow 100% affected offspring.
