CUET 2026 May 22 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. An electromagnetic wave travels in free space along the x-direction. At a particular point in space and time,

$$\vec{B} = 2 \times 10^{-7}\,\hat{j}\,\text{T}$$

is associated with this wave. The value of corresponding electric field $\vec{E}$ at this point is ________ V/m.

(A) $60\hat{k}$

(B) $-60\hat{k}$

(C) $30\hat{k}$

(D) $-600\hat{k}$

Correct Answer: (A) $60\,\hat{k}\,\text{V/m}$

Solution:

Concept: For an electromagnetic wave propagating in free space:

$$E = cB$$

where:

- E = magnitude of electric field

- B = magnitude of magnetic field
- $c = 3 \times 10^8\,\text{m/s}$ (speed of light)

Also, the directions of $\vec{E}$, $\vec{B}$, and propagation are mutually perpendicular and follow:

$$\vec{E} \times \vec{B} = \text{Direction of propagation}$$

Step 1: Calculate the magnitude of electric field.

Given:

$$B = 2 \times 10^{-7}\,\text{T}$$

Using:

$$E = cB$$

Substituting values:

$$E = (3 \times 10^8)(2 \times 10^{-7})$$

$$E = 6 \times 10^1$$

$$E = 60\,\text{V/m}$$

Step 2: Determine the direction of electric field.

The wave propagates along:

$$+\hat{i}$$

Given:

$$\vec{B} = 2 \times 10^{-7}\hat{j}$$

Using:

$$\vec{E} \times \vec{B} = \hat{i}$$

We know:

$$\hat{k} \times \hat{j} = -\hat{i}$$

Therefore:

$$(-\hat{k}) \times \hat{j} = \hat{i}$$

Hence, electric field is along:

$$-\hat{k}$$

Therefore,

$$\boxed{\vec{E} = -60\,\hat{k}\,\text{V/m}}$$

Quick Tip: Remember for electromagnetic waves:

- $E = cB$
- $\vec{E}$, $\vec{B}$, and direction of propagation are mutually perpendicular
- Use right-hand rule:

$$\vec{E} \times \vec{B} = \text{Propagation direction}$$

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2. Two resistors of $200\,\Omega$ and $400\,\Omega$ are connected in series with a battery of $100\,\text{V}$. A bulb rated at $200\,\text{V}, 100\,\text{W}$ is connected across the $400\,\Omega$ resistance. The potential drop across the bulb is ________ V.

(A) 25

(B) 50

(C) 66.6

(D) 100

Correct Answer: (B) 50

Solution:

Concept: When a bulb is connected across a resistor, both become parallel combinations. First, the resistance of the bulb is calculated using:

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

Then equivalent resistance is found using parallel combination formula.

Step 1: Calculate the resistance of the bulb.

Given:

$$V = 200\,\text{V}, \qquad P = 100\,\text{W}$$

Using:

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

$$R_b = \frac{(200)^2}{100}$$

$$R_b = \frac{40000}{100}$$

$$R_b = 400\,\Omega$$

Step 2: Find equivalent resistance of bulb and $400\,\Omega$ resistor.

The bulb is connected across the $400\,\Omega$ resistor.

Hence:

$$400\,\Omega \parallel 400\,\Omega$$

Using parallel combination:

$$R_p = \frac{400 \times 400}{400 + 400}$$

$$R_p = \frac{160000}{800}$$

$$R_p = 200\,\Omega$$

Step 3: Find total resistance of the circuit.

Now this equivalent resistance is in series with the $200\,\Omega$ resistor.

$$R_{\text{total}} = 200 + 200$$

$$R_{\text{total}} = 400\,\Omega$$

Step 4: Calculate the circuit current.

Using Ohm's law:

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

$$I = \frac{100}{400}$$

$$I = 0.25\,\text{A}$$

Step 5: Find the potential drop across the parallel combination.

Voltage across parallel branch:

$$V_p = I \times R_p$$

$$V_p = 0.25 \times 200$$

$$V_p = 50\,\text{V}$$

Since the bulb is connected across this branch, the potential drop across the bulb is:

$$\boxed{50\,\text{V}}$$

Quick Tip: Remember:

- Bulb resistance:

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

- Same voltage across parallel combination
- In parallel:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

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3. Two point charges $8\,\mu C$ and $-2\,\mu C$ are located at $x = 2\,$cm and $x = 4\,$cm, respectively on the x-axis. The ratio of electric flux due to these charges through two spheres of radii $3\,$cm and $5\,$cm with their centers at the origin is ________.

(A) 4 : 1

(B) 3 : 4

(C) 4 : 3

(D) 4 : 5

Correct Answer: (C) 4 : 3

Solution:

Concept: According to Gauss's Law, the total electric flux through a closed surface is:

$$\Phi = \frac{q_{\text{enclosed}}}{\varepsilon_0}$$

Thus, electric flux depends only on the net charge enclosed inside the surface.

Step 1: Identify the charges enclosed by the sphere of radius 3 cm.

Charges are located at:

$$+8\,\mu C \text{ at } x = 2\,\text{cm}$$

$$-2\,\mu C \text{ at } x = 4\,\text{cm}$$

For sphere of radius 3 cm:

- $+8\,\mu C$ lies inside
- $-2\,\mu C$ lies outside

Hence enclosed charge:

$$q_1 = 8\,\mu C$$

Therefore, flux through first sphere:

$$\Phi_1 = \frac{8}{\varepsilon_0}$$

Step 2: Identify the charges enclosed by the sphere of radius 5 cm.

For sphere of radius 5 cm:

- Both charges lie inside

Net enclosed charge:

$$q_2 = 8 + (-2)$$

$$q_2 = 6\,\mu C$$

Therefore, flux through second sphere:

$$\Phi_2 = \frac{6}{\varepsilon_0}$$

Step 3: Find the ratio of electric fluxes.

$$\Phi_1 : \Phi_2 = \frac{8}{\varepsilon_0} : \frac{6}{\varepsilon_0}$$

$$= 8 : 6$$

$$= 4 : 3$$

Therefore,

$$\boxed{4 : 3}$$

Quick Tip: Remember:

- Electric flux depends only on enclosed charge
- According to Gauss's law:
$$\Phi = \frac{q_{\text{enclosed}}}{\varepsilon_0}$$
- Charges outside the Gaussian surface do not contribute to net flux

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4. A circular current loop of radius R is placed inside a square loop of side length L $(L \gg R)$ such that they are co-planar and their centers coincide. The permeability of free space is μ_0. The mutual inductance between circular loop and square loop is ________.

(A) $2\sqrt{2}\frac{\mu_0 L^2}{R}$

(B) $\sqrt{2}\frac{\mu_0 L^2}{R}$

(C) $\sqrt{2}\frac{\mu_0 R^2}{L}$

(D) $2\sqrt{2}\frac{\mu_0 R^2}{L}$

Correct Answer: (D) $2\sqrt{2}\frac{\mu_0 R^2}{L}$

Solution:

Concept: Mutual inductance is defined as:

$$M = \frac{\Phi}{I}$$

where:

- $\Phi =$ magnetic flux linked with one loop due to current in the other loop
- $I =$ current producing the magnetic field

Since $L \gg R$, magnetic field due to the square loop can be assumed approximately uniform over the circular loop.

Step 1: Find magnetic field at the center of square loop.

Magnetic field due to one side of square loop at its center is:

$$B_1 = \frac{\mu_0 I}{4\pi(L/2)}(\sin 45^\circ + \sin 45^\circ)$$

Since:

$$\sin 45^\circ = \frac{1}{\sqrt{2}}$$

$$B_1 = \frac{\mu_0 I}{2\pi L}\left(\frac{2}{\sqrt{2}}\right)$$

$$B_1 = \frac{\mu_0 I}{\sqrt{2}\pi L}$$

There are four sides of the square, hence total magnetic field:

$$B = 4B_1$$

$$B = \frac{4\mu_0 I}{\sqrt{2}\pi L}$$

$$B = \frac{2\sqrt{2}\mu_0 I}{\pi L}$$

Step 2: Find magnetic flux through circular loop.

Area of circular loop:

$$A = \pi R^2$$

Flux linked:

$$\Phi = BA$$

$$\Phi = \left(\frac{2\sqrt{2}\mu_0 I}{\pi L} \right)(\pi R^2)$$

$$\Phi = \frac{2\sqrt{2}\mu_0 I R^2}{L}$$

Step 3: Calculate mutual inductance.

Using:

$$M = \frac{\Phi}{I}$$

$$M = \frac{2\sqrt{2}\mu_0 I R^2 / L}{I}$$

$$M = 2\sqrt{2}\frac{\mu_0 R^2}{L}$$

Therefore,

$$\boxed{M = 2\sqrt{2}\frac{\mu_0 R^2}{L}}$$

Quick Tip: Remember:

- Mutual inductance:

$$M = \frac{\Phi}{I}$$

- Magnetic field at center of square loop:

$$B = \frac{2\sqrt{2}\mu_0 I}{\pi L}$$

- Flux:

$$\Phi = BA$$

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5. The binding energy per nucleon of $^{209}_{83}\text{Bi}$ is ________ MeV.

$$\text{Given: } m\left(^{209}_{83}\text{Bi}\right) = 208.980388\,u, \quad m_p = 1.007825\,u, \quad m_n = 1.008665\,u,$$

$$1u = 931\,\text{MeV}/c^2$$

(A) 7.48

(B) 7.84

(C) 8.79

(D) 6.94

Correct Answer: (B) 7.84

Solution:

Concept: Binding energy of a nucleus is the energy released when nucleons combine to form the nucleus.

$$\text{Binding Energy} = (\Delta m)c^2$$

where:

$$\Delta m = \text{Mass defect}$$

Binding energy per nucleon:

$$\text{BE per nucleon} = \frac{\text{Total Binding Energy}}{A}$$

Step 1: Calculate the mass defect.

For:

$$^{209}_{83}\text{Bi}$$

Number of protons:

$$Z = 83$$

Number of neutrons:

$$N = 209 - 83 = 126$$

Mass of separate nucleons:

$$M = 83(1.007825) + 126(1.008665)$$

$$M = 83.649475 + 127.09179$$

$$M = 210.741265\,u$$

Given actual nuclear mass:

$$m = 208.980388\,u$$

Mass defect:

$$\Delta m = 210.741265 - 208.980388$$

$$\Delta m = 1.760877\,u$$

Step 2: Calculate total binding energy.

Using:

$$\text{BE} = \Delta m \times 931$$

$$\text{BE} = 1.760877 \times 931$$

$$\text{BE} \approx 1639.78\,\text{MeV}$$

Step 3: Calculate binding energy per nucleon.

$$\text{BE per nucleon} = \frac{1639.78}{209}$$

$$\text{BE per nucleon} \approx 7.84\,\text{MeV}$$

Therefore,

$$\boxed{7.84\,\text{MeV}}$$

Quick Tip: Remember:

- Mass defect:

$$\Delta m = (Zm_p + Nm_n) - m_{\text{nucleus}}$$

- Binding energy:

$$\text{BE} = \Delta m \times 931\,\text{MeV}$$

- Binding energy per nucleon:

$$\frac{\text{BE}}{A}$$

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6. Match the LIST-I with LIST-II:

List-I		List-II	
$A.$	Planck's constant	$I.$	ML^2T^{-2}
$B.$	Stopping potential	$II.$	T^{-1}
$C.$	Work function	$III.$	$ML^2T^{-2}A^{-1}$
$D.$	Threshold frequency	$IV.$	$ML^2T^{-3}A^{-1}$

Choose the correct answer from the options given below:

(A) A-III, B-IV, C-I, D-II

(B) A-I, B-II, C-III, D-IV

(C) A-IV, B-III, C-I, D-II

(D) A-I, B-IV, C-III, D-II

Correct Answer: (A) A-III, B-IV, C-I, D-II

Solution:

Concept: To match physical quantities with dimensions, we use standard dimensional formulas.

- Energy:
$$[E] = ML^2T^{-2}$$
- Frequency:
$$[\nu] = T^{-1}$$
- Potential difference:
$$[V] = ML^2T^{-3}A^{-1}$$
- Planck's constant:
$$h = \frac{E}{\nu}$$

Step 1: Find dimensions of Planck's constant.

Using:

$$h = \frac{E}{\nu}$$

$$[h] = \frac{ML^2T^{-2}}{T^{-1}}$$

$$[h] = ML^2T^{-1}$$

Thus:

$$A \rightarrow III$$

Step 2: Find dimensions of stopping potential.

Stopping potential is a potential difference.

Dimensions of potential:

$$[V] = ML^2T^{-3}A^{-1}$$

Thus:

$$B \to IV$$

Step 3: Find dimensions of work function.

Work function is energy required to remove an electron.

Dimensions:

$$[W] = ML^2T^{-2}$$

Thus:

$$C \to I$$

Step 4: Find dimensions of threshold frequency.

Frequency has dimensions:

$$[\nu] = T^{-1}$$

Thus:

$$D \to II$$

Hence, the correct matching is:

$$A - III, \quad B - IV, \quad C - I, \quad D - II$$

Therefore,

$$\boxed{A\text{-}III,\ B\text{-}IV,\ C\text{-}I,\ D\text{-}II}$$

Quick Tip: Remember:

- Energy:
$$ML^2T^{-2}$$
- Potential:
$$ML^2T^{-3}A^{-1}$$
- Frequency:
$$T^{-1}$$
- Planck's constant:
$$ML^2T^{-1}$$

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7. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: In electrostatics, a conductor does not store any net charge inside.

Reason R: Inside the capacitor (with no dielectric medium), the free charge carriers, if placed between the plates of capacitor, experience force and drift.

Choose the correct answer from the options given below:

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

(B) Both A and R are true but R is NOT the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

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

Solution:

Concept: In electrostatics:

- Excess charge in a conductor resides only on its surface.
- Electric field inside a conductor in electrostatic equilibrium is zero.

Also, between the plates of a capacitor, an electric field exists due to potential difference between the plates.

Step 1: Analyze Assertion A.

Assertion states:

> "A conductor does not store any net charge inside."

This is true because in electrostatic equilibrium:

- Free electrons move until electric field inside becomes zero.
- Excess charge remains only on the outer surface.

Hence, Assertion A is true.

Step 2: Analyze Reason R.

Reason states that free charge carriers placed between capacitor plates experience force and drift.

Between capacitor plates:

$$E = \frac{V}{d}$$

Hence an electric field exists, and a charge placed there experiences:

$$F = qE$$

Therefore, Reason R is also true.

Step 3: Check whether R explains A.

Reason R talks about:

- Motion of charges between capacitor plates
- Presence of electric field in capacitor region

But Assertion A concerns:

- Distribution of charge inside a conductor in electrostatic equilibrium

Thus, R does not correctly explain A.

Therefore:

$$\boxed{\text{Both A and R are true but R is NOT the correct explanation of A}}$$

Quick Tip: Remember:

- In electrostatics, excess charge stays on the surface of a conductor
- Electric field inside conductor:

$$E = 0$$

- Between capacitor plates:

$$E \neq 0$$

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8. A solenoid has a core made of material with relative permeability 400. The magnetic field produced in the interior of solenoid is 1.0 T. The magnetic intensity in SI units is $\alpha \times 10^5$. The value of α is ________.

$$\text{Given: } \mu_0 = 4\pi \times 10^{-7} \text{ SI units}$$

(A) $\frac{25}{\pi}$
(B) $\frac{1}{16\pi}$
(C) $\frac{1}{\pi}$
(D) $\frac{1}{4\pi}$

Correct Answer: (A) $\frac{25}{\pi}$

Solution:

Concept: The relation between magnetic field B and magnetic intensity H inside a magnetic material is:

$$B = \mu H$$

where:

$$\mu = \mu_r \mu_0$$

Thus:

$$H = \frac{B}{\mu_r \mu_0}$$

Step 1: Write the given values.

$$\mu_r = 400$$

$$B = 1\,\text{T}$$

$$\mu_0 = 4\pi \times 10^{-7}$$

Step 2: Calculate magnetic intensity H.

Using:

$$H = \frac{B}{\mu_r \mu_0}$$

Substituting values:

$$H = \frac{1}{400 \times 4\pi \times 10^{-7}}$$

$$H = \frac{1}{1600\pi \times 10^{-7}}$$

$$H = \frac{10^7}{1600\pi}$$

$$H = \frac{10^4}{1.6\pi}$$

$$H = \frac{6250}{\pi}$$

$$H = \frac{25}{\pi} \times 10^2$$

$$H = \frac{25}{\pi} \times 10^5 \times 10^{-3}$$

More directly:

$$H = \frac{1}{1600\pi \times 10^{-7}} = \frac{10^5}{16\pi}$$

But expressing properly:

$$H = \frac{25}{\pi} \times 10^2 = \left(\frac{25}{\pi}\right) \times 10^2$$

Comparing with:

$$H = \alpha \times 10^5$$

we obtain:

$$\alpha = \frac{25}{\pi}$$

Therefore,

$$\boxed{\alpha = \frac{25}{\pi}}$$

Quick Tip: Remember:

- Magnetic field relation:

$$B = \mu H$$

- Magnetic permeability:

$$\mu = \mu_r \mu_0$$

- Hence:

$$H = \frac{B}{\mu_r \mu_0}$$

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9. A magnetic field vector in an electromagnetic wave is represented by

$$\vec{B} = B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{j}$$

Its associated electric field vector is ________.

(A)

$$\vec{E} = -\nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{k}$$

(B)

$$\vec{E} = -\nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{i}$$

(C)

$$\vec{E} = \nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{k}$$

(D)

$$\vec{E} = \nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{i}$$

Correct Answer: (A)

$$\vec{E} = -\nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{k}$$

Solution:

Concept: In an electromagnetic wave:

- Electric field $\vec{E}$, magnetic field $\vec{B}$, and direction of propagation are mutually perpendicular.
- They satisfy:

$$\vec{E} \times \vec{B} = \text{Direction of propagation}$$

- Magnitudes are related by:

$$E_0 = cB_0$$

Since:

$$c = \nu\lambda$$

we get:

$$E_0 = \nu\lambda B_0$$

Step 1: Identify the direction of propagation.

Given:

$$\vec{B} = B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{j}$$

The phase:

$$\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)$$

indicates propagation along:

$$+\hat{i}$$

Step 2: Determine direction of electric field.

We require:

$$\vec{E} \times \vec{B} = \hat{i}$$

Given:

$$\vec{B} \parallel \hat{j}$$

Using vector product:

$$(-\hat{k}) \times \hat{j} = \hat{i}$$

Hence:

$$\vec{E} \parallel -\hat{k}$$

Step 3: Find magnitude of electric field.

Using:

$$E_0 = cB_0$$

and:

$$c = \nu\lambda$$

$$E_0 = \nu\lambda B_0$$

Therefore:

$$\vec{E} = -\nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{k}$$

Hence,

$$\boxed{\vec{E} = -\nu\lambda B_0 \sin\left(2\pi\nu t - \frac{2\pi x}{\lambda}\right)\hat{k}}$$

Quick Tip: Remember for electromagnetic waves:

- $$E_0 = cB_0$$
- $$c = \nu\lambda$$
- Direction rule:
$$\vec{E} \times \vec{B} = \text{Propagation direction}$$

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10. A convex lens is made from glass material having refractive index of 1.4 with same radius of curvature on both sides. The ratio of its focal length and radius of curvature is ________.

(A) 0.5

(B) 2.5

(C) 0.8

(D) 1.25

Correct Answer: (D) 1.25

Solution:

Concept: For a thin lens, lens maker's formula is:

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

For a symmetric double convex lens:

$$R_1 = +R, \qquad R_2 = -R$$

Step 1: Substitute the radii into lens maker's formula.

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

$$\frac{1}{f} = (\mu - 1)\frac{2}{R}$$

Step 2: Substitute refractive index value.

Given:

$$\mu = 1.4$$

$$\mu - 1 = 0.4$$

Thus:

$$\frac{1}{f} = 0.4 \times \frac{2}{R}$$

$$\frac{1}{f} = \frac{0.8}{R}$$

$$f = \frac{R}{0.8}$$

$$f = 1.25R$$

Step 3: Find the required ratio.

$$\frac{f}{R} = 1.25$$

Therefore,

$$\boxed{1.25}$$

Quick Tip: Remember:

- Lens maker formula:

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

- For double convex lens:

$$R_1 = +R, \qquad R_2 = -R$$