IIT-JEE-2012 PAPER 1

PART-I: PHYSICS

[Time allowed: 3 hours Maximum Marks: 210]

SECTION – I : Single Correct Answer Paper

This section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1 Sol. (A)

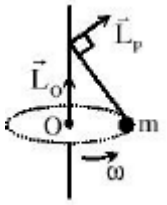
$$L.C. = \frac{0.5}{100} = 0.005\,\text{mm}$$

$$\frac{\Delta Y}{Y} = \frac{\Delta \ell}{\ell} + \frac{2\Delta(d)}{d}$$

$$\frac{\Delta \ell}{\ell} = \frac{0.005\times10^{-3}}{0.25\times10^{-3}} = \frac{1}{50}$$

$$2\frac{\Delta(d)}{d} = \frac{2\times0.005\times10^{-3}}{0.5\times10^{-3}} = \frac{1}{50}$$

2 Sol. (C)



3 Sol. (B)

$$P_T = (1.5-1)\left(\frac{1}{14}-0\right)+(1.2-1)\left(0-\frac{1}{-14}\right) = \frac{0.5}{14}+\frac{0.2}{14} = \frac{1}{20}$$

$$f = +20\,\text{cm}$$

$$\frac{1}{v} = \frac{1}{-40} = \frac{1}{20}$$

$$\frac{1}{v} = \frac{1}{20} - \frac{1}{40} = \frac{1}{40}$$

$$\therefore v = 40\,\text{cm}$$

4 Sol. (B)

$$\begin{aligned}\tau &= \omega\frac{dI}{dt}\omega\frac{d}{dt}\left(C+mv^2t^2\right)\\ &= m\omega v^2 2t\end{aligned}$$

5 Sol. (D)

$$V_{rms}=\sqrt{\frac{3RT}{M}}$$

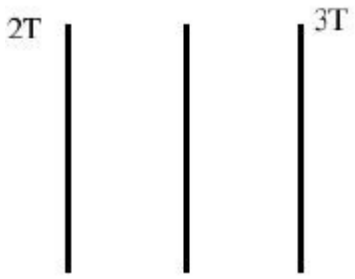
$$Required\ ration\ =\sqrt{\frac{M_{Ar}}{M_{He}}}=\sqrt{\frac{40}{4}}=\sqrt{10}=3.16$$

6 Sol. (C)

$$qE=mg$$
$$q\left(V/d\right)=mg$$

$$\begin{aligned}V &= \frac{mgd}{q}\\ &= \frac{1.67\times10^{-27}\times10\times10^{-2}}{1.6\times10^{-19}}\\ &= \frac{10^{-28}}{10^{-19}}=10^{-19}\text{V}\end{aligned}$$

7 Sol. (C)



$$\sigma A\left(2T\right)^4+\sigma A\left(3T\right)^4=\sigma 2A\left(T'\right)^4$$
$$16T^4+81T^4=2\left(T'\right)^4$$
$$97T^4=2\left(T'\right)^4$$
$$\left(T'\right)^4=\frac{97}{2}T^4$$
$$\therefore T'=\left(\frac{97}{2}\right)^{1/4}T$$

8 Sol. (A)

$$\frac{2v\sin 45^\circ}{g}=1$$
$$\therefore v=\sqrt{50}\ \text{m/s}.$$

9 Sol. (D)

$$\lambda_R>\lambda_G>\lambda_B$$
$$\therefore \beta_R>\beta_G>\beta_B$$

10 Sol. (D)

SECTION II : Multiple Correct Answer(s) Type

This section contains **5 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

11 Sol. (C,D)

If $\theta=90^\circ$, $\vec{B}$ exerts no force on q.

If $\theta=0^\circ, 10^\circ$; the charge particle moves in helix with increasing pitch due $\vec{E}$ along y-axis.

12 Sol. (A, C, D)

$$Net\ flux through the cubical region=\frac{-q+3q-q}{\varepsilon_0}=\frac{q}{\varepsilon_0}$$

The flux passing through the faces $x=\frac{-a}{2}, x=+\frac{a}{2}$ and $z=+\frac{a}{2}$ are same due to symmetry.

13 Sol. (B, D)

At the open end, the phase of a pressure wave changes by π radian due to reflection. At the closed end, there is no change in the phase of a pressure wave due to reflection.

14 Sol. (A, C)

At $\theta=45^\circ$, $mg\sin\theta=1\times cos\theta$

At $\theta>45^\circ$, $mg\sin\theta>1\times cos\theta$ (friction acts upward)

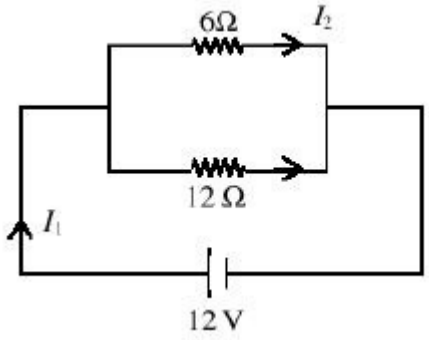
At $\theta < 45°$, $mg\sin\theta < 1 \times cos\theta$ (friction acts downward)

15 Sol. (A, B, C, D)

Nodes P and Q are equipotential and nodes S and T are equipotential from wheatstone bridge, no current passes through PQ and ST.

$$I_1 = \frac{12}{4} = 3\text{A}$$

$$\text{I}_2 = I_1\left(\frac{12}{6+12}\right) = 2\text{A}$$



SECTION III : Integer Answer Type

This section contains **5 questions**. The answer to each question is single digit integer, ranging from 0 to 9 (both inclusive)

16 Sol. (7)

$$M = \frac{N\phi}{I} = \frac{2\left[\frac{\mu_0 IR^2}{2\left(8R^3\right)}\right]a^2\cos 45°}{I}\frac{\mu_0 a^2}{8R2^{1/2}} = \frac{\mu_0 a^2}{R2^{7/2}}$$

So $P = 7$

17 Sol. (6)

$$\vec{E}=\frac{\lambda(j)}{2\pi\varepsilon_0(2R)}+\frac{K\left(\rho\frac{4}{3}\pi\frac{R^3}{8}\right)(-j)}{4R^2}$$

$$\vec{E}=\frac{\rho\pi R^2(j)}{4\pi\varepsilon_0 R}+\frac{K\pi\rho R(-j)}{24}$$

$$\vec{E}=K\rho\pi R(j)+\frac{K}{24}\rho\pi R(-j)$$

$$\vec{E}=K\rho\pi R\frac{23}{24}(j)=\frac{23}{96\varepsilon_0}\rho R(-j)$$

18 Sol. (7)

$$0+\frac{1}{2}mv^2=\frac{K(Q)e}{10\times10^{-15}}=\frac{K(120e)e}{10\times10^{-15}}$$

$$\frac{1}{2}\times\frac{5}{3}\times10^{-27}v^2=\frac{9\times10^9\times120\times\left(1.6\times10^{-19}\right)^2}{10\times10^{-15}}$$

$$v=\frac{9\times6\times10^9\times120\times2.56\times10^{-38}}{50\times10^{-42}}$$

$$v=\frac{9\times6\times10^9\times120\times2.56\times10^{-38}}{50\times10^{-42}}$$

$$v=\sqrt{331.776\times10^{13}}$$

$$\lambda=\frac{h}{mv}$$

$$\lambda=\frac{4.2\times10^{-15}\times1.6\times10^{-19}}{\frac{5}{3}\times10^{-27}\times\sqrt{331.776\times10^{13}}}=\frac{4.2\times4.8\times10^{-34}}{57.6\times5\times10^{-21}}=0.07\times10^{-13}$$

$$\lambda=7\times10^{-15}=7\,\text{fm}$$

19 Sol. (3)

$$I_p = \left[\frac{4mR^2}{2} + m\left(4R^2\right)\right] - \left[\frac{m}{4}\frac{R^2}{2} + \frac{m}{4}5R^2\right]$$

$$I_p = mR^2\left[\left(2+4\right) - \left(\frac{1}{8} + \frac{5}{4}\right)\right]$$

$$I_p = mR^2\left(6 - \frac{11}{8}\right) = \frac{37}{8}mR^2 \quad \ldots\ldots(1)$$

$$I_0 = \left(\frac{4mR^2}{2}\right) - \left(\frac{m}{4}\frac{R^2}{2} + \frac{m}{4}R^2\right)$$

$$I_0 = mR^2\left[2 - \left(\frac{1}{8} + \frac{1}{4}\right)\right] = mR^2\left[2 - \frac{3}{8}\right] = mR^2\left(\frac{13}{8}\right)\ldots(2)$$

So $\frac{I_P}{I_o} = \frac{37/8}{13/8}$ 3 (Nearest integer)

20 Sol. (5)

$$B = \frac{\mu_0\left(J\pi a^2\right)}{2\pi a} - \frac{\mu_0\left(J\pi a^2/4\right)}{2\pi\left(\frac{3a}{2}\right)}$$

$$B = \frac{5\mu_0 Ja}{12} = \frac{\mu_0 NJa}{12}$$

So $N = 5$