JEE MAIN-2006

PHYSICS

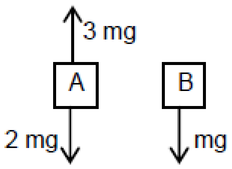
1. **Sol. (D)**

$\tau_1 = 8/9\,\mu S$

$\tau_2 = 18\mu S$

$\tau_3 = 4\mu S$

2. **Sol. (B)**



$a_A = g/2$

$a_B = g$

3. **Sol. (C)**

$$-\frac{1}{F} = \frac{2}{f_\ell} + \frac{1}{\infty} \Rightarrow F = -\frac{15}{2}$$

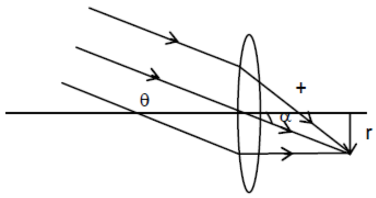
$$-\frac{2}{15} = \frac{1}{V} - \frac{1}{20}$$

$\Rightarrow v = -12\,\text{cm}$ i.e. $12\,\text{cm}$ left of AB

4. **Sol. (B)**

$r = f \tan \alpha$

Hence, $\pi r^2 \propto f^2$



5. **Sol. (B)**

Disintegration of each nuclei is independent of any factor. Hence, each nuclei has same chance of disintegration.

6. **Sol. (D)**

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow f = 5\text{cm}$$

$$\text{f} = \frac{uv}{u+v}$$

$$\frac{\Delta f}{f} = \left|\frac{\Delta u}{u}\right| + \left|\frac{\Delta v}{v}\right| + \frac{|\Delta u| + |\Delta v|}{|u| + |v|}$$

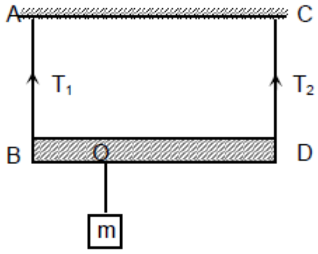
$$\Delta f = 0.15 \quad (\text{for } f = 5\text{cm})$$

The most appropriate answer is $5.00 \pm 0.10\text{cm}$

7. **Sol. (A)**

$$\frac{1}{2\ell}\sqrt{\frac{T_1}{\mu}}=\frac{1}{\ell}\sqrt{\frac{T_2}{\mu}}$$

$$T_2=T_1/4$$



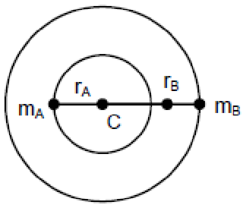
For rotational equilibrium, $T_1x=T_2\left(L-x\right)\Rightarrow x=L/5$

8. **Sol. (D)**

$$\frac{Gm_Am_B}{\left(r_A+r_B\right)^2}=\frac{m_Ar_A4\pi^2}{T_A^2}=\frac{m_Br_B4\pi^2}{T_B^2}$$

$$\Rightarrow m_Ar_A=m_Br_B$$

$$\therefore T_A=T_B$$



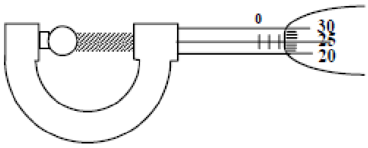
9. **Sol. (A)**

$$\frac{2}{5}MR^2=\frac{3}{2}Mr^2$$

$$r=\frac{2R}{\sqrt{15}}$$

10. **Sol. (D)**

11. **Sol. (C)**



Zero error $= 5 \times \frac{0.5}{50} = 0.05\,\text{mm}$

Actual measurement

$= 2 \times 0.5\text{mm} + 25 \times \frac{0.5}{50} - 0.05\,\text{mm}$

$= 1\text{mm} + 0.25\text{mm} - 0.05\text{mm} = 1.20\text{mm}$

12. **Sol. (B)**

$\frac{R_1}{R_2} = \frac{A_1}{A_2} = \frac{4}{1}$

$\frac{P_1}{P_2} = \frac{I^2 R_1}{I^2 R_2} = \frac{4}{1}$

$\frac{V_1}{V_2} = \frac{IR_1}{IR_2} = \frac{4}{1}$

$\frac{J_1}{J_2} = \frac{4}{1}$

13. **Sol. (A,C)**

14. **Sol. (A,B,C,D)**

The potential shown is for charged spherical conductor.

15. **Sol. (C,D)**

16. **Sol. (A,B,D)**

$$x = \frac{A}{2}(1-\cos\ 2\omega t) + \frac{B}{2}(1+\cos\ 2\omega t) + \frac{C}{2}\sin 2\omega t$$

For $A = 0, B = 0$

$$x = \frac{C}{2}\sin 2\omega t$$

For $A = -B$ and $C = 2B$

$$x = B\cos 2\omega t + B\sin 2\omega t$$

Amplitude $= |B\sqrt{2}|$

For $A = B; C = 0$

$$x = A$$

Hence this is not correct option

For $A = B; C = 2B$

$$x = B + B\sin 2\omega t$$

It is also represents SHM .

17. **Sol. (A,B,C,D)**

18. **Sol. (A,C)**

$$\frac{hc}{\lambda}-\phi=eV$$

$$V=\frac{hc}{e\lambda}-\frac{\phi}{c}$$

For plate 1: plate 2 plate 3

$$\frac{\phi_1}{hc}=0.001 \quad \frac{\phi_2}{hc}=0.002 \quad \frac{\phi_3}{hc}=0.004$$

$$\phi_1:\phi_2:\varphi_3=1:2:4$$

For plate 2, threshold wavelength

$$\lambda=\frac{hc}{\phi_2}=\frac{hc}{0.220hc}=\frac{1000}{2}=500\text{nm}$$

For plate 3, threshold wavelength

$$\lambda=\frac{hc}{\phi_2}=\frac{hc}{0.220hc}=\frac{1000}{2}=500\text{nm}$$

Since violet colour light λ is 400nm, so $\lambda_{\text{viplet}}<\lambda_{\text{threshol}}$ for plate 2

So, violet colour light will eject photo-electrons from plate 2 and not from plate 3.

19. **Sol. (A,C)**

Magnetic force on wire BC would be perpendicular to the plane of the loop along the outward direction and on wire DA the magnetic force would be along the inward normal, so net force on the wire loop is zero and torque on the loop would be along the clockwise sense as seen from O.

20. **Sol. (A,B,D)**

$$E_A = mgh_A + K_A$$

$$E_B = K_B$$

$$E_C = mgh_C + K_C$$

Using conservation of energy

$$E_A = E_B = E_C$$

$$K_B > K_C$$

$$K_B > K_A$$

$$Mg(h_A - h_C) + (K_A - K_C) = 0$$

$$\Rightarrow h_A - h_C = \frac{K_C - K_A}{Mg}$$

21. **Sol. (B)**

$$Q = Q_0\left(1 - e^{-t/\tau}\right)$$

$Q = CV\left(1 - e^{-t/\tau}\right)$ after time interval 2τ .

22. **Sol. (D)**

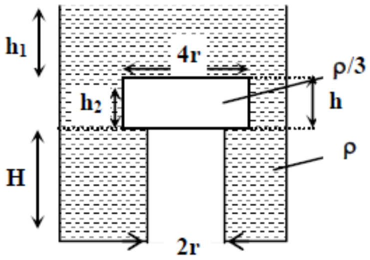
$$q = Q_0 \cos \omega t$$

$$i = -\frac{dq}{dt} = Q_0 \omega \sin \omega t$$

$$\Rightarrow i_{\text{kax}} = C\omega V = V\sqrt{\frac{C}{L}}$$

23. **Sol. (C)**

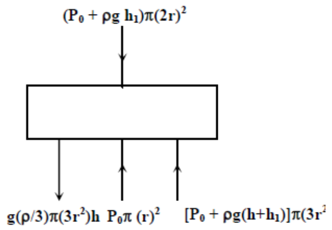
A wooden cylinder of diameter $4r$, height h and density $\rho/3$ is kept on a hole of diameter $2r$ of a tank, filled with water of density ρ as shown in the figure. The height of the base of cylinder from the base of tank is H.



24. **Sol. (C)**

$$[P_0+\rho gh_1]\pi\left(4r^2\right)+\frac{\rho}{3}\pi 4r^2hg=\left[P_0+\rho g\left(h_1+h_2\right)\right]\pi\left(3r^2\right)+P_0\pi r^2$$

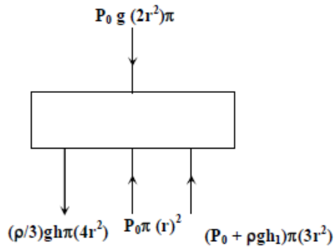
$$h_1=5h/3$$



25. **Sol. (B)**

$$P_0\pi\left(4r^2\right)+\frac{\rho}{3}\pi 4r^2hg=\left(P_0+\rho gh_2\right)\pi\left(3r^2\right)+P_0\pi r^2$$

$$h_1=4h/9$$



26. **Sol. (A)**

For $h_2 < 4h/9$ cylinder does not moves up

27. **Sol. (A)**

$[f_1 - f_2) = 4s^{-1}$

28. **Sol. (C)**

$v_1 = v_2 = 200\,\text{m/s}$

29. **Sol. (D)**

$y_1 + y_2 = A\cos 100\pi t + A\cos 92\pi t = 0$

$\cos 100\pi(2n+1)\pi - 92\pi t$

$t = \frac{(2n+1)}{192}$

$\Delta t = t_{n+1} - t_n = \frac{2}{192}$

33. **Sol.**

Torque about hinge side

$a \times \frac{b}{2} n(2mv) \times \frac{3b}{4} = Mg\frac{b}{2}$

$v = \frac{2}{3}\frac{Mg}{abnm}\frac{2}{3} \times \frac{M \times 10}{2 \times 100 \times 0.01} = 10\,\text{m/s}$

34. **Sol.**

$$\sum \Delta Q = 0$$

Heat lost by steam to convert into $0°C$ water

$$H_L = 0.05 \times 540 + 0.05 \times 10 \times 1$$

$$= 27 + 5 = 32 \text{ kcal}$$

Heat required by ice to change into $0°C$ water

$$H_g = 0.45 \times \frac{1}{2} \times 20 + 0.45 \times 80 = 4.5 + 36.00 = 40.5 \text{ kcal}$$

Thus, final temperature of mixture is $0°C$.

35. **Sol.**

$$\frac{1}{\lambda} = Rz^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{1}{\lambda} = R(11)^2\left(\frac{1}{1} - \frac{1}{n^2}\right)$$

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

$$\lambda = \frac{hr}{mvr} = \frac{rh2\pi}{nh} = \frac{2\pi r}{n}.$$

$$\lambda = \frac{2\pi r}{n} = \frac{\pi\left(0.529 \times 10^{-10}\right)n^2}{(n)(11)}$$

$$\therefore \frac{1}{\lambda} = \frac{11}{2\pi\left(0.529 \times 10^{-10}\right)n} = \frac{11}{(2\pi)\left(0.529 \times 10^{-10}\right)n} = 1.1 \times 10^7 (11)^2\left(1 - \frac{1}{n^2}\right)$$

$$=\frac{1}{(2\pi)(0.529\times10^{-10})(1.1\times10^{2})(11)}=n-\frac{1}{n}$$

$$n-\frac{1}{n}=25$$

$$n^2-1=25n$$

$$n^2-25n-1=0$$

$$n=25$$

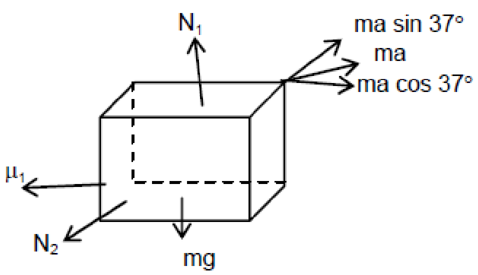
Hence answer $=24$

36. **Sol.**

$$N_1=mg$$

$$N_2=ma\sin37°$$

$$a_{bd}=\frac{ma\cos37°-\mu N_2-\mu N_1}{m}=10\,\text{m/s}^2.$$



37. **Sol.**

(A)→ (Q), (B)→(P), (S), (C)→(S), (D)→ (Q), (R)

38. **Sol.**

(A)→(P), (Q), (B)→(P), (R), (C)→(S), (P), (D)→(P), (Q), (R)

39. **Sol.**

(A)→(P), (B)→(Q), (S), (C)→(Q), (S), (D)→(Q), (R), (S)

4. **Sol.**

(A)→(P), (B)→(R), (C)→(R), (D)→ (P), (Q), (S)