CUET 2026 May 19 Shift 1 Physics

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)

General Instructions

(i) The examination will be conducted in Computer-Based Test (CBT) mode.

(ii) Each question carries +5 marks for correct answer and -1 mark for wrong answer.

(iii) The total number of questions are 50.

(iv) Duration of the exam is 1 hour (60 minutes).

1. In Young's double slit experiment, if the distance between the slits is increased while keeping all other parameters constant, the fringe width will:

(A) Increase

(B) Decrease

(C) Remain unchanged

(D) First increase then decrease

Correct Answer: (B) Decrease

Solution:

Concept: In Young's Double Slit Experiment (YDSE), the spatial separation between consecutive bright or dark fringes on the screen is defined as the fringe width (β). The mathematical formula governing the fringe width is given by:

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

Where:

- λ is the wavelength of the monochromatic light source used.
- D is the perpendicular distance between the plane containing the double slits and the observation screen.

- d is the distance between the two slits (S_1 and S_2).

Step 1: Analyze the mathematical relationship between variables.

From the standard formula, we can isolate how the fringe width β reacts specifically to adjustments in the slit separation distance d when the wavelength λ and the screen distance D are held completely constant:

$$\beta \propto \frac{1}{d}$$

This demonstrates an inverse proportionality between the fringe width and the distance separating the two slits.

Step 2: Evaluate the effect of increasing the slit distance.

Because β and d are inversely proportional, any increase in the slit separation distance d will automatically cause the fringe width β to diminish. Physically, this means the interference fringes on the observation screen will contract and pack closer together.

Quick Tip: Remember the inverse relationship: $\beta \propto \frac{1}{d}$. If you push the two slits further apart ($d \uparrow$), the interference pattern on the screen shrinks and compresses, meaning the fringe width must decrease ($\beta \downarrow$).

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2. The dimensional formula of capacitance is:

(A) $[M^{-1}L^{-2}T^4A^2]$

(B) $[ML^2T^{-2}A^{-2}]$

(C) $[M^{-1}L^{-1}T^3A]$

(D) $[MLT^{-3}A^{-1}]$

Correct Answer: (A) $[M^{-1}L^{-2}T^4A^2]$

Solution:

Concept: The capacitance (C) of a conductor is defined as the ratio of the magnitude of the electric charge (Q) on it to its electric potential (V):

$$C = \frac{Q}{V}$$

By evaluating the dimensional formulas of charge and electric potential back to fundamental SI units (Mass $[M]$, Length $[L]$, Time $[T]$, and Electric Current $[A]$), we can derive the dimensions of capacitance.

Step 1: Find the dimensional formulas for Charge (Q) and Work (W).

- Electric charge is current multiplied by time ($Q = I \cdot t$):

$$[Q] = [A^1 T^1]$$

- Mechanical Work or Energy is force times distance ($W = F \cdot s = m \cdot a \cdot s$):

$$[W] = [M^1 L^2 T^{-2}]$$

Step 2: Derive the dimensional formula for Electric Potential (V).

Electric potential is defined as the work done per unit charge ($V = \frac{W}{Q}$):

$$[V] = \frac{[M^1 L^2 T^{-2}]}{[A^1 T^1]} = [M^1 L^2 T^{-3} A^{-1}]$$

Step 3: Calculate the dimensions of Capacitance (C).

Now substitute the dimensional formulas of Q and V back into our baseline capacitance definition ($C = \frac{Q}{V}$):

$$[C] = \frac{[A^1 T^1]}{[M^1 L^2 T^{-3} A^{-1}]}$$

Using exponent rules to shift all base parameters to the numerator:

$$[C] = [M^{-1} L^{-2} T^{1-(-3)} A^{1-(-1)}] = [M^{-1} L^{-2} T^4 A^2]$$

Quick Tip: Capacitance is highly storage-effective, meaning it has large positive powers for Time (T^4) and Current (A^2), while Mass (M^{-1}) and Length (L^{-2}) are negative. Memorizing the structural signature $[-1, -2, 4, 2]$ helps identify option (A) instantly.

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3. Polarisation of light proves that light waves are:

(A) Longitudinal

(B) Transverse

(C) Stationary

(D) Electromagnetic only in vacuum

Correct Answer: (B) Transverse

Solution:

Concept: Wave propagation can be classified based on the orientation of particle or field oscillations relative to the direction of energy travel. Polarization is an optical phenomenon where oscillations are restricted to a single plane perpendicular to the direction of propagation.

Step 1: Differentiate between longitudinal and transverse wave traits.

- **Longitudinal Waves:** The oscillations occur parallel to the direction of wave travel (e.g., sound waves). Because their vibrations point along the axis of movement, they look symmetrical from all sides and cannot be polarized.

- **Transverse Waves:** The oscillations occur perpendicular to the direction of wave travel (e.g., strings, light). Since these vibrations happen along a perpendicular plane, they can be restricted to a single line or direction within that plane.

Step 2: Analyze the implication of light polarization.

Interference and diffraction confirm that light behaves as a wave, but they do not reveal its specific directional nature. Because light can be polarized using a polaroid crystal—filtering out all orientations except a single perpendicular plane—it serves as definitive, direct experimental proof that light waves must be Transverse waves.

Quick Tip: Keep this clear rule in mind: Common wave behaviors like Interference and Diffraction happen for *both* longitudinal and transverse waves. However, Polarization is a unique property *exclusively* possible for Transverse Waves.

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4. The work function of a metal is 2 eV. Photoelectric emission will occur when the metal is

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illuminated with light of energy:

(A) 1 eV

(B) 1.5 eV

(C) 2.5 eV

(D) 2 eV only

Correct Answer: (C) 2.5 eV

Solution:

Concept: According to Einstein's Photoelectric Equation, photoelectric emission is an instantaneous, one-to-one interaction between an incoming photon and a bound electron. The energy (E) of the incident photon must satisfy:

$$E = \phi_0 + K_{\max}$$

Where:

- ϕ_0 is the work function of the metal (the minimum threshold energy required to just liberate an electron from the metal surface).
- $K_{\max}$ is the maximum kinetic energy of the ejected photoelectron.

Step 1: Establish the conditional rule for electron emission.

For an electron to successfully escape the metal surface, the energy of the incident photon (E) must be greater than or equal to the metal's work function (ϕ_0):

$$E \geq \phi_0$$

- If $E < \phi_0$: The photon doesn't have enough energy to break the electron's atomic bonds, so no emission occurs, regardless of light intensity or duration.
- If $E \geq \phi_0$: Electron emission happens instantly, and any leftover energy becomes kinetic energy ($K_{\max} = E - \phi_0$).

Step 2: Evaluate the given energy options against the threshold.

The metal's work function is given as $\phi_0 = 2$ eV. Let us check each option:

- Option (A): 1 eV $<$ 2 eV $\rightarrow$ No emission.

- Option (B): 1.5 eV $<$ 2 eV $\rightarrow$ No emission.

- Option (C): 2.5 eV $>$ 2 eV $\rightarrow$ Emission occurs successfully, and the electron retains 0.5 eV of kinetic energy.

Quick Tip: Think of the work function as an escape toll. If the toll is $2, any incoming photon with less than $2 will fail. Only an option strictly equal to or higher than the toll—like 2.5 eV—can trigger emission.

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5. In a moving coil galvanometer, the magnetic field is made radial so that the:

(A) Resistance decreases

(B) Current sensitivity decreases

(C) Deflection becomes directly proportional to current

(D) Coil does not rotate

Correct Answer: (C) Deflection becomes directly proportional to current

Solution:

Concept: A moving coil galvanometer measures small electric currents using a current-carrying coil suspended in a uniform magnetic field. The deflecting torque (τ_d) experienced by a coil with N turns, area A, carrying current I in a magnetic field B is:

$$\tau_d = NIAB \sin\theta$$

Where θ is the angle between the normal to the plane of the coil and the magnetic field lines.

Step 1: Understand the purpose and geometry of a radial magnetic field.

By using cylindrically concave permanent magnet poles alongside a soft iron core at the center, the magnetic field lines are bent radially. This ensures that as the coil rotates, its plane remains parallel to the magnetic field lines at all positions.

Consequently, the angle between the normal to the coil's area and the field lines is always kept at exactly $\theta = 90^\circ$. Since $\sin(90^\circ) = 1$, the deflecting torque formula simplifies to its maximum value:

$$\tau_d = NIAB$$

Step 2: Link torque equilibrium to scale linearity.

The rotation is resisted by a suspension spring that creates a restoring torque ($\tau_r = k\alpha$), where k is the torsional spring constant and α is the angular deflection. At equilibrium:

$$\tau_r = \tau_d \implies k\alpha = NIAB$$

Solving for the angular deflection (α):

$$\alpha = \left(\frac{NAB}{k}\right)I \implies \alpha \propto I$$

Because the magnetic field is radial, the non-linear $\sin\theta$ term is eliminated. This makes the scale perfectly linear, meaning the angular Deflection is directly proportional to the current flowing through it.

Quick Tip: A radial magnetic field ensures that $\sin\theta = 1$ at all times. This eliminates angular distortion from the torque equation, ensuring a linear scale where deflection changes directly with current ($\alpha \propto I$).

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6. The SI unit of magnetic flux is:

(A) Tesla

(B) Weber

(C) Henry

(D) Coulomb

Correct Answer: (B) Weber

Solution:

Concept: Magnetic flux (Φ_B) measures the total magnetic field lines passing perpendicularly through a given surface area. It is calculated as the dot product of the magnetic field vector ($\vec{B}$) and the area vector ($\vec{A}$):

$$\Phi_B = \vec{B} \cdot \vec{A} = BA\cos\theta$$

Step 1: Evaluate the SI metrics and define the units.

Since the SI unit for the magnetic field (B) is the Tesla (T) and the SI unit for area (A) is the

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square meter (m^2), the derived unit for magnetic flux is:

$$1 \text{ Unit of Magnetic Flux} = 1 \text{ Tesla} \cdot m^2$$

This composite metric ($T \cdot m^2$) is officially named the Weber (Wb) in honor of German physicist Wilhelm Eduard Weber.

Step 2: Differentiate other units listed in the choices.

To avoid confusion in future questions, let's review the other units:

- **Tesla (T):** The SI unit for magnetic field intensity or magnetic flux density.
- **Henry (H):** The SI unit for electrical inductance (both self and mutual inductance).
- **Coulomb (C):** The SI unit for electric charge.

Therefore, the Weber is the correct unit for magnetic flux.

Quick Tip: Be careful not to confuse Magnetic Field with Magnetic Flux. Field strength is measured in Tesla, while total Flux over an area is measured in Weber ($1 \text{ Wb} = 1 \text{ T} \cdot m^2$).

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7. In an electromagnetic wave, the electric field and magnetic field are:

(A) Parallel to each other

(B) Anti-parallel to each other

(C) Perpendicular to each other and to the direction of propagation

(D) Parallel to the direction of propagation

Correct Answer: (C) Perpendicular to each other and to the direction of propagation

Solution:

Concept: Electromagnetic waves (EM waves) are self-propagating transverse oscillations of electric and magnetic fields traveling through space. Their transverse nature is directly defined by Maxwell's equations.

Step 1: Analyze the spatial orientation of field vectors.

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In an electromagnetic wave, the oscillating electric field vector ($\vec{E}$) and the magnetic field vector ($\vec{B}$) vary in phase, but they oscillate along paths that are exactly perpendicular (at 90°) to one another.

Step 2: Determine orientation relative to the direction of wave travel.

The direction in which the EM wave carries energy is given by the Poynting vector ($\vec{S}$), which follows the right-hand cross product rule:

$$\vec{S} = \frac{1}{\mu_0}\left(\vec{E} \times \vec{B}\right)$$

Because the cross product of two vectors is always Perpendicular to both of them, the direction of wave propagation is simultaneously perpendicular to both the electric field $\vec{E}$ and the magnetic field $\vec{B}$. Thus, $\vec{E}$, $\vec{B}$, and the propagation vector $\vec{k}$ form a mutually orthogonal triad.

Quick Tip: Remember the Mutually Orthogonal Rule for EM waves: The electric field, the magnetic field, and the direction of wave travel are all at right angles (90°) to one another.

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8. The half-life of a radioactive substance is 10 days. The fraction of the original sample left after 30 days is:

(A) 1/2

(B) 1/4

(C) 1/6

(D) 1/8

Correct Answer: (D) 1/8

Solution:

Concept: Radioactive decay follows first-order kinetics. The half-life ($T_{1/2}$) is the time required for a radioactive sample to decay to exactly half of its initial amount. The remaining fraction of active nuclei after a total time t can be calculated using the formula:

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n$$

Where:

- N_0 is the initial number of radioactive nuclei at time $t = 0$.
- N is the number of active nuclei left after time t.
- n is the total number of elapsed half-lives ($n = \frac{t}{T_{1/2}}$).

Step 1: Calculate the total number of elapsed half-lives (n).

Given parameters from the text:

- Half-life ($T_{1/2}$) = 10 days
- Total decay tracking period (t) = 30 days

$$n = \frac{t}{T_{1/2}} = \frac{30}{10} = 3 \text{ half-lives}$$

Step 2: Calculate the remaining fraction.

Substitute $n = 3$ back into the remaining fraction equation:

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^3 = \frac{1}{2 \times 2 \times 2} = \frac{1}{8}$$

Therefore, exactly 1/8th of the original radioactive sample remains after 30 days.

Quick Tip: You can track this step-by-step: Start at 1 $\rightarrow$ after 10 days $\rightarrow$ 1/2 $\rightarrow$ after 20 days $\rightarrow$ 1/4 $\rightarrow$ after 30 days $\rightarrow$ 1/8.

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9. The focal length of a convex lens is 20 cm. An object is placed at 40 cm from the lens. The image formed will be:

(A) Virtual and erect

(B) Real and inverted

(C) Virtual and inverted

(D) Real and erect

Correct Answer: (B) Real and inverted

Solution:

Concept: Ray optics principles for a converging (convex) lens establish predictable image

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characteristics based on where the object is located relative to the lens's focal point (F) and center of curvature ($2F$).

Step 1: Analyze the object placement relative to the focal metrics.
Let's look at the given values from the problem:

- Focal length (f) $= +20$ cm
- Center of curvature distance ($2f$) $= 2 \times 20$ cm $= 40$ cm
- Object distance (u) $= -40$ cm

This shows that the object is placed exactly at the center of curvature ($2F$) on the left side of the convex lens.

Step 2: Apply the lens principles to determine image traits.
When an object is located exactly at $2F_1$ for a convex lens:

- The image is formed on the opposite side of the lens at exactly $2F_2$ ($v = +40$ cm).
- The image is the exact same size as the object ($m = -1$).
- The light rays physically converge at that point, making the image Real and Inverted.

Quick Tip: Whenever an object is placed at $2F$ ($u = 2f = 40$ cm) for a convex lens, the image is formed on the other side at $2F$. Like all real images formed by a single lens, it is Real and Inverted.

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10. The magnetic field at the center of a circular current carrying loop depends on:

(A) Only the radius of the loop

(B) Only the current flowing

(C) Current and radius of the loop

(D) Resistance of the wire only

Correct Answer: (C) Current and radius of the loop

Solution:

Concept: The Biot-Savart Law allows us to calculate the magnetic field induction (B) generated

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at the center of a circular wire loop carrying a steady current. The derived formula for a loop with N turns is:

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

Where:

- μ_0 is the permeability of free space constant ($4\pi \times 10^{-7}\ \mathrm{T \cdot m/A}$).
- N is the number of turns in the circular wire loop.
- I is the electric current flowing through the loop.
- r is the radius of the circular loop.

Step 1: Isolate the operational variables.
From the formula, we can see that for a given loop configuration, the magnetic field strength depends directly on two main physical properties:

- It is directly proportional to the current (I) flowing through the wire ($B \propto I$).
- It is inversely proportional to the radius (r) of the circular loop ($B \propto \frac{1}{r}$).

Therefore, the magnetic field at the center depends on both the Current and the radius of the loop.

Quick Tip: Keep the center field formula in mind: $B = \frac{\mu_0 I}{2r}$. This tells you right away that the magnetic field changes based on both the amount of current (I) and the radius (r) of the loop.

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