CUET 2026 May 22 Shift 2 Physics

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)

1. A long solenoid has 1000 turns per meter and carries a current of $2A$. The magnetic field inside the solenoid is:

$$(\mu_0 = 4\pi \times 10^{-7}\,TmA^{-1})$$

(A) $8\pi \times 10^{-4}\,T$
(B) $4\pi \times 10^{-4}\,T$
(C) $2\pi \times 10^{-4}\,T$
(D) $16\pi \times 10^{-4}\,T$

Correct Answer: (1) $8\pi \times 10^{-4}\,T$

Solution:

Concept:
Magnetic field inside a long solenoid is:

$$B = \mu_0 n I$$

where:

- $B =$ magnetic field
- $n =$ turns per unit length
- $I =$ current

Step 1: Write the formula.

$$B = \mu_0 n I$$

Step 2: Substitute values.

$$B = (4\pi \times 10^{-7}) \times 1000 \times 2$$

$$= 8\pi \times 10^{-4}\,T$$

Step 3: Final answer.

$$\boxed{8\pi \times 10^{-4}\,T}$$

Quick Tip: For long solenoids:

$$B \propto nI$$

Increasing turns or current increases magnetic field strength.

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2. In a series LCR circuit, resonance occurs when:

(A) $X_L > X_C$
(B) $X_C > X_L$
(C) $X_L = X_C$
(D) $R = 0$

Correct Answer: (3) $X_L = X_C$

Solution:

Concept:

In an LCR circuit:

$$X_L = \omega L$$

and

$$X_C = \frac{1}{\omega C}$$

At resonance:

$$X_L = X_C$$

which makes impedance minimum and current maximum.

Step 1: Condition for resonance.

At resonance:

$$\omega L = \frac{1}{\omega C}$$

Thus:

$$X_L = X_C$$

Step 2: Effect at resonance.

Net reactance becomes zero:

$$X = X_L - X_C = 0$$

Therefore impedance:

$$Z = R$$

becomes minimum.

Step 3: Final conclusion.

$$\boxed{X_L = X_C}$$

Quick Tip: At resonance:

$$Z = R$$

and current becomes maximum in a series LCR circuit.

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3. A semiconductor diode is forward biased. The depletion layer width will:

(A) Increase

(B) Become zero immediately

(C) Decrease

(D) Remain unchanged

Correct Answer: (3) Decrease

Solution:

Concept:

In forward bias:

- Positive terminal is connected to p-side.
- Negative terminal is connected to n-side.

This reduces the barrier potential and narrows the depletion region.

Step 1: Understand depletion region.

The depletion layer contains immobile ions and acts as a barrier to charge flow.

Step 2: Effect of forward bias.

Forward bias opposes the built-in electric field.

Hence barrier potential decreases.

Therefore depletion layer thickness decreases.

Step 3: Conclusion.

$$\boxed{\text{Depletion layer decreases}}$$

Quick Tip: Forward bias decreases barrier potential, while reverse bias increases it.

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4. The drift velocity of electrons in a conductor increases when:

(A) Temperature increases only

(B) Electric field increases

(C) Length of conductor increases

(D) Area of cross-section increases

Correct Answer: (2) Electric field increases

Solution:

Concept:

Drift velocity is:

$$v_d = \frac{eE\tau}{m}$$

where:

- $E =$ electric field
- $\tau =$ relaxation time

Thus:

$$v_d \propto E$$

Step 1: Write relation.

$$v_d = \frac{eE\tau}{m}$$

Step 2: Analyze dependence.

As electric field increases:

$$v_d$$

also increases.

Step 3: Final answer.

$$\boxed{\text{Electric field increases}}$$

Quick Tip: Current density:

$$J = nev_d$$

Hence higher drift velocity produces larger current.

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5. The magnetic field at the center of a circular coil carrying current is directly proportional to:

(A) Radius of coil

(B) Square of radius

(C) Current through coil

(D) Resistance of wire

Correct Answer: (3) Current through coil

Solution:

Concept:

Magnetic field at the center of a circular coil is:

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

where:

- N = number of turns
- I = current
- R = radius

Step 1: Observe proportionality.

From:

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

we get:

$$B \propto I$$

Step 2: Analyze options.

Magnetic field increases linearly with current.

It decreases with radius.

Step 3: Final answer.

$$\boxed{\text{Current through coil}}$$

Quick Tip: For circular loops:

$$B \propto \frac{I}{R}$$

Smaller radius produces stronger magnetic field.

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6. A charged particle enters perpendicular to a uniform magnetic field. The path followed by the particle is:

(A) Straight line

(B) Parabolic

(C) Circular

(D) Elliptical

Correct Answer: (3) Circular

Solution:

Concept:
When a charged particle moves perpendicular to a magnetic field, magnetic force acts as centripetal force.

Magnetic force:

$$F = qvB\sin\theta$$

For perpendicular motion:

$$\theta = 90^\circ$$

thus:

$$F = qvB$$

Step 1: Identify direction of force.

Magnetic force is always perpendicular to velocity.

Therefore it changes direction of velocity but not speed.

Step 2: Compare with centripetal force.

For circular motion:

$$\frac{mv^2}{r} = qvB$$

Hence:

$$r = \frac{mv}{qB}$$

Thus particle moves in a circular path.

Step 3: Final answer.

$$\boxed{\text{Circular path}}$$

Quick Tip: If velocity is perpendicular to magnetic field:

$$\vec{v} \perp \vec{B}$$

the particle performs uniform circular motion.

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7. In an AC circuit, the average value of alternating current over one complete cycle is:

(A) Maximum

(B) Minimum

(C) Infinite

(D) Zero

Correct Answer: (4) Zero

Solution:

Concept:

Alternating current changes direction periodically.

Positive half cycle and negative half cycle are equal and opposite.

Hence their net average over one full cycle becomes zero.

Step 1: Understand sinusoidal current.

AC current is generally:

$$i = I_0 \sin \omega t$$

During first half cycle:

$$i > 0$$

During second half cycle:

$$i < 0$$

Step 2: Find average over complete cycle.

Average current:

$$I_{avg} = \frac{1}{T}\int_0^T I_0 \sin\omega t \, dt$$

Since positive and negative areas cancel each other:

$$I_{avg} = 0$$

Step 3: Final conclusion.

$$\boxed{0}$$

Quick Tip: Average value of AC over a complete cycle is zero, but RMS value is non-zero.

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8. The forbidden energy gap in conductors is approximately:

(A) $0\,eV$

(B) $1\,eV$

(C) $5\,eV$

(D) $10\,eV$

Correct Answer: (1) $0\,eV$

Solution:

Concept:

In solids:

- Conductors have overlapping valence and conduction bands.

- Semiconductors have small band gap.
- Insulators have large band gap.

Step 1: Understand conductors.

In conductors:

$$E_g \approx 0$$

Valence band and conduction band overlap.

Hence electrons move freely.

Step 2: Compare with semiconductors and insulators.

- Semiconductor:

$$E_g \approx 1\,eV$$

- Insulator:

$$E_g > 5\,eV$$

Thus conductor has negligible forbidden gap.

Step 3: Final answer.

$$\boxed{0\,eV}$$

Quick Tip: Smaller band gap means easier movement of electrons and higher conductivity.

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9. The self inductance of a coil depends upon:

(A) Number of turns only

(B) Magnetic permeability of core only

(C) Geometry of coil and medium

(D) Current flowing through coil

Correct Answer: (3) Geometry of coil and medium

Solution:

Concept:

Self inductance is:

$$L = \frac{\mu_0 \mu_r N^2 A}{l}$$

where:

- N = number of turns
- A = area
- l = length
- μ_r = relative permeability

Step 1: Analyze dependence.

From formula:

$$L \propto \mu_r$$

and

$$L \propto \frac{N^2 A}{l}$$

Thus inductance depends upon:

- Shape and dimensions of coil
- Nature of core material

Step 2: Check options.

Only option involving geometry and medium correctly represents all dependencies.

Step 3: Final answer.

$$\boxed{\text{Geometry of coil and medium}}$$

Quick Tip: Greater number of turns and magnetic permeability increase self inductance.

10. The efficiency of an ideal transformer is:

(A) 25%

(B) 50%

(C) 75%

(D) 100%

Correct Answer: (4) 100%

Solution:

Concept:

Efficiency of transformer:

$$\eta = \frac{\text{Output Power}}{\text{Input Power}} \times 100$$

An ideal transformer has:

- No flux leakage
- No copper loss
- No hysteresis loss
- No eddy current loss

Step 1: Understand ideal transformer.

In ideal transformer:

$$P_{in} = P_{out}$$

Thus:

$$\eta = \frac{P_{out}}{P_{in}} \times 100 = 100\%$$

Step 2: Final answer.

$$\boxed{100\%}$$

Quick Tip: Practical transformers always have efficiency less than 100% due to energy losses.