CUET 2026 May 25 Shift 2 Physics

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)

1. Two nuclei have mass numbers 64 and 27. The ratio of their nuclear densities is:

(A) 4 : 3

(B) 3 : 4

(C) 1 : 1

(D) 16 : 9

Correct Answer: (C) 1 : 1

Solution:

Concept:

The density of atomic nuclei is approximately constant for all elements irrespective of their mass numbers. This happens because the radius of a nucleus depends on the mass number according to the relation:

$$R = R_0 A^{1/3}$$

where:

- R = radius of nucleus
- R_0 = nuclear constant
- A = mass number

Since volume of a nucleus is proportional to R^3,

$$V \propto (A^{1/3})^3$$

$$V \propto A$$

Also, mass of nucleus is directly proportional to mass number A.

Thus,

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\rho \propto \frac{A}{A}$$

$$\rho = \text{constant}$$

Therefore, all nuclei have nearly the same density.

Step 1: Write the relation for nuclear density.

Density is given by:

$$\rho = \frac{\text{Mass of nucleus}}{\text{Volume of nucleus}}$$

Mass of nucleus:

$$m \propto A$$

Radius of nucleus:

$$R = R_0 A^{1/3}$$

Volume of nucleus:

$$V = \frac{4}{3}\pi R^3$$

Substituting the radius relation:

$$V \propto (A^{1/3})^3$$

$$V \propto A$$

Step 2: Find the density dependence.

Since,

$$\rho \propto \frac{A}{A}$$

$$\rho = \text{constant}$$

Thus nuclear density does not depend on mass number.

Step 3: Compare the two nuclei.

Given mass numbers:

$$A_1 = 64$$

$$A_2 = 27$$

Since nuclear density is constant for all nuclei:

$$\rho_1 = \rho_2$$

Therefore,

$$\rho_1 : \rho_2 = 1 : 1$$

Hence, the correct answer is:

$$\boxed{1 : 1}$$

Quick Tip:
Nuclear density is independent of the size of the nucleus because both nuclear mass and nuclear volume are directly proportional to mass number A.

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2. Ratio of radii of the 3rd orbit of H-atom and He^+ ion will be:

(A) 9 : 4

(B) 4 : 9

(C) 1 : 2

(D) 2 : 1

Correct Answer: (D) 2 : 1

Solution:

Concept:

According to Bohr's atomic model, the radius of the n^{th} orbit of a hydrogen-like atom is given by:

$$r_n = \frac{n^2 a_0}{Z}$$

where:

- r_n = radius of the orbit
- n = principal quantum number
- a_0 = Bohr radius
- Z = atomic number

For hydrogen atom:

$$Z = 1$$

For helium ion (He^+):

$$Z = 2$$

Thus, orbital radius is inversely proportional to atomic number.

Step 1: Write the formula for orbital radius.

The radius of the n^{th} orbit is:

$$r_n = \frac{n^2 a_0}{Z}$$

Since both atoms are in the 3rd orbit:

$$n = 3$$

Step 2: Find radius of 3rd orbit of hydrogen atom.

For hydrogen atom:

$$Z = 1$$

Therefore,

$$r_H = \frac{3^2 a_0}{1}$$

$$r_H = 9a_0$$

Step 3: Find radius of 3rd orbit of helium ion.

For helium ion:

$$Z = 2$$

Thus,

$$r_{He^+} = \frac{3^2 a_0}{2}$$

$$r_{He^+} = \frac{9a_0}{2}$$

Step 4: Calculate the ratio.

$$r_H : r_{He^+} = 9a_0 : \frac{9a_0}{2}$$

$$= 2 : 1$$

Hence, the required ratio is:

$$\boxed{2 : 1}$$

Quick Tip:

For hydrogen-like species:

$$r_n \propto \frac{n^2}{Z}$$

As atomic number increases, the electron is pulled closer to the nucleus, decreasing orbital radius.

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3. Value of critical angle is maximum for light travelling from:

(A) Glass to water

(B) Air to glass

(C) Glass to air

(D) Air to water

Correct Answer: (C) Glass to air

Solution:

Concept:

Critical angle is defined as the angle of incidence in a denser medium for which the angle of refraction in the rarer medium becomes 90°.

The relation for critical angle is:

$$\sin C = \frac{n_2}{n_1}$$

where:

- n_1 = refractive index of denser medium
- n_2 = refractive index of rarer medium

Critical angle exists only when light travels from denser medium to rarer medium.

Step 1: Understand the condition for critical angle.

Critical angle can occur only when:

$$n_1 > n_2$$

That means light must travel from optically denser medium to optically rarer medium.

Step 2: Analyze each option carefully.

- **Glass to water:** Possible because glass is denser than water.
- **Air to glass:** Not possible because light travels from rarer to denser medium.
- **Glass to air:** Possible and gives very large critical angle because air has very low refractive index.
- **Air to water:** Not possible because light travels from rarer to denser medium.

Step 3: Compare the critical angles.

For glass to air:

$$\sin C = \frac{1}{1.5}$$

For glass to water:

$$\sin C = \frac{1.33}{1.5}$$

Since:

$$\frac{1.33}{1.5} > \frac{1}{1.5}$$

therefore the critical angle is larger for glass to air.

Hence, the correct answer is:

$$\boxed{\text{Glass to air}}$$

Quick Tip:

Critical angle exists only when light travels:

$$\text{Denser Medium} \rightarrow \text{Rarer Medium}$$

Smaller refractive index of rarer medium gives larger critical angle.

4. Wavefront for a point source, near it, is:

(A) Plane

(B) Spherical

(C) Cylindrical

(D) None of the above

Correct Answer: (B) Spherical

Solution:

Concept:

A wavefront is defined as the locus of all particles of a medium vibrating in the same phase. Depending upon the nature and position of the source, different types of wavefronts are produced:

- Spherical wavefront
- Plane wavefront
- Cylindrical wavefront

A point source emits light uniformly in all directions. Therefore, the wavefront produced around it is spherical in shape.

Step 1: Understand the nature of a point source.

A point source is a very small source of light that emits light equally in all directions.
As the light propagates outward from the source, every point at equal distance from the source forms a surface.
That surface is spherical in shape.

Step 2: Identify the shape of the wavefront near the source.

Near the point source, curvature of the wavefront is clearly visible.
Thus, the wavefront remains spherical.

$$\boxed{\text{Wavefront is spherical}}$$

Step 3: Why other options are incorrect.

- **Plane Wavefront:** Produced when the source is very far away.
- **Cylindrical Wavefront:** Produced by a linear source.
- **None of the above:** Incorrect because spherical wavefront is correct.

Hence, the correct answer is:

$$\boxed{\text{Spherical}}$$

Quick Tip:

A point source always produces spherical wavefronts because light spreads uniformly in all directions from the source.

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5. To convert a galvanometer into an ammeter, we use:

(A) High resistance in series

(B) Low resistance in series

(C) High resistance in parallel

(D) Shunt wire in parallel

Correct Answer: (D) Shunt wire in parallel

Solution:

Concept:

A galvanometer is a sensitive instrument used to detect small electric currents.
To measure large currents, the galvanometer is converted into an ammeter by connecting a very small resistance called shunt resistance in parallel with it.
The shunt allows most of the current to bypass the galvanometer, protecting it from damage.

Step 1: Understand the purpose of an ammeter.

An ammeter is used to measure electric current in a circuit.

An ideal ammeter should have:

$$\text{Very low resistance}$$

so that it does not change the current in the circuit.

Step 2: Why galvanometer alone cannot be used.

A galvanometer has finite resistance and can measure only very small currents.
If large current passes through it directly, the coil may get damaged.
Therefore, most current must be diverted away from the galvanometer.

Step 3: Use of shunt resistance.

A low resistance wire called shunt is connected parallel to the galvanometer.
Since resistance of shunt is very small:

$$I_s \gg I_g$$

where:

- I_s = current through shunt
- I_g = current through galvanometer

Thus, most current flows through the shunt wire.

Step 4: Conclusion.

Therefore, to convert a galvanometer into an ammeter, we use:

$$\boxed{\text{Shunt wire in parallel}}$$

Quick Tip:

- Ammeter $\rightarrow$ Low resistance
- Voltmeter $\rightarrow$ High resistance
- Ammeter is made by connecting shunt resistance in parallel.

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6. Angular width of central maxima increases when:

(A) λ increases

(B) λ decreases

(C) e increases

(D) e decreases

Correct Answer: (A) λ increases

Solution:

Concept:
In single slit diffraction, the angular width of the central bright fringe is given by:

$$\theta = \frac{2\lambda}{e}$$

where:

- θ = angular width of central maxima
- λ = wavelength of light
- e = width of the slit

From the formula:

$$\theta \propto \lambda$$

and

$$\theta \propto \frac{1}{e}$$

Thus, angular width increases with increase in wavelength and decreases with increase in slit width.

Step 1: Write the formula for angular width.

For single slit diffraction:

$$\theta = \frac{2\lambda}{e}$$

This formula directly relates angular width with wavelength and slit width.

Step 2: Analyze the effect of wavelength.

Since:

$$\theta \propto \lambda$$

when wavelength increases, angular width also increases.

Therefore:

$$\lambda \uparrow \Rightarrow \theta \uparrow$$

Step 3: Analyze the effect of slit width.

Since:

$$\theta \propto \frac{1}{e}$$

when slit width increases, angular width decreases.

Thus:

$$e \uparrow \Rightarrow \theta \downarrow$$

Step 4: Choose the correct option.

Among the given choices, only increase in wavelength increases angular width.

Hence, the correct answer is:

$$\boxed{\lambda \text{ increases}}$$

Quick Tip:

For diffraction patterns:

$$\theta = \frac{2\lambda}{e}$$

Larger wavelength or smaller slit width produces broader diffraction patterns.

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7. A bar magnet of magnetic moment M is cut into two parts symmetrically, perpendicular to its length. Then magnetic moment of each part is:

(A) M
(B) $\frac{M}{2}$
(C) $2M$
(D) $\frac{M}{4}$

Correct Answer: (B) $\frac{M}{2}$

Solution:

Concept:

Magnetic moment of a bar magnet is given by:

$$M = m(2l)$$

where:

- m = pole strength
- $2l$ = magnetic length of the magnet

When a magnet is cut perpendicular to its length:

- Pole strength remains unchanged
- Length becomes half

Therefore, magnetic moment becomes half.

Step 1: Write the formula for magnetic moment.

Magnetic moment is:

$$M = m(2l)$$

where magnetic moment depends directly on magnetic length.

Step 2: Understand the effect of cutting perpendicular to length.

When the magnet is cut perpendicular to its length:

$$2l \rightarrow l$$

Thus, new length becomes half.

However, cross-sectional area remains same, so pole strength remains unchanged.

$$m = \text{constant}$$

Step 3: Calculate the new magnetic moment.

New magnetic moment:

$$M' = m(l)$$

But,

$$M = m(2l)$$

Therefore,

$$M' = \frac{M}{2}$$

Hence, magnetic moment of each part is:

$$\boxed{\frac{M}{2}}$$

Quick Tip:

- Cutting magnet perpendicular to length $\rightarrow$ magnetic moment halves.
- Cutting magnet parallel to length $\rightarrow$ pole strength halves.

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8. In an EM wave, if $\vec{B}$ is along z-axis, then direction of $\vec{E}$ and propagation will be:

(A) In xy-plane

(B) In yz-plane

(C) In y-direction

(D) In z-direction

Correct Answer: (C) In y-direction

Solution:

Concept:

Electromagnetic waves are transverse waves in which:

- Electric field $\vec{E}$
- Magnetic field $\vec{B}$
- Direction of propagation

are all mutually perpendicular to each other.

The relation between them is given by:

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

Thus, by applying vector cross product rules, we can determine the direction of electric field and propagation.

Step 1: Write the given information.

Magnetic field is along z-axis:

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

We know:

$$\vec{E} \perp \vec{B}$$

Therefore, electric field must lie either along x-axis or y-axis.

Step 2: Apply the right hand rule.

For electromagnetic waves:

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

Using unit vectors:

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

This means:

- Electric field is along y-axis
- Magnetic field is along z-axis
- Wave propagates along x-axis

Step 3: Choose the correct option.

Since electric field is along y-direction:

$$\boxed{\text{In y-direction}}$$

Hence, the correct answer is:

$$\boxed{\text{(C) In y-direction}}$$

Quick Tip:

In electromagnetic waves:

$$\vec{E} \perp \vec{B} \perp \text{Direction of propagation}$$

Always use the right-hand rule for vector cross products.

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9. A dielectric is inserted between the plates of a capacitor connected to a battery. What happens?

(A) Charge decreases

(B) Electric field increases

(C) Electric field decreases

(D) Charge increases

Correct Answer: (D) Charge increases

Solution:

Concept:

When a dielectric material is inserted between the plates of a capacitor connected to a battery:

- Capacitance increases
- Potential difference remains constant
- Charge stored increases

The relation is:

$$Q = CV$$

where:

- Q = charge
- C = capacitance
- V = potential difference

Step 1: Understand the effect of dielectric on capacitance.

Capacitance of a parallel plate capacitor is:

$$C = \frac{\varepsilon_0 A}{d}$$

After inserting dielectric of dielectric constant K:

$$C' = KC$$

Thus capacitance increases.

Step 2: Analyze the condition of battery connection.

Since capacitor remains connected to the battery:

$$V = \text{constant}$$

Battery continuously maintains the same potential difference.

Step 3: Apply the charge relation.

Using:

$$Q = CV$$

Since:

- C increases
- V remains constant

Therefore:

$$Q \uparrow$$

Hence charge stored on the capacitor increases.

Step 4: Choose the correct option.

Thus, the correct answer is:

$$\boxed{\text{Charge increases}}$$

Quick Tip:

If battery remains connected:

$$V = \text{constant}$$

If battery is disconnected:

$$Q = \text{constant}$$

Always check whether the battery is connected or disconnected in capacitor problems.

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10. Two coherent sources of intensity ratio $9:1$ produce interference fringes. The ratio of maximum intensity to minimum intensity will be:

(A) 9 : 1

(B) 3 : 1

(C) 4 : 1

(D) 16 : 4

Correct Answer: (D) 16 : 4

Solution:

Concept:

In interference of light, the maximum and minimum intensities are given by:

$$I_{\text{max}} = (\sqrt{I_1} + \sqrt{I_2})^2$$

$$I_{\text{min}} = (\sqrt{I_1} - \sqrt{I_2})^2$$

where:

- I_1 and I_2 are intensities of coherent sources.

The ratio of maximum to minimum intensity is:

$$\frac{I_{max}}{I_{min}} = \frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2}$$

Step 1: Write the given intensity ratio.

Given:

$$I_1 : I_2 = 9 : 1$$

Therefore:

$$I_1 = 9$$

$$I_2 = 1$$

Step 2: Calculate maximum intensity.

Using:

$$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$$

Substituting values:

$$I_{max} = (\sqrt{9} + \sqrt{1})^2$$

$$= (3 + 1)^2$$

$$= 4^2$$

$$= 16$$

Step 3: Calculate minimum intensity.

Using:

$$I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$$

Substituting values:

$$I_{\min} = (\sqrt{9} - \sqrt{1})^2$$

$$= (3-1)^2$$

$$= 2^2$$

$$= 4$$

Step 4: Find the required ratio.

$$I_{\max} : I_{\min} = 16 : 4$$

Hence, the correct answer is:

$$\boxed{16 : 4}$$

Quick Tip:

For interference problems:

$$I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$$

$$I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$$

Always take square roots of intensities before substitution.

