GAT-B Physics
Sample Paper – 5

Duration: 23 Minutes **Maximum Marks:** 15

Instructions

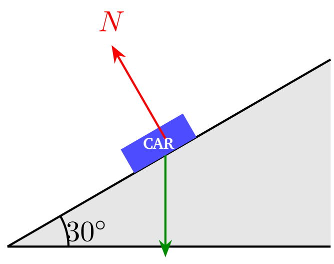
- This paper contains **15 Multiple Choice Questions (MCQs)**.
- Each question has **four options (A–D)** with **only one correct answer**.
- **Marking Scheme:** **+1** for correct answer; −0.5 for wrong answer; **0** for unattempted.
- Questions are based on the **Class 11 & 12 NCERT Physics** syllabus.
- Use of calculator or any electronic device is **not** permitted.

Questions

Q.1. A diver descends to a depth of $10\,\text{m}$ below the surface of sea water. Given atmospheric pressure $P_0 = 1.01\times10^5$ Pa, density of water $\rho = 1000\,\text{kg/m}^3$, and $g = 10\,\text{m/s}^2$, the absolute pressure experienced by the diver is:

(A) 1.01×10^5 Pa
(B) 2.01×10^5 Pa
(C) 2.50×10^5 Pa
(D) 1.50×10^5 Pa

Q.2. A car negotiates a banked curve of radius $r = 100\,\text{m}$ banked at $\theta = 30^\circ$ with no friction. The optimum speed at which the car should travel is (take $g = 10\,\text{m/s}^2$):



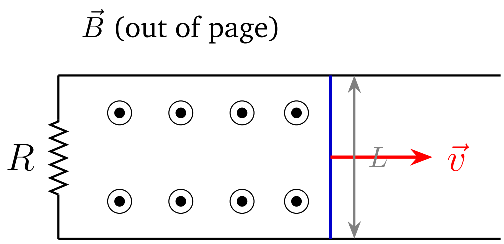
Banked Road Cross-section

(A) 30 m/s
(B) 20 m/s
(C) 24 m/s
(D) 18 m/s

Q.3. An ideal gas absorbs $Q = 500\,\text{J}$ of heat from a thermal reservoir and simultaneously does $W = 200\,\text{J}$ of work on the surroundings. The change in the internal energy of the gas is:

(A) 300 J
(B) 700 J
(C) 200 J
(D) 500 J

Q.4. A conducting rod of length $L = 1\,\text{m}$ slides at velocity $v = 4\,\text{m/s}$ along two smooth parallel conducting rails in a uniform magnetic field $B = 0.5\,\text{T}$ directed out of the plane of the rails. The magnitude of the induced EMF is:



(A) 4 V
(B) 0.5 V
(C) 1 V
(D) 2 V

Q.5. Two point charges $q_1 = q_2 = 2 \times 10^{-6}\,\text{C}$ are placed $r = 0.3\,\text{m}$ apart in a medium of relative permittivity $\varepsilon_r = 4$. The electrostatic force between them is: (Take $k = 9 \times 10^9\,\text{N}\,\text{m}^2\text{C}^{-2}$)

(A) 0.1 N
(B) 0.4 N
(C) 0.025 N

(D) $0.2\,\text{N}$

Q.6. A resonance tube, closed at one end, has an effective air column length of $L = 0.85\,\text{m}$. If the speed of sound in air is $v = 340\,\text{m/s}$, the fundamental frequency of the tube is:

(A) $200\,\text{Hz}$
(B) $50\,\text{Hz}$
(C) $400\,\text{Hz}$
(D) $100\,\text{Hz}$

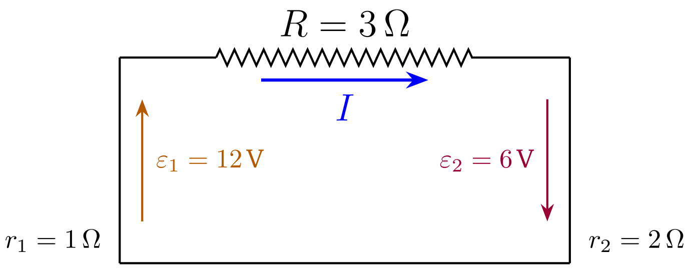
Q.7. An object is placed $30\,\text{cm}$ in front of a convex lens of focal length $20\,\text{cm}$. Using the thin lens formula $\left(\frac{1}{v} - \frac{1}{u} = \frac{1}{f}\right)$, the image distance v is:

(A) $30\,\text{cm}$
(B) $60\,\text{cm}$
(C) $-60\,\text{cm}$
(D) $12\,\text{cm}$

Q.8. A steel rod of length $L_0 = 2\,\text{m}$ at $0°\text{C}$ is heated to $100°\text{C}$. Given the coefficient of linear thermal expansion $\alpha = 12\times10^{-6}\,°\text{C}^{-1}$, the final length of the rod is:

(A) $2.012\,\text{m}$
(B) $2.024\,\text{m}$
(C) $2.0024\,\text{m}$
(D) $2.0012\,\text{m}$

Q.9. In the circuit below, two batteries are connected in series opposition: Battery 1 has $\varepsilon_1 = 12\,\text{V}$ and $r_1 = 1\,\Omega$; Battery 2 has $\varepsilon_2 = 6\,\text{V}$ and $r_2 = 2\,\Omega$; external resistance $R = 3\,\Omega$. Applying Kirchhoff's voltage law, the current in the loop is:



(A) $1\,\text{A}$
(B) $3\,\text{A}$
(C) $2\,\text{A}$
(D) $0.5\,\text{A}$

Q.10. In Young's double-slit experiment using light of wavelength $\lambda = 600\,\text{nm}$, the path difference between waves from the two slits at a particular point on the screen is $\Delta = 300\,\text{nm}$. The nature of the fringe at that point is:

(A) A bright (constructive) fringe, since $\Delta = \lambda/2$ satisfies the bright-fringe condition
(B) A bright fringe with intensity four times the individual slit intensity
(C) A partially illuminated point, neither fully bright nor fully dark
(D) A dark (destructive) fringe, since $\Delta = \lambda/2$

Q.11. In the nuclear fission reaction

$$^{235}_{92}\text{U} + {}^{1}_{0}\text{n} \longrightarrow {}^{141}_{56}\text{Ba} + {}^{92}_{36}\text{Kr} + 3\,{}^{1}_{0}\text{n},$$

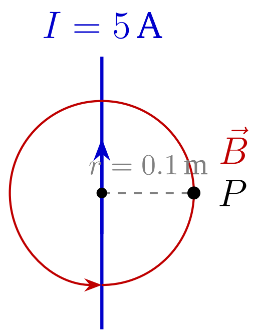
the mass defect is $\Delta m = 0.1860\,\text{u}$. Using $1\,\text{u} = 931.5\,\text{MeV}/c^2$, the energy released ($Q$-value) is:

(A) $200\,\text{MeV}$
(B) $100\,\text{MeV}$
(C) $173\,\text{MeV}$
(D) $235\,\text{MeV}$

Q.12. $100\,\text{g}$ of water at $80°\text{C}$ is mixed with $200\,\text{g}$ of water at $20°\text{C}$ in a thermally insulated container. Assuming no heat loss and specific heat capacity of water $c = 1\,\text{cal}\,\text{g}^{-1}\,°\text{C}^{-1}$, the final equilibrium temperature is:

(A) $50°C$
(B) $60°C$
(C) $30°C$
(D) $40°C$

Q.13. An infinitely long straight wire carries a steady current $I = 5\,\text{A}$. Using Ampere's circuital law, the magnitude of the magnetic field at a perpendicular distance $r = 0.1\,\text{m}$ from the wire is: (Take $\mu_0 = 4\pi \times 10^{-7}\,\text{T m A}^{-1}$)



(A) $10\,\mu\text{T}$
(B) $100\,\mu\text{T}$
(C) $1\,\mu\text{T}$
(D) $50\,\mu\text{T}$

Q.14. The radioactive nucleus $^{226}_{88}\text{Ra}$ undergoes alpha (α) decay. The daughter nucleus produced is:

(A) $^{222}_{84}\text{Po}$
(B) $^{222}_{86}\text{Rn}$
(C) $^{228}_{88}\text{Ra}$
(D) $^{224}_{86}\text{Rn}$

Q.15. When a p-n junction diode is *reverse biased*, which statement *correctly* describes the depletion layer and the resulting current?

(A) The depletion layer narrows and a large current due to majority carriers flows
(B) The depletion layer narrows and virtually no current flows at all
(C) The depletion layer widens and a small reverse saturation current due to minority carriers flows

(D) The depletion layer widens and a large forward current flows

Detailed Solutions

Sol.1.

Solution

Concept: Hydrostatic Pressure

The absolute (total) pressure at depth h in a liquid is given by:

$$P = P_0 + \rho g h$$

Step 1 — Compute gauge pressure (liquid column):

$$\rho g h = 1000\,\text{kg/m}^3 \times 10\,\text{m/s}^2 \times 10\,\text{m} = 1.00 \times 10^5\,\text{Pa}$$

Step 2 — Add atmospheric pressure:

$$P = 1.01 \times 10^5 + 1.00 \times 10^5 = \mathbf{2.01 \times 10^5}\,\text{Pa}$$

Why other options are wrong:

- **(A)** 1.01×10^5 Pa — only the atmospheric pressure; the liquid-column term $\rho g h$ was completely omitted.
- **(C)** 2.50×10^5 Pa — an incorrect $\rho g h = 1.49 \times 10^5$ Pa was used, possibly from a wrong depth or density.
- **(D)** 1.50×10^5 Pa — $\rho g h$ was calculated as 0.49×10^5 Pa; a common error of halving g (using 5 instead of $10\,\text{m/s}^2$).

Answer: (B) **Go Back to Q 1**

Sol.2.

Solution

Concept: Optimum Speed on a Banked Road (No Friction)

For a vehicle on a frictionless banked curve, the horizontal component of the normal force provides the centripetal force:

$$N \sin\theta = \frac{mv^2}{r}, \qquad N\cos\theta = mg$$

Dividing: $\tan\theta = \frac{v^2}{rg}$, so the optimum speed is

$$v_{\text{opt}} = \sqrt{r\,g\tan\theta}$$

Step 1 — Evaluate $\tan 30°$:

$$\tan 30° = \frac{1}{\sqrt{3}} \approx 0.5774$$

Step 2 — Compute v_{opt}:

$$v_{\text{opt}} = \sqrt{100 \times 10 \times 0.5774} = \sqrt{577.4} \approx \mathbf{24.0}\,\text{m/s}$$

Why other options are wrong:

- **(A)** 30 m/s — corresponds to $\tan\theta = 0.90$, i.e. $\theta \approx 42°$, not $30°$.
- **(B)** 20 m/s — gives $\tan\theta = 0.40$, i.e. $\theta \approx 21.8°$; the banking angle was underestimated.
- **(D)** 18 m/s — corresponds to using $\sin 30° = 0.50$ instead of $\tan 30° \approx 0.577$; a common confusion.

Answer: (C) Go Back to Q 2

Sol.3.

Solution

Concept: First Law of Thermodynamics

The first law states:

$$\Delta U = Q - W$$

where $Q > 0$ when heat is *absorbed* by the gas, and $W > 0$ when the gas does work *on* the surroundings.

Given: $Q = +500\,\text{J}$ (absorbed), $W = +200\,\text{J}$ (done by gas on surroundings)

Step 1 — Apply directly:

$$\Delta U = 500 - 200 = \mathbf{300}\,\text{J}$$

The internal energy of the gas increases by $300\,\text{J}$.

Why other options are wrong:

- **(B)** 700 J — uses $\Delta U = Q + W$ (wrong sign); work done by gas must be subtracted, not added.
- **(C)** 200 J — equals the work done W alone; the heat absorbed Q was not considered.
- **(D)** 500 J — equals the heat absorbed Q alone; the work W was not subtracted.

Answer: (A) Go Back to Q 3

Sol.4.

Solution

Concept: Motional EMF

By Faraday's law, when a conductor of length L moves with velocity v perpendicular to both L and a uniform field B:

$$\mathcal{E} = B\,L\,v$$

The free electrons in the rod experience a force $\vec{F} = q(\vec{v} \times \vec{B})$, building up the EMF.

Given: $B = 0.5\,\text{T}$, $L = 1\,\text{m}$, $v = 4\,\text{m/s}$

Step 1 — Substitute:

$$\mathcal{E} = 0.5 \times 1 \times 4 = \mathbf{2}\,\text{V}$$

Why other options are wrong:

- **(A)** 4 V — equals v alone; B and L were not multiplied (or equivalently, $B \times L = 1$ was incorrectly assumed).
- **(B)** 0.5 V — equals B alone; both L and v were omitted from the product.
- **(C)** 1 V — arises from using $v = 2\,\text{m/s}$ (half the given velocity), giving $0.5 \times 1 \times 2 = 1\,\text{V}$.

Answer: (D) Go Back to Q 4

Sol.5.

Solution

Concept: Coulomb's Law in a Dielectric Medium

The electrostatic force between two point charges in a medium of relative permittivity ε_r is:

$$F = \frac{k\,q_1\,q_2}{\varepsilon_r\,r^2}$$

Given: $q_1 = q_2 = 2 \times 10^{-6}\,\text{C}$, $r = 0.3\,\text{m}$, $\varepsilon_r = 4$, $k = 9 \times 10^9\,\text{N}\,\text{m}^2\text{C}^{-2}$

Step 1 — Force in vacuum:

$$F_0 = \frac{k\,q^2}{r^2} = \frac{9 \times 10^9 \times (2 \times 10^{-6})^2}{(0.3)^2} = \frac{9 \times 10^9 \times 4 \times 10^{-12}}{9 \times 10^{-2}} = \frac{36 \times 10^{-3}}{9 \times 10^{-2}} = 0.4\,\text{N}$$

Step 2 — Divide by ε_r:

$$F = \frac{F_0}{\varepsilon_r} = \frac{0.4}{4} = \mathbf{0.1\,N}$$

Why other options are wrong:

- **(B)** 0.4 N — the vacuum Coulomb force; the dielectric effect ($\varepsilon_r = 4$) was completely ignored.
- **(C)** 0.025 N — force was divided by $\varepsilon_r^2 = 16$ instead of $\varepsilon_r = 4$; a common confusion between ε_r and ε_r^2.
- **(D)** 0.2 N — force was divided by $\varepsilon_r = 2$ (reading ε_r as 2 instead of 4).

Answer: (A) Go Back to Q 5

Sol.6.

Solution

Concept: Resonance in a Closed-End Pipe — Fundamental Frequency

A pipe closed at one end supports only odd harmonics. At the fundamental mode, the air column length equals one-quarter wavelength:

$$L = \frac{\lambda_1}{4} \implies \lambda_1 = 4L$$

$$f_1 = \frac{v}{\lambda_1} = \frac{v}{4L}$$

Given: $v = 340\,\text{m/s}$, $L = 0.85\,\text{m}$

Step 1:

$$f_1 = \frac{340}{4 \times 0.85} = \frac{340}{3.4} = 100\,\text{Hz}$$

Why other options are wrong:

- **(A)** 200 Hz — corresponds to the fundamental of an *open* pipe of the same length ($v/2L = 200\,\text{Hz}$); wrong pipe formula used.
- **(B)** 50 Hz — corresponds to a closed pipe of double the length ($L = 1.70\,\text{m}$); length was multiplied by 2 erroneously.
- **(C)** 400 Hz — arises from mistakenly using $L/4$ in the denominator instead of $4L$ for a closed pipe. This is not a harmonic of the given pipe ($f_1 = 100\,\text{Hz}$, odd harmonics: 100, 300, 500, . . .).

Answer: (D) Go Back to Q 6

Sol.7.

Solution

Concept: Thin Lens Formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

Sign convention: distances measured from the optical centre; real object $\Rightarrow u < 0$; convex lens $\Rightarrow f > 0$.

Given: $u = -30\,\text{cm}$, $f = +20\,\text{cm}$

Step 1 — Rearrange for v:

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{20} + \frac{1}{-30} = \frac{1}{20} - \frac{1}{30}$$

Step 2 — LCM of 20 and 30 is 60:

$$\frac{1}{v} = \frac{3}{60} - \frac{2}{60} = \frac{1}{60} \implies v = +60\,\text{cm}$$

Positive v confirms the image is **real** and on the opposite side from the object.

Why other options are wrong:

- **(A)** 30 cm — $v = |u|$ only when the object is at $2f = 40\,\text{cm}$, not $30\,\text{cm}$.
- **(C)** -60 cm — a virtual image forms only when the object lies inside the focal length ($|u| < f$); here $|u| = 30 > 20 = f$.
- **(D)** 12 cm — results from using $\frac{1}{v} = \frac{1}{u} - \frac{1}{f}$ (reversed sign convention),

giving a physically wrong answer.

Answer: (B) Go Back to Q 7

Sol.8.

Solution

Concept: Linear Thermal Expansion

The increase in length upon heating:

$$\Delta L = L_0\,\alpha\,\Delta T$$

Given: $L_0 = 2\,\text{m}$, $\alpha = 12 \times 10^{-6}\,°\text{C}^{-1}$, $\Delta T = 100\,°\text{C}$

Step 1 — Compute ΔL:

$$\Delta L = 2 \times 12 \times 10^{-6} \times 100 = 2400 \times 10^{-6}\,\text{m} = 2.4 \times 10^{-3}\,\text{m} = 0.0024\,\text{m}$$

Step 2 — New length:

$$L = L_0 + \Delta L = 2 + 0.0024 = \mathbf{2.0024}\,\text{m}$$

Why other options are wrong:

- **(A)** 2.012 m — implies $\Delta L = 0.012\,\text{m}$; equivalent to using $\alpha = 6 \times 10^{-5}\,°\text{C}^{-1}$ (five times too large).
- **(B)** 2.024 m — implies $\Delta L = 0.024\,\text{m}$; α was taken as 12×10^{-5} (ten times too large).
- **(D)** 2.0012 m — implies $\Delta L = 0.0012\,\text{m}$; either $\Delta T = 50°\text{C}$ (half) or α was halved.

Answer: (C) Go Back to Q 8

Sol.9.

Solution

Concept: Kirchhoff's Voltage Law — Series-Opposition Circuit

Traversing the loop in the direction of current I and applying KVL:

$$\varepsilon_1 - Ir_1 - IR - \varepsilon_2 - Ir_2 = 0$$

$$\implies I = \frac{\varepsilon_1 - \varepsilon_2}{r_1 + r_2 + R}$$

(valid when $\varepsilon_1 > \varepsilon_2$, so net current flows in the direction of the larger EMF).

Given: $\varepsilon_1 = 12\,\text{V}$, $r_1 = 1\,\Omega$; $\varepsilon_2 = 6\,\text{V}$, $r_2 = 2\,\Omega$; $R = 3\,\Omega$

Step 1 — Net EMF:

$$\varepsilon_{\text{net}} = 12 - 6 = 6\,\text{V}$$

Step 2 — Total resistance:

$$R_{\text{total}} = 1 + 2 + 3 = 6\,\Omega$$

Step 3 — Current:

$$I = \frac{6}{6} = \mathbf{1}\,\text{A}$$

Why other options are wrong:

- **(B)** 3 A — uses $I = \varepsilon_1/(r_1 + R) = 12/4 = 3\,\text{A}$; ε_2 and r_2 were both ignored.
- **(C)** 2 A — uses $I = \varepsilon_{\text{net}}/R = 6/3 = 2\,\text{A}$; the internal resistances $r_1 + r_2 = 3\,\Omega$ were not included.
- **(D)** 0.5 A — uses $I = 6/12$; the resistance was doubled by error (perhaps summed $r_1 + r_2 + R$ twice).

Answer: (A) Go Back to Q 9

Sol.10.

Solution

Concept: Conditions for Constructive and Destructive Interference

In Young's double-slit experiment:

- **Bright fringe** (constructive): $\Delta = n\lambda, \quad n = 0, 1, 2, \ldots$
- **Dark fringe** (destructive): $\Delta = \dfrac{(2n-1)\,\lambda}{2}, \quad n = 1, 2, 3, \ldots$

Given: $\lambda = 600\,\text{nm}$, $\Delta = 300\,\text{nm}$

Step 1 — Check bright condition:

$n\lambda = n \times 600\,\text{nm} = 600, 1200, 1800, \ldots\ \text{nm} \quad \Rightarrow \quad 300\,\text{nm is NOT a bright fringe.}$

Step 2 — Check dark condition for $n = 1$:

$$\Delta_{\text{dark},1} = \frac{(2 \times 1 - 1) \times 600}{2}\,\text{nm} = \frac{600}{2} = 300\,\text{nm} \quad \checkmark$$

The path difference equals $\lambda/2$, confirming a **dark (destructive) fringe**.

Why other options are wrong:

- **(A)** Bright fringe — the condition $\Delta = \lambda/2$ gives *destructive*, not constructive, interference.
- **(B)** Four-times intensity — maximum intensity $4I_0$ occurs only at bright fringes ($\Delta = n\lambda$).
- **(C)** Partial illumination — the path difference satisfies exactly the dark-fringe condition; the resultant intensity is zero.

Answer: (D) **Go Back to Q 10**

Sol.11.

Solution

Concept: Q-Value from Mass Defect

The energy released in a nuclear reaction equals the mass defect converted via $E = mc^2$:

$$Q = \Delta m \times 931.5\,\text{MeV/u}$$

Given: $\Delta m = 0.1860\,\text{u}$

Step 1 — Compute Q:

$$Q = 0.1860 \times 931.5 = 173.3\,\text{MeV} \approx \mathbf{173}\,\text{MeV}$$

Verification of Δm from tabulated atomic masses:

$$\begin{aligned}
\text{Initial mass} &= m(^{235}\text{U}) + m(n) = 235.0439 + 1.0087 = 236.0526\,\text{u} \\
\text{Final mass} &= m(^{141}\text{Ba}) + m(^{92}\text{Kr}) + 3\,m(n) \\
&= 140.9144 + 91.9262 + 3(1.0087) = 235.8667\,\text{u} \\
\Delta m &= 236.0526 - 235.8667 = 0.1859\,\text{u} \approx 0.186\,\text{u} \quad \checkmark
\end{aligned}$$

Why other options are wrong:

- **(A)** 200 MeV — a commonly cited *approximate* total energy release per fission event (including secondary decays); not the precise Q-value for this specific reaction.
- **(B)** 100 MeV — corresponds to $\Delta m \approx 0.107\,\text{u}$, roughly half the actual mass defect.
- **(D)** 235 MeV — coincides with the mass number of ^{235}U; this is a numerical coincidence with no physical derivation.

Answer: (C) Go Back to Q 11

Sol.12.

Solution

Concept: Calorimetry — Principle of Heat Exchange

In a thermally insulated system, heat lost by the hotter body equals heat gained by the cooler body:

$$m_1\, c\, (T_1 - T_f) = m_2\, c\, (T_f - T_2)$$

Since c is identical for both samples, it cancels.

Given: $m_1 = 100\,\text{g}$, $T_1 = 80°\text{C}$; $m_2 = 200\,\text{g}$, $T_2 = 20°\text{C}$

Step 1 — Set up equation:

$$100\,(80 - T_f) = 200\,(T_f - 20)$$

Step 2 — Expand:

$$8000 - 100\,T_f = 200\,T_f - 4000$$

Step 3 — Solve:

$$12000 = 300\,T_f \implies T_f = \frac{12000}{300} = \mathbf{40°C}$$

Why other options are wrong:

- **(A)** $50°\text{C}$ — simple arithmetic mean $(80 + 20)/2$; valid only if $m_1 = m_2$, which is not the case here.
- **(B)** $60°\text{C}$ — weighted mean with m_1 erroneously given double its actual weight.
- **(C)** $30°\text{C}$ — weighted mean with m_2 erroneously given double its actual

weight (hot and cold labels swapped in calculation).

Answer: (D) Go Back to Q 12

Sol.13.

Solution

Concept: Ampere's Circuital Law — Infinite Straight Wire

Choosing a circular Amperian loop of radius r centred on the wire, the field is uniform and tangential:

$$\oint \vec{B}\cdot d\vec{l} = \mu_0\, I_{\text{enc}} \implies B\cdot(2\pi r) = \mu_0 I \implies B = \frac{\mu_0\, I}{2\pi r}$$

Given: $I = 5\,\text{A}$, $r = 0.1\,\text{m}$, $\mu_0 = 4\pi\times 10^{-7}\,\text{T m/A}$

Step 1 — Substitute and cancel π:

$$B = \frac{4\pi\times 10^{-7}\times 5}{2\pi\times 0.1} = \frac{4\times 5\times 10^{-7}}{2\times 0.1} = \frac{20\times 10^{-7}}{0.2} = 100\times 10^{-7}\,\text{T} = 10^{-5}\,\text{T} = \mathbf{10}\,\mu\text{T}$$

Why other options are wrong:

- **(B)** $100\,\mu$T — $r = 0.01\,$m (ten times smaller) was used, giving B ten times larger.
- **(C)** $1\,\mu$T — $r = 1\,$m (ten times larger) was used, giving B ten times smaller.
- **(D)** $50\,\mu$T — π was not cancelled correctly, or I was effectively halved during arithmetic.

Answer: (A) Go Back to Q 13

Sol.14.

Solution

Concept: Alpha Decay — Conservation Laws

In alpha decay, a nucleus emits ${}^{4}_{2}\text{He}$ (the alpha particle). Conservation of mass number and atomic number gives:

$${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\text{He}$$

Given: Parent nucleus ${}^{226}_{88}\text{Ra}$

Step 1 — Daughter mass number:

$$A_d = 226 - 4 = 222$$

Step 2 — Daughter atomic number:

$$Z_d = 88 - 2 = 86$$

Step 3 — Identify the element with $Z = 86$:

$Z = 86$ is **Radon (Rn)**. The full reaction is:

$$^{226}_{88}\text{Ra} \longrightarrow\ ^{222}_{86}\textbf{Rn} + {}^{4}_{2}\text{He}$$

Why other options are wrong:

- **(A)** $^{222}_{84}$Po — $Z = 84$ (Polonium) would require the loss of *two* alpha particles from Ra, not one.
- **(C)** $^{228}_{88}$Ra — same element as parent ($Z = 88$); alpha decay always decreases Z by 2. Also the mass number $228 \neq 226 - 4$.
- **(D)** $^{224}_{86}$Rn — $Z = 86$ is correct (Rn), but $A = 224$ is wrong; alpha emission reduces A by *four*, giving $226 - 4 = 222$, not 224.

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q 14

Sol.15.

Solution

Concept: p-n Junction Diode Under Reverse Bias

When the positive terminal of the battery is connected to the n-side and the negative terminal to the p-side (reverse bias):

1. Majority holes in the p-region are attracted towards the negative terminal, *away* from the junction.
2. Majority electrons in the n-region are attracted towards the positive terminal, *away* from the junction.
3. Both majority-carrier movements widen the depletion layer, raising the potential barrier.
4. Only minority carriers (thermally generated electrons in p-side, holes in n-side) can cross the junction.
5. A very small **reverse saturation current** I_0 (typically $\sim \mu$A) flows; it is

nearly independent of the reverse voltage.

Why other options are wrong:

- **(A)** Narrows / large majority current — this is the description of *forward bias*, where the barrier is reduced and majority carriers flow freely.
- **(B)** Narrows / no current — incorrect on both counts: the depletion layer *widens* (not narrows), and a small minority-carrier current always exists.
- **(D)** Widens / large forward current — a widened depletion layer creates a high potential barrier; no large current can flow. The statement is internally contradictory.

Answer: (C) **Go Back to Q 15**

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	A	4	D	5	A
6	D	7	B	8	C	9	A	10	D
11	C	12	D	13	A	14	B	15	C