

## MOCK TEST PAPER # 1

### SOLUTION

#### IITJEE (Main) PHYSICS

- 1.(B) Since horizontal velocity for both is same. So distance between them will vary as  $y = ut - \frac{1}{2}gt^2$

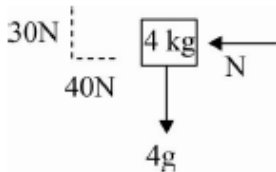
[downward parabola]

2.(C) 
$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$\frac{\Delta R_{eq}}{R_{eq}} = \frac{\Delta R_1}{R_1} + \frac{\Delta R_2}{R_2} + \frac{\Delta R_1 + \Delta R_2}{R_1 + R_2} = \frac{0.1}{10} + \frac{0.05}{5} + \frac{0.1+0.05}{10+5} = 0.01 + 0.01 + 0.01 = 0.03$$

$$\frac{\Delta R_{eq}}{R_{eq}} \times 100 = 3\%$$

- 3.(B)



Limiting value of frictional force  $\mu N = 0.5 \times 40 = 20 N$

Net force in vertical direction

$$30 + f = 40$$

$$f = 10 N$$

$$\text{Net contact force} = \sqrt{10^2 + 40^2} = 10\sqrt{17} N$$

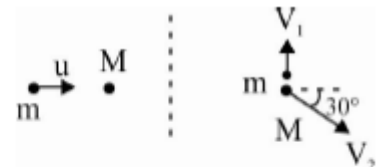


- 4.(B) Conserving momentum along x axis  $v_2 = \frac{2u}{5\sqrt{3}}$

Along y axis  $v_1 = \frac{5}{2}v_2 = \frac{u}{\sqrt{3}}$

Fraction lost =  $\frac{2}{5}$

- 5.(A)  $m[h \cot \theta - x] = Mx \Rightarrow x = \frac{mh \cot \theta}{m + M}$



- 6.(A)  $I_{AB} = I_{cm} + M\left(\frac{R}{2}\right)^2 = I_{CD} = \frac{2}{3}MR^2$

$$7.(C) \quad \frac{mv^2}{R} = \frac{GMm}{R^2} \quad \Rightarrow \quad v = \sqrt{\frac{GM}{R}}$$

$$\text{Total energy of satellite} = \frac{1}{2}mv^2 - \frac{GMm}{R}$$

Energy required to escape field

$$E + \frac{1}{2}mv^2 - \frac{GMm}{R} = 0 \quad \Rightarrow \quad E + \frac{1}{2}m \frac{GM}{R} - \frac{GMm}{R} = 0$$

$$E = \frac{GMm}{2R}$$

$$8.(A) \quad F = \frac{YA}{l} \Delta l \text{ or } F = k \Delta l \quad \Rightarrow \quad \omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{YA}{0.1l}} = 140$$

$$9.(B) \quad R = c_p - c_v = \frac{2}{3}c_v \quad \Rightarrow \quad c_p = \frac{5}{3}c_v \quad \Rightarrow \quad \gamma = 5/3$$

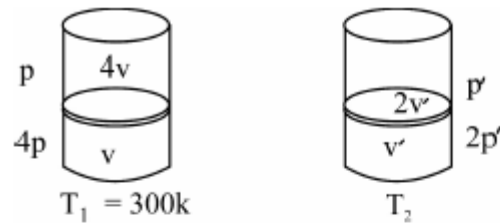
$$pv^\gamma = \text{constant} \quad \Rightarrow \quad p \left( \frac{nRT}{p} \right)^\gamma = \text{constant}$$

$$p^{\frac{1}{\gamma}-1} T = \text{constant} \quad \Rightarrow \quad p \propto T^{5/2}$$

$$10.(B) \quad 4p - p = 2p' - p'$$

$$5V = 3V'$$

$$\frac{p_1 v_1}{T_1} = \frac{p_2 v_2}{T_2} \Rightarrow T_2 = 750 \text{ K}$$



$$11.(B) \quad W = 2\Delta U = 2nC_V \Delta T$$

$$Q = \Delta U + w = 3nC_V \Delta T$$

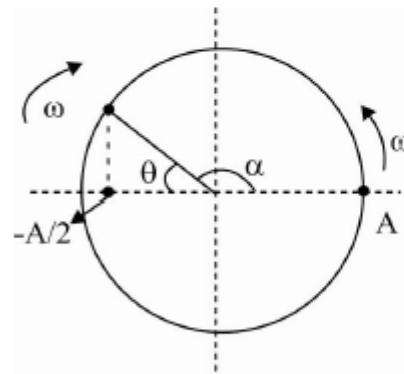
$$nC_V \Delta T = 3nC_V \Delta T$$

$$C = 3C_V = \frac{3R}{\gamma-1} = 6R$$

$$12.(B) \quad A \cos \theta = \frac{A}{2} \Rightarrow \theta = \frac{\pi}{3}$$

$$\alpha = \frac{2\pi}{3}$$

$$t = \frac{2\pi/3}{2\omega} = \frac{\pi}{3 \times 2\pi/T} = T/6$$



$$13.(C) \quad n_1 = n \frac{v}{v-v_s}; \quad n_2 = \frac{nv}{v+v_s}$$

$$\frac{n_1}{n_2} = \frac{4}{5} = \frac{330-v_s}{330+v_s} \Rightarrow v_s = 36.6 \text{ m/s}$$

14.(A)

$$15.(A) \quad \text{Apply } V = \frac{KQ}{2R} \left( 3 - \frac{r^2}{R^2} \right) \text{ for potential inside \& } V = \frac{KQ}{r} \text{ for potential outside.}$$

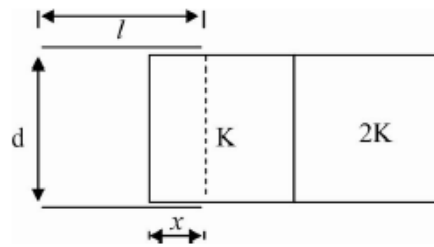
16.(B) Here  $x = vt$

$$C_0 = \frac{\epsilon_0 l^2}{d} \text{ (plates are square shaped)}$$

$$C = \frac{k \epsilon_0 lx}{d} + \frac{k \epsilon_0 (l-x)}{d} = \frac{\epsilon_0 l}{d} [l + (k-1)x]$$

$$C = C_0 + \frac{\epsilon_0 l(k-1)x}{d} \text{ \& } x = vt$$

$$C = C_0 + \frac{\epsilon_0 l(k-1)vt}{d}$$



17.(B) Apply  $i = nAv_d e \Rightarrow v_d = \frac{i}{nAe}$

18.(D)

19.(B) Direction of magnetic dipole moment  $M$  is given by screw law and this is perpendicular to plane of loop. In stable equilibrium position, angle between  $M$  and  $B$  is  $0^\circ$  and in unstable equilibrium angle is  $180^\circ$ .

20.(C) Magnetic force on the wire is given by  $\vec{F}_m = i(\vec{l} \times \vec{B})$

21.(C) Ratio of magnetic moment and angular momentum is given by  $\left(\frac{M}{L} = \frac{q}{2m}\right)$  which is a function of  $q$  and  $m$  only.

22.(C) Just before opening the switch, the current in the inductor is  $E/R$ . Energy stored in it =  $\frac{1}{2} L \left(\frac{E}{R}\right)^2$

Thus energy will dissipate in resistors  $R_1$  and  $R_2$  in the ratio  $\frac{1}{R_1}$  and  $\frac{1}{R_2}$

23.(A)  $\frac{P}{4\pi R^2} = \frac{1}{2} \epsilon_0 E^2 (c) \Rightarrow E = \sqrt{\frac{P}{2\pi R^2 \epsilon_0 C}} \quad (P = 3w) \Rightarrow E = 1.34 V/m$

24.(D) Avoid total internal reflection at the second surface.

25.(A) The vector along the ray is  $3\hat{i} + \hat{j} + 2\hat{k}$  So  $\cos \alpha = \frac{3}{\sqrt{3^2 + 1^2 + 2^2}} = \frac{3}{\sqrt{14}} \Rightarrow \alpha = \cos^{-1}\left(\frac{3}{\sqrt{14}}\right)$

26.(B)  $L = v_0 + f_e$

$$14 = v_0 + 5 \Rightarrow v_0 = 9 \text{ cm}$$

Magnifying power of microscope for relaxed eye,  $m = \frac{v_0}{u} \times \frac{D}{f_e} \Rightarrow 25 = \frac{9}{u_0} \times \frac{25}{5} \Rightarrow u_0 = 1.8 \text{ cm}$

27.(C) Centripetal acceleration =  $v^2 / r$

Further, as  $n$  increases,  $r$  increases and  $v$  decreases. So, centripetal acceleration for  $n = 2$  is less than that for  $n = 1$ . So, statement (i) is wrong.

28.(B)

29.(B)  $c.s. = 2(\Delta f)$

$$\Delta f = \frac{200}{2} = 100 \text{ KHz} \Rightarrow m_f = \frac{\Delta f}{f_m} = \frac{100}{10} = 10$$

30.(C) Here as steady state  $Q_0 = C_{eq} v$

$$Q_0 = 2 \times 10^{-6} \times 20 = 4 \times 10^{-5} \text{ C}$$

$$\text{Now, } \frac{Q_0^2}{2C} = \frac{1}{2} Li_0^2 \Rightarrow \frac{16 \times 10^{-10}}{2 \times 4 \times 10^{-6}} = \frac{1}{2} \times 2 \times 10^{-4} \times i_0^2 \Rightarrow i_0^2 = 2 \Rightarrow i_0 = \sqrt{2} \text{ amp}$$

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