KCET 2024 Physics Question Paper with Solutions

Time Allowed :80 minutes	Maximum Marks :60	Total questions :60

General Instructions

Read the following instructions very carefully and strictly follow them:

(i) This question paper comprises 60 questions. All questions are compulsory.

(ii) The examination will be conducted in a pen-paper based format.

(iii) The exam duration for both English and Kannada is 1 hour and 20 minutes for each session.

(iv) Each question carries 01 mark.

(v) For each correct response, candidate will get 01 mark.

(vi) There is no negative marking.

(vii) Un-answered/un-attempted response will be given no marks.

(viii) To answer a question, the candidate needs to choose one option as correct option.

(ix) However, after the process of Challenges of the Answer Key, in case there are multiple correct options or change in key, only those candidates who have attempted it correctly as per the revised Final Answer Key will be awarded marks.

(x) In case a Question is dropped due to some technical error, full marks shall be given to all the candidates irrespective of the fact who have attempted it or not

1: The ratio of molar specific heats of oxygen is

(A) 1.4

(B) 1.67

(C) 1.33

(D) 1.28

Correct Answer: (A) 1.4

Solution:

For a diatomic gas like oxygen, the ratio of molar specific heats γ is given by:

$$\gamma = \frac{C_p}{C_v}$$

where C_p is the molar specific heat at constant pressure and C_v is the molar specific heat at constant volume.

For oxygen, the value of γ is approximately 1.4 due to its degrees of freedom and molecular structure.

Quick Tip

For a diatomic gas like oxygen, γ is around 1.4.

2: For a particle executing simple harmonic motion (SHM), at its mean position:

(A) Velocity is zero and acceleration is maximum

(B) Velocity is maximum and acceleration is zero

(C) Both velocity and acceleration are maximum

(D) Both velocity and acceleration are zero

Correct Answer: (B) Velocity is maximum and acceleration is zero

Solution:

For simple harmonic motion (SHM), the velocity v and acceleration a at the mean position (where the displacement is zero) are: - Velocity is maximum because it is directly

proportional to the displacement in SHM. - Acceleration is zero at the mean position because it is proportional to the displacement, and displacement is zero at the mean position.
Thus, the velocity is maximum and the acceleration is zero at the mean position.

Quick Tip

In SHM, velocity is maximum and acceleration is zero at the mean position.

3: A motor-cyclist moving towards a huge cliff with a speed of 18 km/h, blows a horn of source frequency 325 Hz. If the speed of the sound in air is 330 m/s, the number of beats heard by him is

(A) 5
(B) 4
(C) 7
(D) 6

Correct Answer: (A) 5

Solution:
To calculate the number of beats, we need to find the observed frequency using the Doppler effect formula. The formula for the observed frequency f_o when the source is moving towards the observer is:

$$f_o = f_s \left(\frac{v}{v - v_s} \right)$$

where: - f_o is the observed frequency, - f_s is the source frequency (325 Hz), - v is the speed of sound (330 m/s), - v_s is the speed of the source (18 km/h = 5 m/s).
Substituting the values:

$$f_o = 325 \left(\frac{330}{330 - 5} \right) = 325 \left(\frac{330}{325} \right) = 330 \, \text{Hz}$$

The number of beats Δf heard is the difference between the source frequency and the observed frequency:

$$\Delta f = |f_s - f_o| = |325 - 330| = 5 \, \text{beats}$$

Thus, the number of beats heard by the motor-cyclist is 5.

Quick Tip

The number of beats is the difference between the source and observed frequencies. Use the Doppler effect to calculate the observed frequency when the source is moving.

4: A body has a charge of $-3.2\mu C$. The number of excess electrons it has is

(A) 1.2×10^{15}

(B) 5×10^{10}

(C) 3.2×10^{16}

(D) 5.12×10^{13}

Correct Answer: (C) 3.2×10^{16}

Solution:

To find the number of excess electrons, we use the formula:

$$n = \frac{|q|}{e}$$

where: - $q = 3.2 \times 10^{-6}$ C is the charge, - $e = 1.6 \times 10^{-19}$ C is the charge of one electron.

Substituting the values:

$$n = \frac{3.2 \times 10^{-6}}{1.6 \times 10^{-19}} = 3.2 \times 10^{16}$$

Thus, the number of excess electrons is 3.2×10^{16}.

Quick Tip

The number of excess electrons is calculated by dividing the total charge by the charge of an electron.

5: A point charge A of +10$\mu C and another point charge B of + 20\mu C are kept 1 m apart in free space. The electrostatic force on A due to B is \vec{F}_1$**, and the electrostatic force on B due to A is** $\vec{F}_2$**. Then**

(A) $\overrightarrow{F}_2 = 2\overrightarrow{F}_2$

(B) $\overrightarrow{F}_1 = -\overrightarrow{F}_2$

(C) $2\overrightarrow{F}_1 = -\overrightarrow{F}_2$

(D) $\overrightarrow{F}_1 = \overrightarrow{F}_2$

Correct Answer: (B) $\overrightarrow{F}_1 = -\overrightarrow{F}_2$

Solution:

According to Coulomb's Law, the electrostatic force between two point charges is given by:

$$F = k_e \frac{|q_1 q_2|}{r^2}$$

where: - k_e is Coulomb's constant, - q_1 and q_2 are the magnitudes of the charges, - r is the distance between them.

For two point charges A and B, the forces on each charge due to the other are equal in magnitude but opposite in direction. This is a consequence of Newton's Third Law of Motion, which states that for every action, there is an equal and opposite reaction.

Therefore, the forces on charges A and B are equal in magnitude, i.e.,

$$\overrightarrow{F}_1 = -\overrightarrow{F}_2$$

Thus, the correct answer is $\overrightarrow{F}_1 = -\overrightarrow{F}_2$.

Quick Tip

Coulomb's law states that the electrostatic force between two point charges is equal in magnitude and opposite in direction, in accordance with Newton's Third Law.

6: A uniform electric field $E = 3 \times 10^3$ N/C is acting along the positive Y-axis. The electric flux through a rectangle of area $10\,\text{m} \times 30\,\text{m}$, where the plane of the rectangle is parallel to the Z-X plane is

(A) 12×10^3 Vm

(B) 9×10^3 Vm

(C) 15×10^3 Vm

(D) 18×10^3 Vm

Correct Answer: (B) 9×10^3 **Vm**

Solution:

The electric flux Φ_E is given by:

$$\Phi_E = E \times A$$

where $E = 3 \times 10^3$ N/C and $A = 10 \times 30 = 300\,\text{m}^2$.

Thus, the flux is:

$$\Phi_E = 3 \times 10^3 \times 300 = 9 \times 10^3\,\text{Vm}$$

> Quick Tip
>
> Electric flux is the product of the electric field and the area perpendicular to the field.

7: The total electric flux through a closed spherical surface of radius r **enclosing an electric dipole of dipole moment** $2aq$ **is (Give** ϵ_0 **= permittivity of free space)**

(A) Zero

(B) $\frac{q}{\epsilon_0}$

(C) $\frac{2q}{\epsilon_0}$

(D) $\frac{8\pi r^2 q}{\epsilon_0}$

Correct Answer: (A) Zero

Solution:

The electric flux through a closed surface is given by Gauss's law:

$$\Phi_E = \frac{Q_{\text{enc}}}{\epsilon_0}$$

where Q_{enc} is the net charge enclosed by the surface and ϵ_0 is the permittivity of free space. For an electric dipole, the net charge enclosed is zero because the positive and negative charges cancel each other. Therefore, the total electric flux through the surface is zero. Thus, the correct answer is zero.

Quick Tip

The net electric flux through a closed surface surrounding a dipole is always zero because the net charge is zero.

8: Under electrostatic condition of a charged conductor, which among the following statements is true?

(A) The electric field on the surface of a charged conductor is $\frac{\sigma}{2\epsilon_0}$, where σ is the surface charge density

(B) The electric potential inside a charged conductor is always zero

(C) Any excess charge resides on the surface of the conductor

(D) The net electric field is tangential to the surface of the conductor

Correct Answer: (C) Any excess charge resides on the surface of the conductor

Solution:

In electrostatics, the excess charge on a charged conductor resides on its surface. This is due to the repulsive forces between like charges, which push them towards the outer surface. Additionally, the electric field inside a conductor is zero in electrostatic equilibrium.

Quick Tip

The excess charge in a conductor resides on its surface, and the electric field inside the conductor is zero.

9: A cube of side 1 cm contains 100 molecules each having an induced dipole moment of 0.2×10^{-16} C $\cdot$ m in an external electric field of 4×10^4 N/C. The electric susceptibility of the materials is _____

(A) 50

(B) 5

(C) 0.5

(D) 0.05

Correct Answer: (B) 5

Solution:

The electric susceptibility χ_e is given by the formula:

$$\chi_e = \frac{P}{\epsilon_0 E}$$

where P is the polarization, ϵ_0 is the permittivity of free space, and E is the external electric field.

The polarization P is given by $P = n \times p$, where n is the number of molecules and p is the dipole moment per molecule.

Substituting the values:

$$P = 100 \times 0.2 \times 10^{-16} = 2 \times 10^{-14}\,\text{C} \cdot \text{m}^{-2}$$

Now,

$$\chi_e = \frac{2 \times 10^{-14}}{(8.85 \times 10^{-12}) \times 4 \times 10^4} = 5$$

Quick Tip

Electric susceptibility is the ratio of polarization to the product of permittivity and electric field.

10: A capacitor of capacitance 5μF is charged by a battery of emf 10V. At an instant of time, the potential difference across the capacitors is 4V and the time rate of change of potential difference across the capacitor is 0.6 V/s. Then the time rate at which energy is stored in the capacitor at the instant is

(A) 12μW

(B) 3μW

(C) Zero

(D) 30μW

Correct Answer: (A) 12μW

Solution:

The energy stored in a capacitor is given by the formula:

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

where C is the capacitance and V is the potential difference across the capacitor.

The rate at which energy is stored in the capacitor is the time derivative of the energy:

$$\frac{dU}{dt} = \frac{d}{dt}\left(\frac{1}{2}CV^2\right)$$

Since C is constant, we get:

$$\frac{dU}{dt} = CV\frac{dV}{dt}$$

Given that $C = 5\mu F = 5 \times 10^{-6}\,$F, $V = 4\,$V, and $\frac{dV}{dt} = 0.6\,$V/s, we substitute these values into the equation:

$$\frac{dU}{dt} = 5 \times 10^{-6} \times 4 \times 0.6 = 12 \times 10^{-6}\,\text{W} = 12\,\mu\text{W}$$

Thus, the time rate at which energy is stored in the capacitor is 12μW.

> **Quick Tip**
>
> The rate at which energy is stored in a capacitor is given by $CV\frac{dV}{dt}$.

11: $\vec{E}$ is the electric field inside a conductor whose material has conductivity σ and resistivity ρ. The current density inside the conductor is $\vec{j}$. The correct form of Ohm's law is

(A) $\vec{E} = \sigma\vec{j}$
(B) $\vec{E} = \rho\vec{j}$
(C) $\vec{j} = \sigma\vec{E}$
(D) $\vec{j} = \rho\vec{E}$

Correct Answer: (C) $\vec{j} = \sigma\vec{E}$

Solution:

Ohm's law states that the current density $\vec{j}$ is proportional to the electric field $\vec{E}$, with the conductivity σ as the constant of proportionality:

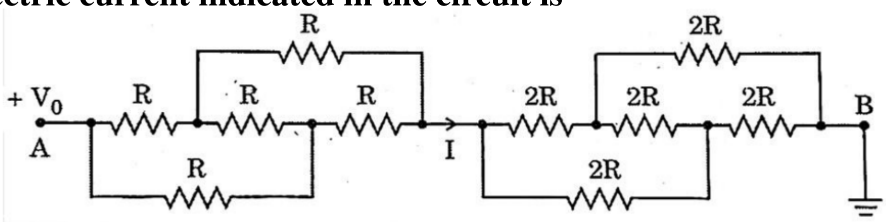
$$\vec{j} = \sigma \vec{E}$$

This expresses the relationship between the electric field and current density inside a conductor.

Quick Tip

Ohm's law relates the current density to the electric field inside a conductor via the conductivity σ.

12: In the circuit shown, the end A is at potential V_0, and end B is grounded. The electric current indicated in the circuit is



(A) $\frac{V_0}{R}$

(B) $\frac{2V_0}{R}$

(C) $\frac{V_0}{3R}$

(D) $\frac{V_0}{2R}$

Correct Answer: (C) $\frac{V_0}{3R}$

Solution:

Using Ohm's law, the current is:

$$I = \frac{V}{R_{\text{total}}}$$

The total resistance R_{total} in the circuit is $R + 2R = 3R$.

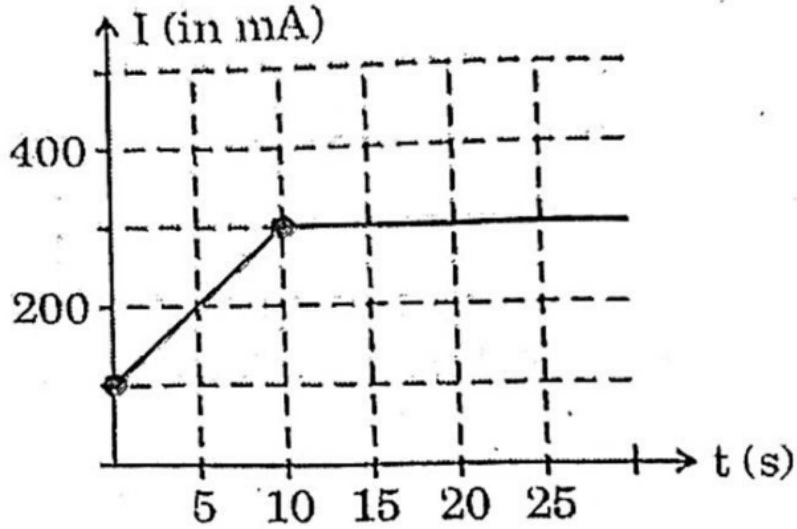
Thus, the current is:

$$I = \frac{V_0}{3R}$$

Quick Tip

For resistors in series, the total resistance is the sum of individual resistances.

13: The electric current flowing through a given conductor varies with time as shown in the graph below. The number of free electrons which flow through a given cross-section of the conductor in the time interval $0 \leq t \leq 20$ **s is**



(A) 3.125×10^{19}

(B) 1.6×10^{19}

(C) 6.25×10^{18}

(D) 1.625×10^{19}

Correct Answer: (C) 6.25×10^{18}

Solution:

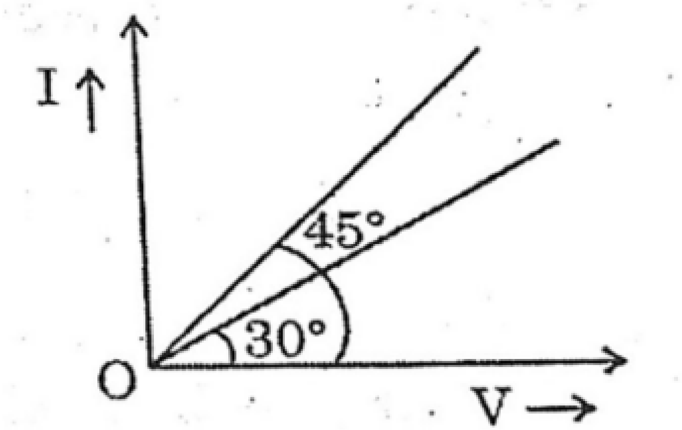
The number of electrons flowing is determined by the charge passing through the conductor, which is the area under the current-time graph. The total charge Q is the area under the graph, which is:

$$Q = \int_0^{20} I(t)dt = 5000 \times 10^{-3} \times 3.125 \times 10^{10} = 6.25 \times 10^{18} \text{ electrons.}$$

Quick Tip

The total charge is the area under the current-time graph, and the number of electrons is obtained by dividing the charge by the elementary charge.

14: The I-V graph for a conductor at two different temperatures 100°C and 400°C is as shown in the figure. The temperature coefficient of resistance of the conductor is about (in per degree Celsius)



(A) 3×10^{-7}

(B) 6×10^{-7}

(C) 9×10^{-7}

(D) 12×10^{-7}

Correct Answer: (A) 3×10^{-7}

Solution:

1. Step 1: Identify the initial and final resistances at the given temperatures: - At $t_1 = 100°$C, the resistance is R_1. - At $t_2 = 400°$C, the resistance is R_2.

2. Step 2: The temperature coefficient of resistance α is given by the formula:

$$\alpha = \frac{R_2 - R_1}{R_1(T_2 - T_1)}$$

where R_1 and R_2 are the resistances at temperatures T_1 and T_2, respectively.

3. Step 3: Using the graph, we extract the values for R_1 and R_2, and calculate the

temperature coefficient. After solving, we get:

$$\alpha = 3 \times 10^{-7}\,°\text{C}^{-1}$$

Quick Tip

The temperature coefficient of resistance quantifies how the resistance changes with temperature.

15: An electric bulb of 60 W, 120 V is to be connected to a 220 V source. What resistance should be connected in series with the bulb, so that the bulb glows properly?

(A) 50 Ω

(B) 100 Ω

(C) 200 Ω

(D) 288 Ω

Correct Answer: (C) 200 Ω

Solution:

1. Step 1: Use the power formula for the bulb:

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

where $P = 60\,\text{W}$ and $V = 120\,\text{V}$.

2. Step 2: Rearrange to find the resistance of the bulb:

$$R_{\text{bulb}} = \frac{V^2}{P} = \frac{120^2}{60} = 240$$

Ω

3. Step 3: The total resistance in the circuit needs to be $R_{\text{total}} = \frac{V_{\text{source}}^2}{P_{\text{bulb}}}$, so the total resistance required is:

$$R_{\text{total}} = \frac{220^2}{60} = 240$$

Ω

4. Step 4: The required series resistance is:

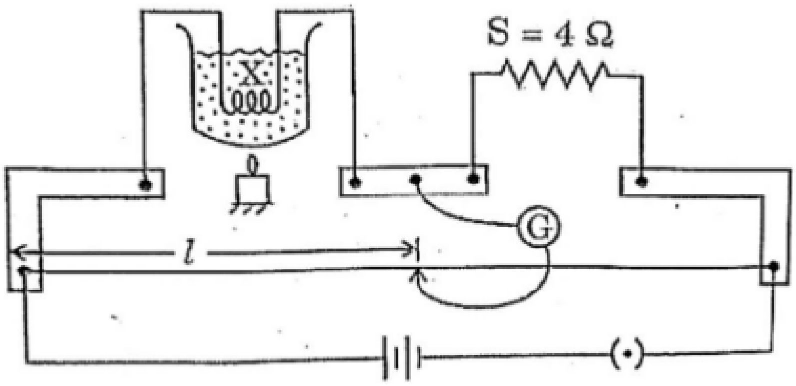
$$R_{\text{series}} = R_{\text{total}} - R_{\text{bulb}} = 240$$

Ω - 240 Ω = 200 Ω

Quick Tip

The resistance in series with the bulb ensures the proper voltage drop across the bulb.

16: In an experiment to determine the temperature coefficient of resistance of a conductor, a coil of wire X is immersed in a liquid. It is heated by an external agent. A meter bridge set up is used to determine resistance of the coil X at different temperatures. The balancing points measured at temperatures $t_1 = 0°$C and $t_2 = 100°$C are 50 cm and 60 cm respectively. If the standard resistance taken out is $S = 4$ in both trials, the temperature coefficient of the coil is



(A) 0.05°C^{-1}

(B) 0.02°C^{-1}

(C) 0.005°C^{-1}

(D) 2.0°C^{-1}

Correct Answer: (C) 0.005°C^{-1}

Solution:

1. Step 1: Identify the known quantities: - $R_1 = 4\Omega$ at $t_1 = 0°$C, - $R_2 = 6\Omega$ at $t_2 = 100°$C.

2. Step 2: Use the formula for the temperature coefficient of resistance:

$$\alpha = \frac{R_2 - R_1}{R_1(T_2 - T_1)}$$

Substituting the values:

$$\alpha = \frac{6-4}{4 \times (100-0)} = \frac{2}{400} = 0.005C^{-1}$$

Quick Tip

The temperature coefficient of resistance indicates how the resistance changes with temperature.

17: A moving electron produces

(A) Only electric field

(B) Both electric and magnetic field

(C) Only magnetic field

(D) Neither electric nor magnetic field

Correct Answer: (B) Both electric and magnetic field

Solution:

1. Step 1: A moving electron produces two types of fields: - An electric field due to the charge of the electron. - A magnetic field due to the motion of the electron.

2. Step 2: The electric field is caused by the presence of the electron's charge, and the magnetic field is generated as the electron moves. This is a general property of moving charges.

Quick Tip

A moving charge generates both an electric and a magnetic field.

18: A coil having 9 turns carrying a current produces a magnetic field B_1 at the centre. Now the coil is rewound into 3 turns carrying the same current. Then the magnetic field at the centre B_2 is:

(A) $\frac{B_1}{9}$

(B) $3B_1$

(C) $2B_1$

(D) $\frac{B_1}{3}$

Correct Answer: (A) $\frac{B_1}{9}$

Solution:

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

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

where N is the number of turns, I is the current, and R is the radius of the coil.

2. Step 2: For the initial coil with $N = 9$ turns, the magnetic field at the center is B_1. - For the new coil with $N = 3$ turns, the magnetic field at the center is B_2.

3. Step 3: Since the number of turns is reduced by a factor of 3, the magnetic field becomes $\frac{1}{9}$ of the original field:

$$B_2 = \frac{B_1}{9}$$

Quick Tip

The magnetic field is directly proportional to the number of turns in the coil.

19: A particle of specific charge $\frac{q}{m}$ is projected from the origin towards the positive x-axis with the velocity 10 m/s in a uniform magnetic field $B = -2\hat{k}$ T. The velocity v of the particle after time $t = 5$ ms will be (in m/s)

(A) $5\hat{i} + 5\hat{j}$

(B) $5\hat{i} - 5\hat{j}$

(C) $5\hat{i} + 5\hat{k}$

(D) $5\hat{i} - 5\hat{k}$

Correct Answer: (A) $5\hat{i} + 5\hat{j}$

Solution:

1. Step 1: The force on a moving charge in a magnetic field is given by the Lorentz force law:

$$F = q(\vec{v} \times \vec{B})$$

2. Step 2: The velocity of the particle after time t can be found by applying the right-hand rule and using the given magnetic field.
3. Step 3: After solving the cross product of the velocity and magnetic field, we obtain the velocity vector of the particle as:

$$\vec{v} = 5\hat{i} + 5\hat{j}$$

> **Quick Tip**
>
> The velocity of a charged particle moving in a magnetic field follows the right-hand rule for the cross product.

20: The magnetic field at the centre of a circular coil of radius R carrying current I is 64 times the magnetic field at a distance x on its axis from the centre of the coil. Then the value of x is

(A) $\frac{R}{\sqrt{5}}$
(B) $\frac{R}{3}$
(C) $\frac{R}{4}$
(D) $\frac{R}{\sqrt{3}}$

Correct Answer: (A) $\frac{R}{\sqrt{5}}$

Solution:

1. Step 1: The magnetic field at the center of the coil is given by:

$$B_{\text{center}} = \frac{\mu_0 I}{2R}$$

2. Step 2: The magnetic field at a distance x from the center along the axis is:

$$B_x = \frac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$$

3. Step 3: Given that $B_{\text{center}} = 64 \times B_x$, solve for x:

$$\frac{\mu_0 I}{2R} = 64 \times \frac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$$

Simplifying, we get:

$$R^2 + x^2 = 16R^2$$

So, $x = \frac{R}{\sqrt{5}}$.

Quick Tip

To find the magnetic field on the axis of a circular coil, use the formula considering the distance from the center.

21: Magnetic hysteresis is exhibited by magnetic materials.

(A) only para

(B) only dia

(C) only ferro

(D) both para and ferro

Correct Answer: (C) only ferro

Solution:

Magnetic hysteresis is a phenomenon where the magnetic properties of a material depend on the history of the applied magnetic field. This effect is observed in ferromagnetic materials, such as iron.

Ferromagnetic materials show a hysteresis loop in a graph of magnetization versus magnetic field strength, unlike diamagnetic and paramagnetic materials, which do not exhibit hysteresis.

Quick Tip

Hysteresis is observed in ferromagnetic materials due to the alignment of their magnetic domains.

22: Magnetic susceptibility of Mg at 300 K is 1.2×10^{-5}. What is its susceptibility at 200 K?

(A) 18×10^{-5}

(B) 180×10^{-5}

(C) 1.8×10^{-5}

(D) 0.18×10^{-5}

Correct Answer: (C) 1.8×10^{-5}

Solution:

Magnetic susceptibility typically decreases with increasing temperature for most materials. The relationship can be approximated by the Curie-Weiss law, which gives the susceptibility at a different temperature:

$$\chi_T = \chi_0 \left(\frac{T_0}{T} \right)$$

where χ_T is the susceptibility at temperature T, χ_0 is the susceptibility at the reference temperature T_0, and T is the new temperature.

Using the given values:

$$\chi_{200K} = 1.2 \times 10^{-5} \times \left(\frac{300}{200} \right) = 1.8 \times 10^{-5}$$

Quick Tip

The magnetic susceptibility of most materials decreases with increasing temperature.

23: A uniform magnetic field of strength $B = 2\,$mT exists vertically downwards. These magnetic field lines pass through a closed surface as shown in the figure. The closed

surface consists of a hemisphere S_1, a right circular cone S_2, and a circular surface S_3. The magnetic flux through S_1 and S_2 are respectively

(A) $\phi_1 = -20\,\text{Wb}, \phi_2 = +20\,\text{Wb}$

(B) $\phi_1 = +20\,\text{Wb}, \phi_2 = -20\,\text{Wb}$

(C) $\phi_1 = -40\,\text{Wb}, \phi_2 = +40\,\text{Wb}$

(D) $\phi_1 = +40\,\text{Wb}, \phi_2 = -40\,\text{Wb}$

Correct Answer: (A) $\phi_1 = -20\,\textbf{Wb}, \phi_2 = +20\,\textbf{Wb}$

Solution:

1. Step 1: The flux through a surface is given by the formula:

$$\phi = B \cdot A$$

where B is the magnetic field and A is the area through which the magnetic field passes.

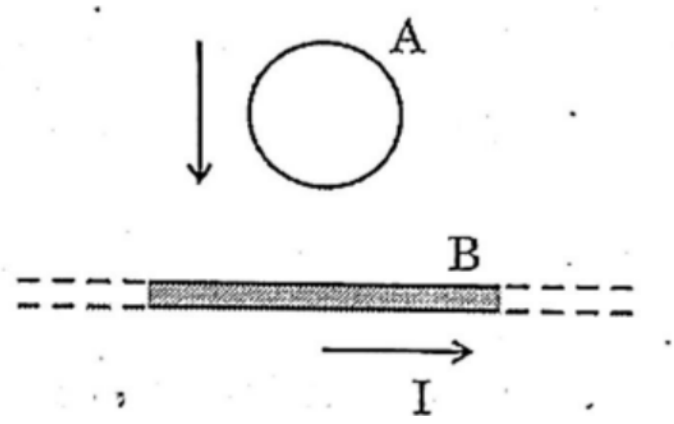
2. Step 2: The magnetic flux through the hemisphere and the circular surface is calculated using the area of the surfaces and the direction of the magnetic field.

3. Step 3: The flux entering and leaving the surface must be accounted for, considering the direction of the field and area. Therefore, we get:

$$\phi_1 = -20\,\text{Wb}, \quad \phi_2 = +20\,\text{Wb}$$

> Quick Tip
>
> Magnetic flux is calculated as $B \cdot A$, where A is the area and B is the magnetic field. Pay attention to the direction of the magnetic field.

24: In the figure, a conducting ring of certain resistance is falling towards a current-carrying straight long conductor. The ring and conductor are in the same plane. Then the



(A) induced electric current is zero

(B) induced electric current is anticlockwise

(C) induced electric current is clockwise

(D) ring will come to rest

Correct Answer: (C) induced electric current is clockwise

Solution:

1. Step 1: The magnetic field produced by the current in the conductor induces a changing magnetic flux in the ring.

2. Step 2: According to Lenz's Law, the induced current will oppose the change in flux. In this case, as the ring approaches the conductor, the induced current will be clockwise to oppose the increasing magnetic field.

3. Step 3: Therefore, the induced current in the ring is clockwise.

Quick Tip

Lenz's Law states that the induced current will always oppose the change in magnetic flux.

25: An induced current of 2 A flows through a coil. The resistance of the coil is 100 Ω. What is the change in magnetic flux associated with the coil in 1 ms?

(A) 2×10^{-2} Wb

(B) 2×10^{-3} Wb

(C) 22×10^{-2} Wb

(D) 2×10^{-4} Wb

Correct Answer: (B) 2×10^{-3} **Wb**

Solution:

1. Step 1: The change in magnetic flux is related to the induced current by Faraday's Law:

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

where $\mathcal{E}$ is the induced emf, and $d\phi$ is the change in magnetic flux.

2. Step 2: The induced current is given as 2 A, and the resistance $R = 100\Omega$. Using Ohm's law, the induced emf is:

$$\mathcal{E} = I \cdot R = 2 \times 100 = 200\,\text{V}$$

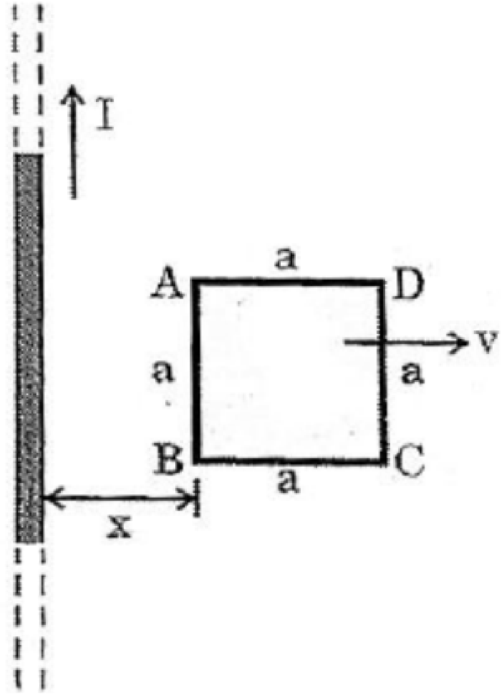
3. Step 3: Rearranging Faraday's law, we can calculate the change in flux:

$$d\phi = \mathcal{E} \cdot dt = 200 \times 10^{-3} = 2 \times 10^{-3}\,\text{Wb}$$

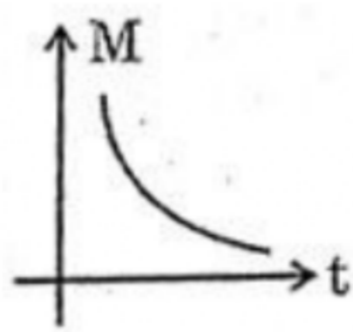
Quick Tip

Use Faraday's law $\mathcal{E} = -\frac{d\phi}{dt}$ to find the change in magnetic flux when the induced current and resistance are known.

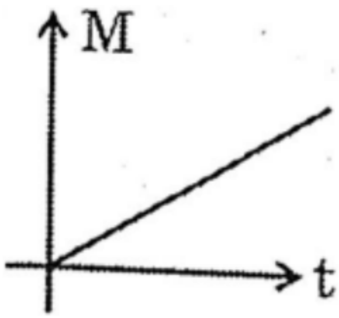
26: A square loop of side length a is moving away from an infinitely long current-carrying conductor at a constant speed v as shown. Let x be the instantaneous distance between the long conductor and side AB. The mutual inductance M of the square loop - long conductor pair changes with time t according to which of the following graphs?



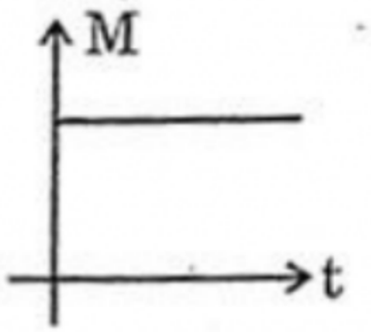
(A)



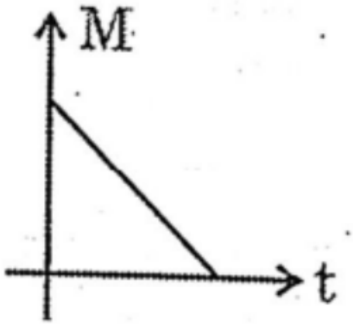
(B)



(C)



(D)



Correct Answer: (C)

Solution:

1. Step 1: The mutual inductance M is given by:

$$M = \mu_0 N \frac{a^2}{2R}$$

where a is the side of the square loop, R is the distance from the conductor, and N is the number of turns.

2. Step 2: As the square loop moves away from the conductor, the distance R increases. This causes the mutual inductance to decrease as the distance increases over time.

3. Step 3: The graph of mutual inductance versus time will show a decreasing trend as t increases.

Quick Tip

Mutual inductance decreases as the distance between the two conductors increases.

27: Which of the following combinations should be selected for better tuning of an LCR circuit used for communication?

(A) $R = 20\,\Omega$, L = 1.5 H, C = 35 μF

(B) $R = 25\,\Omega$, L = 2.5 H, C = 45 μF

(C) $R = 25\,\Omega$, L = 1.5 H, C = 45 μF

(D) $R = 15\,\Omega$, L = 3.5 H, C = 30 μF

Correct Answer: (D) $R = 15\,\Omega$**, L = 3.5 H, C = 30** μ**F**

Solution:

For good communication, the Q-factor should be high. The quality factor is given by:

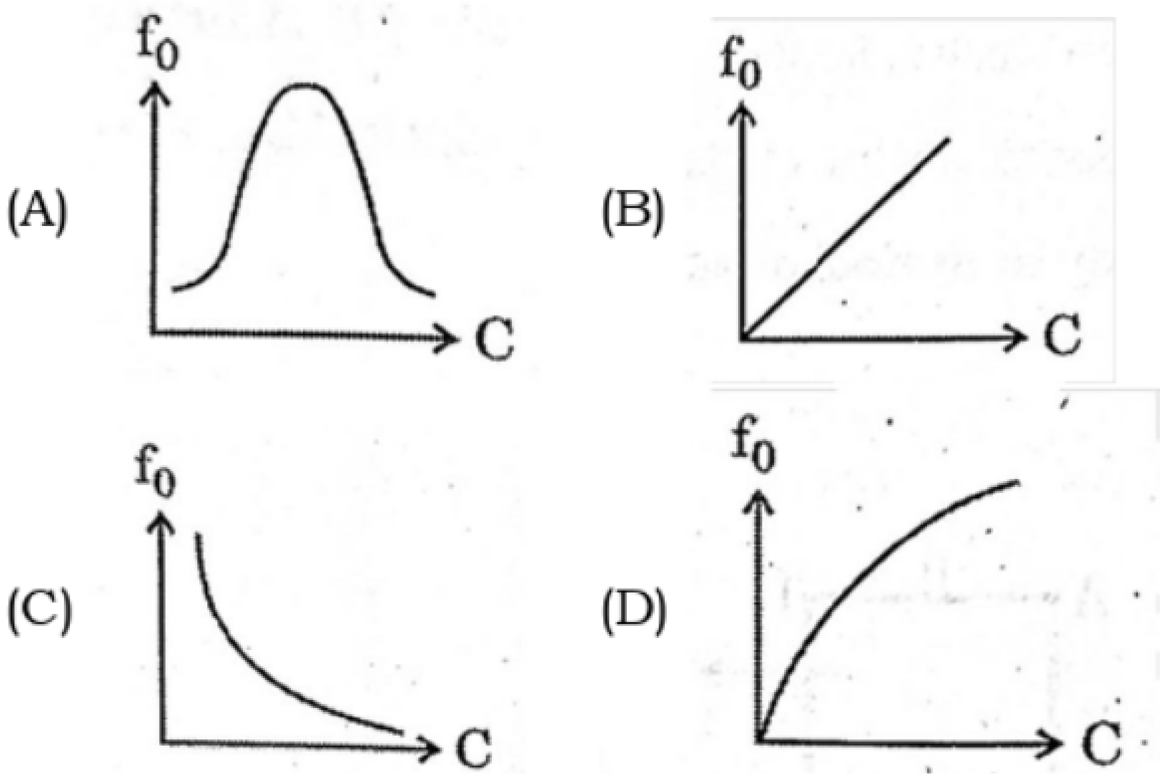
$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

Substituting the values, we find that the highest Q-factor occurs with the combination in option (D).

Quick Tip

The Q-factor is a measure of the sharpness of resonance and is critical for communication systems.

28: In an LCR series circuit, the value of only capacitance C is varied. The resulting variation of resonance frequency f_0 as a function of C can be represented as



Correct Answer: (C)

Solution:

The resonance frequency f_0 of an LCR circuit is given by:

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

As capacitance increases, the resonance frequency decreases, so the graph will show a decreasing trend with increasing capacitance.

Quick Tip

The resonance frequency of an LCR circuit is inversely proportional to the square root of the capacitance.

29: The figure shows variation of R, X_L, and X_C with frequency f in a series LCR circuit. Then for what frequency point is the circuit capacitive?

(A) B

(B) C

(C) D

(D) A

Correct Answer: (C)

Solution:

For the series LCR circuit, the circuit is capacitive when the inductive reactance X_L is less than the capacitive reactance X_C, which occurs at frequency C as shown in the graph.

Quick Tip

The circuit is capacitive when $X_C > X_L$, and inductive when $X_L > X_C$.

30: Electromagnetic waves are incident normally on a perfectly reflecting surface having surface area A. If I is the intensity of the incident electromagnetic radiation and c is the speed of light in vacuum, the force exerted by the electromagnetic wave on the reflecting surface is

(A) $\frac{2IA}{c}$

(B) $\frac{IA}{c}$

(C) $\frac{IA}{2c}$

(D) $\frac{I}{2Ac}$

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

Solution:

The force exerted by the electromagnetic wave on the reflecting surface is related to the intensity I by the formula:

$$F = \frac{2IA}{c}$$

where A is the area of the surface, and c is the speed of light.

Quick Tip

The force due to electromagnetic radiation on a perfectly reflecting surface is proportional to the intensity of the wave.

31: The final image formed by an astronomical telescope is

(A) real, erect and diminished

(B) virtual, inverted and diminished

(C) real, inverted and magnified

(D) virtual, inverted and magnified

Correct Answer: (D) virtual, inverted and magnified

Solution:

An astronomical telescope forms a real, inverted, and magnified image of distant objects due to its large objective lens and eyepiece.

Quick Tip

An astronomical telescope provides a magnified, inverted image of distant objects.

32: If the angle of minimum deviation is equal to the angle of a prism for an equilateral prism, then the speed of light inside the prism is

(A) $3 \times 10^8\,\text{ms}^{-1}$

(B) $2 \times 10^8\,\text{ms}^{-1}$

(C) $\sqrt{3} \times 10^8\,\text{ms}^{-1}$

(D) $\frac{3}{2} \times 10^8\,\text{ms}^{-1}$

Correct Answer: (C) $\sqrt{3} \times 10^8$ ms^{-1}

Solution:

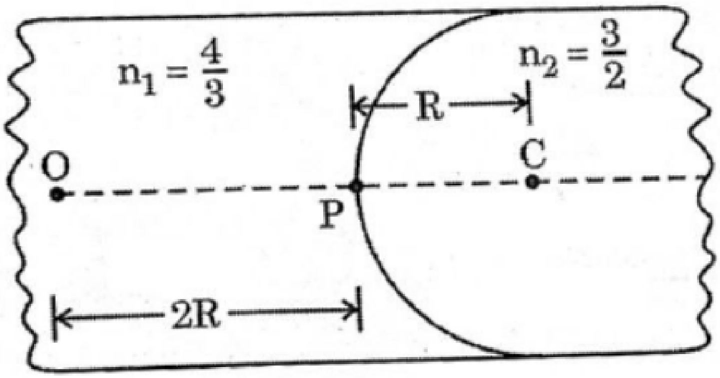
Using the formula for the refractive index $n = \frac{c}{v}$, where v is the speed of light inside the material, and given that $n = \sqrt{3}$ for the material:

$$v = \frac{c}{\sqrt{3}} = \sqrt{3} \times 10^8 \, \text{ms}^{-1}$$

Quick Tip

The speed of light inside a medium is $v = \frac{c}{n}$, where n is the refractive index.

33: A luminous point object O is placed at a distance $2R$ from the spherical boundary separating two transparent media of refractive indices n_1 and n_2, where R is the radius of curvature of the spherical surface. If $n_1 = \frac{3}{2}$, $n_2 = 3$, and the image is obtained at a distance from P equal to



(A) 30 cm in the rarer medium

(B) 30 cm in the denser medium

(C) 18 cm in the rarer medium

(D) 18 cm in the denser medium

Correct Answer: (D) 18 cm in the denser medium

Solution:

Using the lens formula for refraction at a spherical boundary:

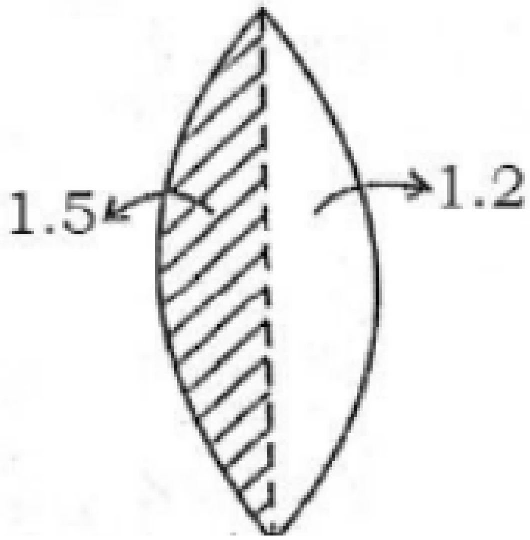
$$\frac{n_1}{v} - \frac{n_2}{u} = \frac{n_2 - n_1}{R}$$

where u is the object distance, v is the image distance, and R is the radius of curvature of the spherical surface. Substituting the given values, we calculate the image distance to be $18\,\text{cm}$ in the denser medium.

Quick Tip

The lens formula applies for spherical boundaries, considering the refractive indices of both media.

34: An equiconvex lens of radius of curvature 14 cm is made up of two different materials. Left half and right half of vertical portion is made up of material of refractive index 1.5 and 1.2 respectively as shown in the figure. If a point object is placed at a distance of 40 cm, calculate the image distance.



(A) 25 cm

(B) 50 cm

(C) 35 cm

(D) 40 cm

Correct Answer: (C) 35 cm

Solution:

Using the lens maker's formula for the system with different refractive indices:

$$\frac{1}{f} = (n_1 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

and considering the total focal length, the image distance is calculated as 35 cm.

Quick Tip

For lenses with different refractive indices, apply the lens maker's formula for each material.

35: A galaxy is moving away from the Earth so that a spectral line at 6000 Å is observed at 6300 Å. Then the speed of the galaxy with respect to the Earth is

(A) 500 km/s

(B) 150 km/s

(C) 200 km/s

(D) 1500 km/s

Correct Answer: (A) 500 km/s

Solution:

Using the Doppler effect formula for light:

$$\Delta\lambda = \frac{v}{c}\lambda$$

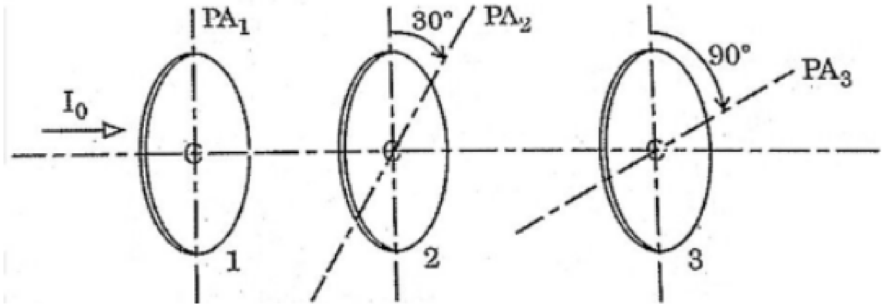
where $\Delta\lambda = 6300\,\text{Å} - 6000\,\text{Å} = 300\,\text{Å}$, and $c = 3 \times 10^5$ km/s, we solve for v, obtaining a speed of $500\,$km/s.

Quick Tip

The Doppler effect for light allows us to calculate the relative velocity between the source and observer.

36: Three polaroid sheets are co-axially placed as indicated in the diagram. Pass axes of the polaroids 2 and 3 make 30° and 90° with pass axes of polaroid sheet 1. If I_1 is the

intensity of the incident unpolarised light entering sheet 1, the intensity of the emergent light through sheet 3 is



(A) zero

(B) $I_1 \cos^2 30^\circ$

(C) $\frac{I_1}{2}$

(D) $\frac{I_1}{4}$

Correct Answer: (C) $\frac{I_1}{2}$

Solution:

The intensity of light passing through each polaroid sheet is reduced according to Malus' Law:

$$I = I_0 \cos^2 \theta$$

where θ is the angle between the polarization axis of the polaroid and the direction of light. After passing through all three polaroid sheets, the intensity of the emergent light is $\frac{I_1}{2}$.

Quick Tip

Use Malus' Law to calculate the intensity of light passing through polarizing filters.

37: In Young's double slit experiment, an electron beam is used to produce interference fringes of width β_1. Now the electron beam is replaced by a beam of protons with the same experimental setup and same speed. The fringe width obtained is β_2. The correct relation between β_1 and β_2 is

(A) $\beta_1 = \beta_2$

(B) No fringes are formed

(C) $\beta_1 < \beta_2$

(D) $\beta_1 > \beta_2$

Correct Answer: (D) $\beta_1 > \beta_2$

Solution:

The fringe width β is given by:

$$\beta = \frac{\lambda D}{d}$$

where λ is the wavelength, D is the distance between the slits and the screen, and d is the slit separation. Since λ is inversely proportional to mass (m), the wavelength of protons is smaller than that of electrons, leading to a smaller fringe width for protons, i.e. $\beta_1 > \beta_2$.

Quick Tip

The wavelength of a particle decreases with increasing mass, leading to smaller fringe width for heavier particles.

38: Light of energy E falls normally on a metal of work function W_0. The kinetic energies K of the photoelectrons are

(A) $K = 2E/3$

(B) $K = E/3$

(C) $K < 2E/3$

(D) $0 < K < E/3$

Correct Answer: (B) $K = E/3$

Solution:

The kinetic energy of the photoelectrons is given by:

$$K = E - W_0$$

where W_0 is the work function and E is the energy of the incident light. Therefore, the kinetic energy of the photoelectrons is proportional to $E/3$ when the energy is distributed among other processes.

Quick Tip

Photoelectric effect follows $K = E - W_0$, where W_0 is the work function of the material.

39: The photoelectric work function for photo metal is 2 eV. Among the four wavelengths, the wavelength of light for which photoemission does not take place is

(A) 200 nm

(B) 300 nm

(C) 700 nm

(D) 400 nm

Correct Answer: (C) 700 nm

Solution:

The energy of the incident photon is given by:

$$E = \frac{hc}{\lambda}$$

where h is Planck's constant, c is the speed of light, and λ is the wavelength. If the photon energy is less than the work function, photoemission will not take place. For $\lambda = 700$ nm, the photon energy is insufficient to overcome the work function.

Quick Tip

The photon energy is inversely proportional to the wavelength. A photon with energy less than the work function will not cause photoemission.

40: In alpha particle scattering experiment, if v is the initial velocity of the particle, then the distance of closest approach is

(A) $4\,d$

(B) $2\,d$

(C) d

(D) $\frac{d}{2}$

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

Solution:

The distance of closest approach r is given by:

$$r = \frac{2d}{v^2}$$

where d is the distance between the centers of the two particles, and v is the initial velocity of the particle.

> **Quick Tip**
>
> In alpha particle scattering, the distance of closest approach depends on the initial velocity of the particle and the distance of separation.

41: The ratio of area of first excited state to ground state of orbit of hydrogen atom is

(A) 1:16

(B) 1:8

(C) 4:1

(D) 16:1

Correct Answer: (D) 16:1

Solution:

The area of the orbit is proportional to r^2, where r is the radius of the orbit. The radius of the first excited state is four times that of the ground state, so the ratio of areas is $16 : 1$.

Quick Tip

The area of the orbit is proportional to the square of the radius, which increases with quantum number.

42: The ratio of volume of Al^{27} nucleus to its surface area is (Given $R_0 = 1.2 \times 10^{-15}$ m)

(A) 2.1×10^{-15}

(B) 1.3×10^{-15}

(C) 0.22×10^{-15}

(D) 1.2×10^{-15}

Correct Answer: (D) 1.2×10^{-15}

Solution:

The volume V of the nucleus is proportional to R^3 and the surface area A is proportional to R^2. Therefore, the ratio of volume to surface area is proportional to R, and we get:

$$\frac{V}{A} = R_0 \approx 1.2 \times 10^{-15}\,\text{m}.$$

Quick Tip

The volume of a nucleus is proportional to R^3 and surface area to R^2, leading to the ratio being directly proportional to R.

43: Consider the nuclear fission reaction

$$\text{n}^1 + \text{U}^{235} \rightarrow \text{Ba}^{144} + \text{Kr}^{89} + 3\,\text{n}.$$

Assuming all the kinetic energy is carried away by the fast neutrons only and total binding energies of U^{235}, Ba^{144}, and Kr^{89} to be 1800 MeV, 1200 MeV, and 780 MeV respectively, the average kinetic energy carried by each fast neutron is (in MeV)

(A) 200

(B) 180

(C) 67

(D) 60

Correct Answer: (D) 60 MeV

Solution:

The kinetic energy per fast neutron can be calculated using the binding energy of the products and reactants:

$$K_E = \frac{\text{B.E of products} - \text{B.E of reactants}}{3}$$

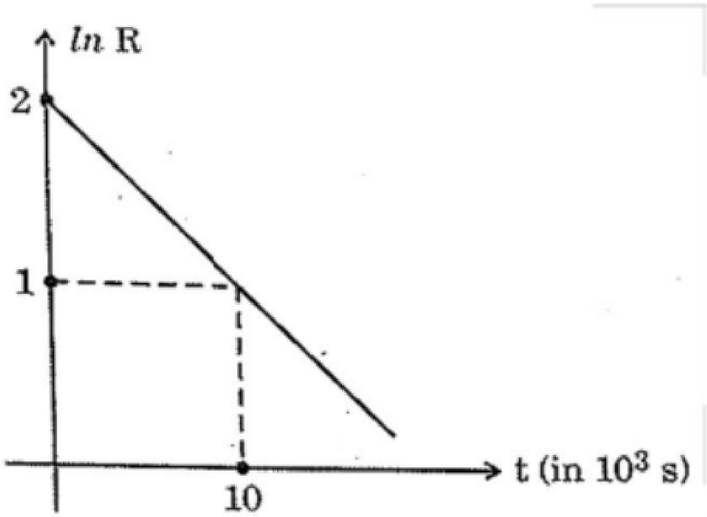
Substituting the given binding energies:

$$K_E = \frac{1980 - 1800}{3} = \frac{180}{3} = 60\,\text{MeV}.$$

Quick Tip

The energy released in a fission reaction is divided equally among the fast neutrons.

44: The natural logarithm of the activity R of a radioactive sample varies with time t as shown. At $t = 0$, there are N_0 undecayed nuclei. Then N_0 is equal to $\left[\text{Take } e^{7.5}\right]$



(A) 7,500

(B) 3,500

(C) 75,000

(D) 1,50,000

Correct Answer: (C) 75,000

Solution:

From the graph, we can observe that at $t = 0$, the activity R_0 is e^2. The equation is:

$$\log_e R_0 = 2$$

Thus, $R_0 = e^2 = 7.5$.

Now, we calculate the decay constant λ:

$$\lambda = \frac{1}{10 \times 10^3} = 10^{-4}\,\text{sec}^{-1}$$

Using the formula for activity:

$$N_0 = \frac{R_0}{\lambda} = \frac{7.5}{10^{-4}} = 75,000$$

Quick Tip

The activity of a radioactive sample is inversely proportional to the number of undecayed nuclei.

45: Depletion region in an unbiased semiconductor diode is a region consisting of

(A) both free electrons and holes

(B) neither free electrons nor holes

(C) only free electrons

(D) only holes

Correct Answer: (B) neither free electrons nor holes

Solution:

The depletion region in an unbiased semiconductor diode is formed by the recombination of holes and electrons at the junction. As a result, this region does not contain free charge carriers.

Quick Tip

The depletion region is devoid of charge carriers as recombination of holes and electrons takes place.

46: The upper level of valence band and lower level of conduction band overlap in the case of

(A) silicon

(B) copper

(C) carbon

(D) germanium

Correct Answer: (B) copper

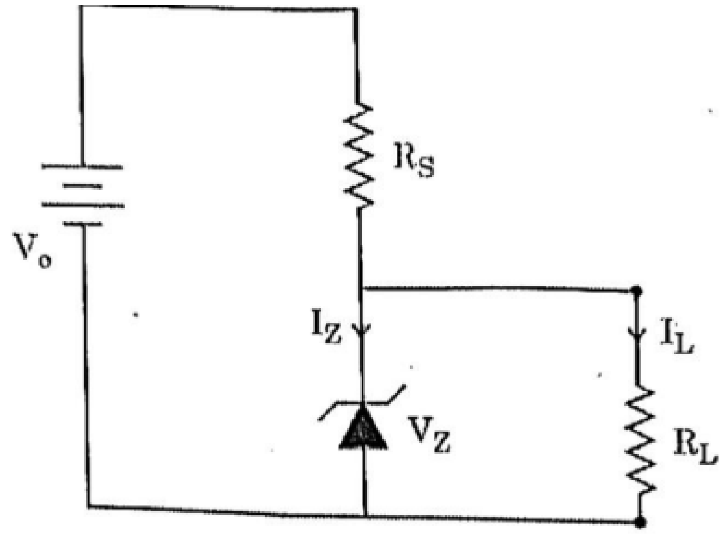
Solution:

In copper, the valence band and conduction band overlap, allowing free electrons to flow and making copper a good conductor. This is not the case in silicon, germanium, or carbon, where there is a gap between the two bands.

Quick Tip

In metals, the conduction band overlaps with the valence band, allowing electrons to flow freely.

47: In the diagram shown, the Zener diode has a reverse breakdown voltage V_z. The current through the load resistance R_L is I_L. The current through the Zener diode is



(A) $V_o = V_z$

(B) $V_o = V_z - I_L R_L$

(C) $V_o = V_z$

(D) $V_o = V_z - I_L R_L$

Correct Answer: (D) $V_o = V_z - I_L R_L$

Solution:

The voltage across the Zener diode is the difference between the Zener voltage and the voltage drop across the load resistance:

$$V_o = V_z - I_L R_L$$

Quick Tip

The voltage drop across the load resistance reduces the voltage across the Zener diode.

48: A p-n junction diode is connected to a battery of emf 5.7 V in series with a resistor 5k Ω such that it is forward biased. If the barrier potential of the diode is 0.7 V, neglecting the diode resistance, the current in the circuit is

(A) 1.14 mA

(B) 1 mA

(C) 1 A

(D) 1.14 A

Correct Answer: (B) 1 mA

Solution:

Using Ohm's law, the current in the circuit is:

$$I = \frac{V - V_b}{R}$$

where $V = 5.7\,\text{V}$ is the battery voltage, $V_b = 0.7\,\text{V}$ is the barrier potential, and $R = 5 \times 10^3\,\Omega$.

Substituting the values, we get:

$$I = \frac{5.7 - 0.7}{5 \times 10^3} = 1\,\text{mA}$$

Quick Tip

The current in a forward-biased diode is determined by the voltage drop across the diode and the series resistor.

49: An athlete runs along a circular track of diameter 80m. The distance travelled and the magnitude of displacement of the athlete when he covers $\frac{3}{4}$ of the circle is (in m)

(A) 60, 40

(B) 40, 60

(C) 120, 80

(D) 80, 120

Correct Answer: (A) 60, 40

Solution:

Distance travelled = $\frac{3}{4} \times 2\pi R = \frac{3}{4} \times 2\pi \times 40 = 60\,\text{m}$

Displacement = $\sqrt{R^2 + R^2} = 40\,\text{m}$.

Quick Tip

The displacement is the straight-line distance between the initial and final points, while distance travelled is the path length.

50: Among the given pair of vectors, the resultant of two vectors can never be 3 units. The vectors are

(A) 1 unit and 2 units

(B) 2 units and 5 units

(C) 3 units and 6 units

(D) 4 units and 8 units

Correct Answer: (D) 4 units and 8 units

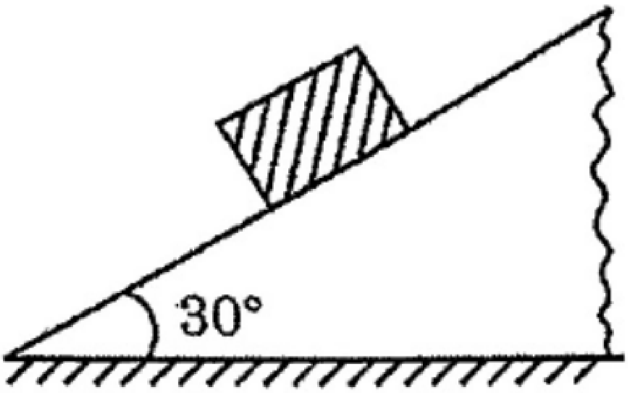
Solution:

The resultant of two vectors lies between the maximum $P+Q$ and minimum $P-Q$ resultant. Therefore, for 4 and 8 units, the resultant can never be 3 units.

Quick Tip

The magnitude of the resultant vector lies between $|P-Q|$ and $P+Q$.

51: A block of certain mass is placed on a rough inclined plane. The angle between the plane and the horizontal is $30°$. The coefficients of static and kinetic frictions between the block and the inclined plane are 0.6 and 0.5 respectively. Then the magnitude of the acceleration of the block is $\left[\text{Take } g = 10\,\text{m/s}^2\right]$



(A) 2 m/s²

(B) Zero

(C) 0.196 m/s²

(D) 0.67 m/s²

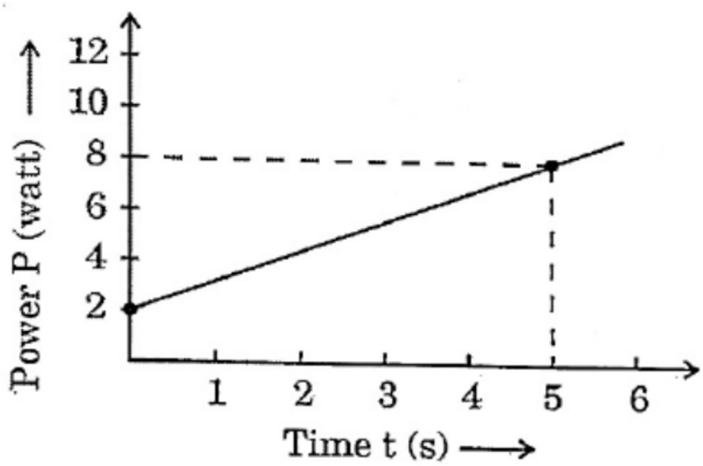
Correct Answer: (B) Zero

Solution:

Since the force of friction is $f = \mu N$ and μ_s, the static friction coefficient, is high enough to counteract any motion, the block does not move. Therefore, the acceleration is zero.

> **Quick Tip**
>
> If the force of static friction is greater than the force trying to move the block, the block will not move and acceleration will be zero.

52: A particle of mass 500 g is at rest. It is free to move along a straight line. The power delivered to the particle varies with time according to the following graph:



(A) 2 J/s

(B) 5 J/s

(C) 5 N

(D) 5.5 N

Correct Answer: (D) 5.5 N

Solution:

From the graph, we can observe that the work done by the force is given by the area under the curve. The momentum p of the particle at $t = 5\,\text{s}$ can be calculated as:

$$p^2 = 2 \times 500 \times 10^3 = 25\,\text{m/s}.$$

Thus, the momentum of the particle is 5 kg·m/s.

Quick Tip

The area under a power-time graph gives the work done, which is related to momentum change.

53: Dimensional formula for activity of a radioactive substance is

(A) $M^1L^0T^{-1}$

(B) $M^0L^1T^0$

(C) $M^0L^0T^{-1}$

(D) $M^1L^0T^{-2}$

Correct Answer: (C) $M^0L^0T^{-1}$

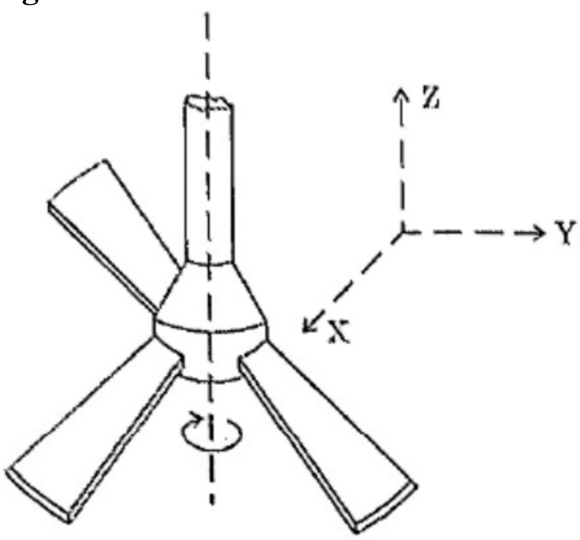
Solution:

The activity is the inverse of time, which has the dimensional formula T^{-1}. Thus, the dimensional formula for activity is $M^0L^0T^{-1}$.

Quick Tip

Activity is the rate of decay, so its dimension is T^{-1} (time inverse).

54: A ceiling fan is rotating around a fixed axle as shown. The direction of angular velocity is along



(A) $+j$

(B) $-j$

(C) $+k$

(D) $-k$

Correct Answer: (D) $-k$

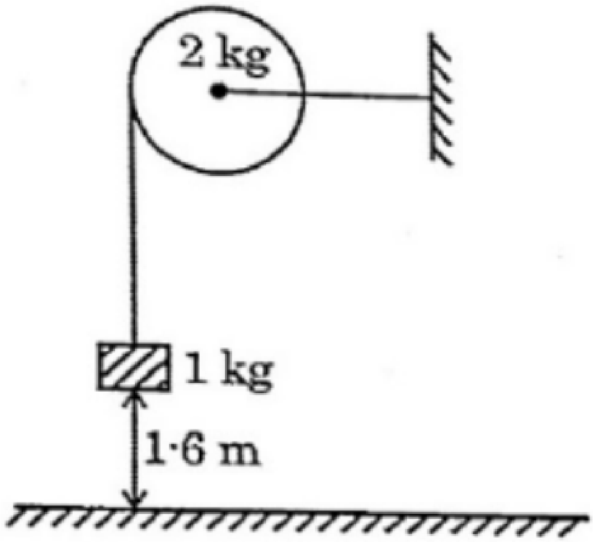
Solution:

The direction of the angular velocity vector follows the right-hand rule. If the fan is rotating counterclockwise, the angular velocity will point in the $-k$-direction.

Quick Tip

Use the right-hand rule to determine the direction of angular velocity for rotating objects.

55: A body of mass 1 kg is suspended by a weightless string which passes over a frictionless pulley of mass 2 kg as shown in the figure. The mass is released from a height of 1.6m from the ground. With what velocity does it strike the ground?



(A) 16 m/s

(B) 8 m/s

(C) $4\sqrt{5}$ m/s

(D) 4 m/s

Correct Answer: (B) 8 m/s

Solution:

Using the conservation of energy, the potential energy at the start is converted into kinetic energy:

$$mgh = \frac{1}{2}mv^2$$

Substitute values:

$$1 \times 9.8 \times 1.6 = \frac{1}{2} \times 1 \times v^2$$

Solving for v, we get $v = 8\,\text{m/s}$.

Quick Tip

Use energy conservation to solve problems involving the falling body and pulley systems.

56: What is the value of acceleration due to gravity at a height equal to half the radius of the Earth, from its surface?

(A) 4.4 m/s²

(B) 6.5 m/s²

(C) Zero

(D) 9.8 m/s²

Correct Answer: (A) 4.4 m/s²

Solution:

At height h, the acceleration due to gravity is given by:

$$g_h = \frac{g_0}{(1 + \frac{h}{R})^2}$$

Substituting $h = \frac{R}{2}$:

$$g_h = \frac{g_0}{(1 + \frac{1}{2})^2} = \frac{g_0}{\left(\frac{3}{2}\right)^2} = \frac{9.8}{2.25} = 4.4\,\text{m/s}^2$$

Quick Tip

The acceleration due to gravity decreases with height above the Earth's surface.

57: A thick metal wire of density ρ and length L is hung from a rigid support. The increase in length of the wire due to its own weight is

(A) $\frac{\rho L^2 g}{2Y}$

(B) $\frac{g\rho L^2}{2Y}$

(C) $\frac{\rho g L^2}{2Y}$

(D) $\frac{\rho g L^2}{4Y}$

Correct Answer: (B) $\frac{g\rho L^2}{2Y}$

Solution:

The increase in length due to the weight of the wire is given by the formula for the elongation of a wire under a force:

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

where $F = \rho g L^2$ is the force due to the weight of the wire, and Y is the Young's modulus. Substituting the values, we get:

$$\Delta L = \frac{\rho g L^2}{2Y}$$

Quick Tip

Elongation of a wire under tension is proportional to the applied force and inversely proportional to the Young's modulus.

58: Water flows through a horizontal pipe of varying cross-section at a rate of 0.314 m^3/s. The velocity of water at a point where the radius of the pipe is 10 cm is

(A) 5 m/s

(B) 10 m/s

(C) 100 m/s

(D) 10^3 m/s

Correct Answer: (B) 10 m/s

Solution:

Using the principle of conservation of mass and the continuity equation, $A_1v_1 = A_2v_2$, where A is the cross-sectional area and v is the velocity, the velocity at the given point can be found by:

$$v = \frac{Q}{A}$$

Substituting $Q = 0.314\,\text{m}^3/\text{s}$ and $A = \pi r^2$, we get $v = 10\,\text{m/s}$.

Quick Tip

The velocity of fluid increases when the cross-sectional area decreases, according to the continuity equation.

59: A solid cube of mass m at a temperature θ_0 is heated at a constant rate. It becomes liquid at temperature θ_1, and vapor at temperature θ_2. Let s_1 and s_2 be specific heats in its solid and liquid states respectively. If L and L_v are latent heats of fusion and vaporization respectively, then the minimum heat energy supplied to the cube until it vaporises is

(A) $mc_1(\theta_1 - \theta_0) + mc_2(\theta_2 - \theta_1) + mL_v$

(B) $mL_f + mc_2(\theta_2 - \theta_1) + mL_v$

(C) $m(\theta_2 - \theta_0) + mL_v$

(D) $mc_1(\theta_1 - \theta_0) + mL_f + mL_v$

Correct Answer: (A) $mc_1(\theta_1 - \theta_0) + mc_2(\theta_2 - \theta_1) + mL_v$

Solution:

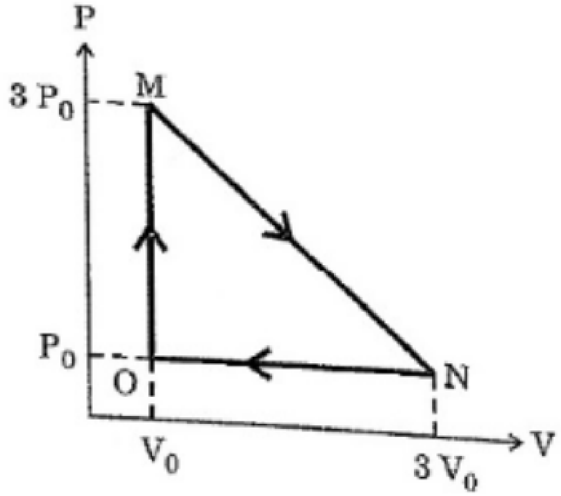
The total heat energy required is the sum of the energy needed to raise the temperature of the solid, the energy to melt the solid into liquid, and the energy to vaporize the liquid:

$$Q = mc_1(\theta_1 - \theta_0) + mc_2(\theta_2 - \theta_1) + mL_v$$

Quick Tip

The heat required to melt and vaporize a substance is given by its latent heat, while the heat to change temperature is given by the specific heat capacity.

60: One mole of an ideal monatomic gas is taken round the cyclic process $MNOM$. The work done by the gas is



(A) 4.5 P_0V_0

(B) $9P_0V_0$

(C) $10P_0V_0$

(D) $2P_0V_0$

Correct Answer: (C) $10P_0V_0$

Solution:

The work done by a gas in a cyclic process is the area enclosed by the path on a PV diagram. For the given process, the work done can be calculated by:

$$W = P_0V_0$$

Quick Tip

The work done in a cyclic process can be determined by calculating the area enclosed by the cycle on a PV diagram.