# JEE-MAIN EXAM APRIL, 2025

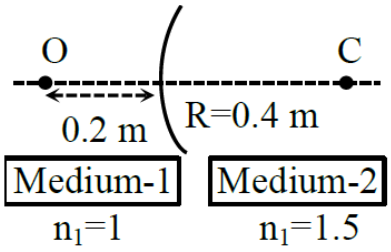
**Date: - 02-04-2025 (SHIFT-1)**

## PHYSICS

### SECTION-A

**1.** A spherical surface separates two media of refractive indices 1 and 1.5 as shown in figure. Distance of the image of an object ' O ', is :

(C is the center of curvature of the spherical surface and R is the radius of curvature)



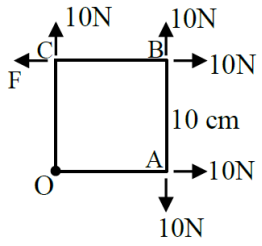

(1) 0.24 m left to the spherical surface (2) 0.4 m right to the spherical surface

(3) 0.24 m right to the spherical surface (4) 0.4 m left to the spherical surface

**2.** Let $B_1$ be the magnitude of magnetic field at center of a circular coil of radius $R$ carrying current $I$. Let $B_2$ be the magnitude of magnetic field at an axial distance '$x$' from the center. For $x:R=3:4, \frac{B_2}{B_1}$ is :

(1) 25 : 16 (2) 16 : 25 (3) 4 : 5 (4) 64 : 125

**3.** A square Lamina OABC of length 10 cm is pivoted at ' O '. Forces act at Lamina as shown in figure. If Lamina remains stationary, then the magnitude of F is:




(1) 20 N (2) 10 N (3) $10\sqrt{2}N$ (4) 0 (zero)

**4.** In an adiabatic process, which of the following statements is true?

(1) The molar heat capacity is infinite

(2) Work done by the gas equals the increase in internal energy

(3) The internal energy of the gas decreases as the temperature increases

(4) The molar heat capacity is zero

**5.** The equation for real gas is given by $\left(P+\frac{a}{V^2}\right)(V-b)=RT$, where P, V, T and $R$ are the pressure, volume, temperature and gas constant, respectively. The dimension of $ab^{-2}$ is equivalent to that of :

(1) Planck's constant (2) Compressibility

(3) Strain (4) Energy density

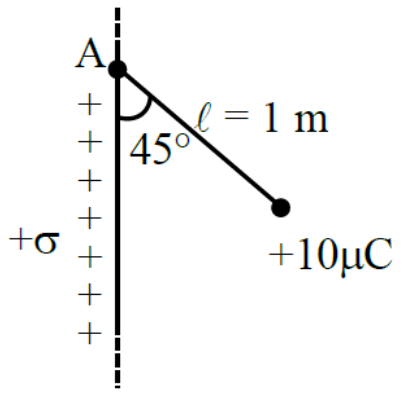
**6.** A zener diode with 5 V zener voltage is used to regulate an unregulated dc voltage input of 25 V . For a $400\Omega$ resistor connected in series, the zener current is found to be 4 times load current. The load current $(I_L)$ and load resistance $(R_L)$ are :

(1) $I_L=0.02mA; R_L=250\Omega$ (2) $I_L=10mA; R_L=500\Omega$

(3) $I_L=20mA; R_L=250\Omega$ (4) $I_L=10A; R_L=0.5\Omega$

**7.** A small bob of mass 100 mg and charge $+10\mu C$ is connected to an insulating string of length 1 m. It is brought near to an infinitely long non-conducting sheet of charge density ' $\sigma$ ' as shown in figure. If string subtends an angle of $45^\circ$ with the sheet at equilibrium the charge density of sheet will be.

(Given, $\epsilon_0=8.85\times10^{-12}\frac{F}{m}$ and acceleration due to gravity, $g=10\frac{m}{s^2}$)




(1) $1.77nC/m^2$ (2) $17.7nC/m^2$ (3) $885nC/m^2$ (4) $0.885nC/m^2$

**8.** The battery of a mobile phone is rated as 4.2 V, 5800 mAh. How much energy is stored in it when fully charged?

(1) 87.7 kJ (2) 24.4 kJ (3) 43.8 kJ (4) 48.7 kJ

**9.** A particle is subjected to two simple harmonic motions as :

$x_1=\sqrt{7}\sin 5tcm$ and $x_2=2\sqrt{7}\sin\left(5t+\frac{\pi}{3}\right)cm$

where $x$ is displacement and $t$ is time in seconds.

The maximum acceleration of the particle is $x\times10^{-2}ms^{-2}$. The value of $x$ is :

(1) $5\sqrt{7}$ (2) $25\sqrt{7}$ (3) 175 (4) 125

**10.** Match List - I with List - II.

| List - I | List - II |
|---|---|
| (A) Coefficient of viscosity | (I) $\left[ML^0T^{-3}\right]$ |
| (B) Intensity of wave | (II) $\left[ML^{-2}T^{-2}\right]$ |
| (C) Pressure gradient | (III) $\left[M^{-1}LT^2\right]$ |
| (D) Compressibility | (IV) $\left[ML^{-1}T^{-1}\right]$ |

Choose the correct answer from the options given below :

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

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

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

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

**11.** Considering Bohr's atomic model for hydrogen atom :

(A) the energy of H atom in ground state is same as energy of $He^+$ ion in its first excited state.

(B) the energy of H atom in ground state is same as that for $Li^{++}$ ion in its second excited state.

(C) the energy of H atom in its ground state is same as that of $He^+$ ion for its ground state.

(D) the energy of $He^+$ ion in its first excited state is same as that for $Li^{++}$ ion in its ground state.

Choose the correct answer from the options given below :

(1) (A), (B) only (2) (A), (D) only

(3) (B), (D) only (4) (A), (C) only

**12.** A monochromatic light is incident on a metallic plate having work function $\phi$. An electron, emitted normally to the plate from a point A with maximum kinetic energy, enters a constant magnetic field, perpendicular to the initial velocity of electron. The electron passes through a curve and hits back the plate at a point B. The distance between A and B is :

(Given : The magnitude of charge of an electron is e and mass is m, h is Planck's constant and $c$ is velocity of light. Take the magnetic field exists throughout the path of electron)

(1) $\sqrt{m(hc/\lambda-\phi)}/eB$ (2) $\sqrt{8m\left(\frac{hc}{\lambda}-\phi\right)}/eB$

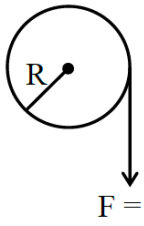
(3) $2\sqrt{m(hc/\lambda-\phi)}/eB$ (4) $\sqrt{2m\left(\frac{hc}{\lambda}-\phi\right)}/eB$

**13.** A point charge + q is placed at the origin. A second point charge +9 q is placed at $(d,0,0)$ in Cartesian coordinate system. The point in between them where the electric field vanishes is :

(1) $(d/4,0,0)$ (2) $(d/3,0,0)$

(3) $(4d/3,0,0)$ (4) $(3d/4,0,0)$

**14.** A cord of negligible mass is wound around the rim of a wheel supported by spokes with negligible mass. The mass of wheel is 10 kg and radius is 10 cm and it can freely rotate without any friction. Initially the wheel is at rest. If a steady pull of 20 N is applied on the cord, the angular velocity of the wheel, after the cord is unwound by 1 m, would be :

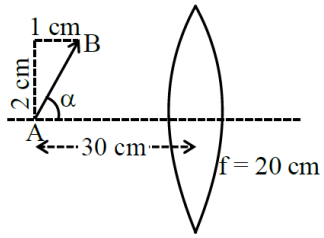



(1) 10 rad/s (2) 30 rad/s (3) 20 rad/s (4) 0 rad/s

**15.** A light wave is propagating with plane wave fronts of the type $x+y+z=$ constant. The angle made by the direction of wave propagation with the $x$-axis is :

(1) $\cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$ (2) $\cos^{-1}\left(\frac{1}{3}\right)$ (3) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (4) $\cos^{-1}(2/3)$

**16.** A slanted object AB is placed on one side of convex lens as shown in the diagram. The image is formed on the opposite side. Angle made by the image with principal axis is :

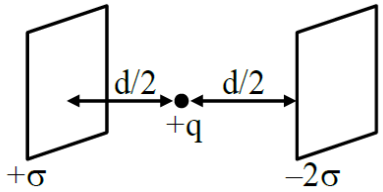



(1) $-45^{\circ}$ (2) $-\frac{\alpha}{2}$ (3) $+45^{\circ}$ (4) $-\alpha$

**17.** Moment of inertia of a rod of mass 'M' and length 'L' about an axis passing through its center and normal to its length is '$\alpha$'. Now the rod is cut into two equal parts and these parts are joined symmetrically to form a cross shape. Moment of inertia of cross about an axis passing through its center and normal to plane containing cross is :

(1) $\alpha/4$ (2) $\alpha/2$ (3) $\alpha$ (4) $\alpha/8$

**18.** Consider two infinitely large plane parallel conducting plates as shown below. The plates are uniformly charged with a surface charge density $+\sigma$ and $-2\sigma$. The force experienced by a point charge + q placed at the mid point between two plates will be :




(1) $\frac{3\sigma q}{4\epsilon_0}$ (2) $\frac{3\sigma q}{2\epsilon_0}$ (3) $\frac{\sigma q}{4\epsilon_0}$ (4) $\frac{\sigma q}{2\epsilon_0}$

**19.** The relationship between the magnetic susceptibility $(\chi)$ and the magnetic permeability $(\mu)$ is given by : ( $\mu_0$ is the permeability of free space and $\mu_r$ is relative permeability)

(1) $\chi = \mu_r + 1$ (2) $X = \frac{\mu_r}{\mu_0} + 1$ (3) $\chi = 1 - \frac{\mu}{\mu_0}$ (4) $\chi = \frac{\mu}{\mu_0} - 1$

**20.** A river is flowing from west to east direction with speed of $9 kmh^{-1}$. If a boat capable of moving at a maximum speed of $27 kmh^{-1}$ in still water, crosses the river in half a minute, while moving with maximum speed at an angle of 150º to direction of river flow, then the width of the river is :

(1) 75 m (2) 300 m (3) 112.5 m (4) $112.5 \times \sqrt{3} m$

## SECTION-B

**21.** If the measured angular separation between the second minimum to the left of the central maximum and the third minimum to the right of the central maximum is 30º in a single slit diffraction pattern recorded using 628 nm light, then the width of the slit is_____ $\mu m$.

**22.** $\gamma_A$ is the specific heat ratio of monoatomic gas A having 3 translational degrees of freedom. $\gamma_B$ is the specific heat ratio of polyatomic gas B having 3 translational, 3 rotational degrees of freedom and 1 vibrational mode. If $\frac{\gamma_A}{\gamma_B} = \left(1 + \frac{1}{n}\right)$, then the value of $n$ is ____

**23.** A person travelling on a straight line moves with a uniform velocity $v_1$ for a distance x and with a uniform velocity $v_2$ for the next $\frac{3}{2}x$ distance. The average velocity in this motion is $\frac{50}{7} m/s$. If $v_1$ is $5 m/s$ then $v_2 =$ _____ $m/s$.

**24.** A steel wire of length 2 m and Young's modulus $2.0 \times 10^{11} Nm^{-2}$ is stretched by a force. If Poisson ratio and transverse strain for the wire are 0.2 and $10^{-3}$ respectively, then the elastic potential energy density of the wire is _____ $\times 10^5$ (in SI units).

**25.** A vessel with square cross-section and height of 6 m is vertically partitioned. A small window of $100 cm^2$ with hinged door is fitted at a depth of 3 m in the partition wall. One part of the vessel is filled completely with water and the other side is filled with the liquid having density $1.5 \times 10^3 kg/m^3$. What force one needs to apply on the hinged door so that it does not get opened ?

(Acceleration due to gravity $= 10 m/s^2$)

## NTA ANSWER

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** | **(4)** | **2.** | **(4)** | **3.** | **(2)** | **4.** | **(4)** | **5.** | **(4)** | **6.** | **(2)** | **7.** | **(1)** |
| **8.** | **(1)** | **9.** | **(3)** | **10.** | **(2)** | **11.** | **(1)** | **12.** | **(2)** | **13.** | **(1)** | **14.** | **(3)** |
| **15.** | **(3)** | **16.** | **(1)** | **17.** | **(1)** | **18.** | **(2)** | **19.** | **(4)** | **20.** | **(3)** | **21.** | **6** |
| **22.** | **3** | **23.** | **10** | **24.** | **25** | **25.** | **150** | | | | | | |