IIT-JEE 2006 Solutions by MOMENTUM

(questions based on memory of students)

PHYSICS

INSTRUCTIONS:

(i) Question no. 1 to 12 has only one correct option. You will be awarded 3 marks for right answer and –1 mark for wrong answer.

(ii) Question no. 13 to 20 has one or more than one correct option(s). You will be awarded 5 marks if you answer all correct options and only correct option(s) and –1 mark will be awarded for wrong answer.

(iii) Question no. 21 to 32 are based on small write up first go through it then answer these questions. You will be awarded 5 marks for right answer and –2 marks for wrong answer.

(iv) Question no. 33 to 36 are subjective problems. Circle their correct answers. There is no negative marking for it. Each question carries 6 marks.

(v) Question no. 37 to 40 carry 6 marks each. These may have more than one correct options. There is no negative marking for these.

1. $g = \frac{4\pi^2 L}{T^2}$

A student measures g N number of times. The error is ΔL in L and ΔT in T. Which will give best result?

(a) $\Delta L = 0.5, \Delta T = 0.1, N = 20$ (b) $\Delta L = 0.5, \Delta T = 0.1, N = 50$

(c) $\Delta L = 0.5, \Delta T = 0.01, N = 20$ (d) $\Delta L = 0.1, \Delta T = 0.05, N = 50$

Sol. $\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$

In option (d) error in Δg is minimum and number of repetition of measurement are maximum. In this case the error in g is minimum.

$\therefore$ **(d)**

2. Parallel rays of light from Sun falls on a biconvex lens of focal length f and the circular image of radius r is formed on the focal plane of the lens. Then which of the following statement is correct?

(a) Area of image is πr^2 and area is directly proportional to f

(b) Area of image is πr^2 and area is directly proportional to f^2

(c) Intensity of image increases if f is increased.

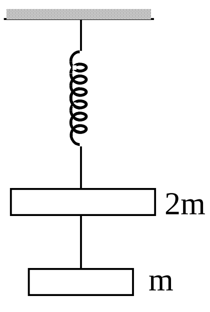
(d) If lower half of the lens is covered with black paper area will become half.

Sol. **(b)**

3. The string between mass m and 2m is inextensible. If the string is cut find the magnitudes of accelerations of mass 2m and m

(a) g, g (b) g, g/2

(c) g/2, g (d) g/2, g/2



Sol. Initially the spring force Kx = 3 mg (before the string is cut)

Just after the string is cut, for block 2m

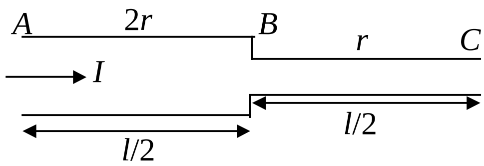
$Kx - 2mg = 2ma_1$

$\Rightarrow 3mg - 2mg = 2ma_1 \Rightarrow a_1 = g/2$

For block of mass m,

$mg = ma_2$ or $a_2 = g$ $\therefore$ **(c)**

4. If current I is flowing through ABC. Then the correct relationship is



(a) $V_{AB} = 2V_{BC}$
(b) Power across BC is 4 times the power across AB.
(c) Current densities in AB and BC are equal.
(d) Electric field due to current inside AB and BC are equal.

Sol. $R = \rho\frac{l}{A} = \rho\frac{l}{\pi r^2}$

$$R_{AB} : R_{BC} = \frac{1}{4} : 1 = 1 : 4$$

$$V_{AB} : V_{BC} = IR_{AB} : IR_{BC} = 1 : 4$$

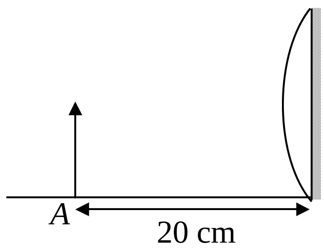
$$P_{AB} : P_{BC} = I^2R_{AB} : I^2R_{BC} = 1 : 4$$

$$j_{AB} : j_{BC} = \frac{I}{A_{AB}} : \frac{I}{A_{BC}} = 1 : 4$$

$$E_{AB} : E_{BC} = V_{AB} : V_{BC} = 1 : 4$$

$\therefore$ **(b)**

5. Focal length of the plano-convex lens is 15 cm. The object is at A as shown in the figure. The plane side is silvered. The image is



(a) 60 cm to the left of lens
(b) 12 cm to the left of lens
(c) 60 cm to the right of lens
(d) 30 cm to the left of lens

Sol. Focal length F of equivalent mirror is given by

$$\frac{1}{F} = \frac{2}{f_e} + \frac{1}{f_m} = \frac{2}{15} + \frac{1}{\infty} \qquad \text{or} \qquad F = \frac{15}{2} \text{ cm}$$

The equivalent mirror will concave mirror of focal length $\frac{15}{2}$ cm.

Now for a spherical mirror,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{F}$$

$$\Rightarrow \quad \frac{1}{v} + \frac{1}{-20} = \frac{-2}{15} \qquad \Rightarrow \quad \frac{1}{v} = \frac{-2}{15} + \frac{1}{20} = \frac{-8+3}{60} = -\frac{5}{60} = -\frac{1}{12}$$

v = -12 cm

$\therefore$ **(b)**

6. Double star system consists of two stars A and B which have time period T_A and T_B, Radius R_A and R_B and mass M_A and M_B. Choose the correct option.

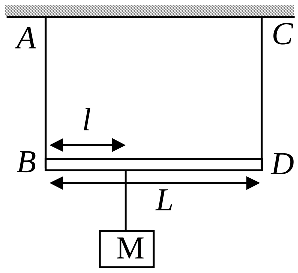
(a) If $T_A > T_B$ then $R_A > R_B$
(b) If $T_A > T_B$ then $M_A > M_B$
(c) $\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{R_A}{R_B}\right)^3$
(d) $T_A = T_B$

Sol. For binary star the time period of two stars are equal.

$\therefore$ **(d)**

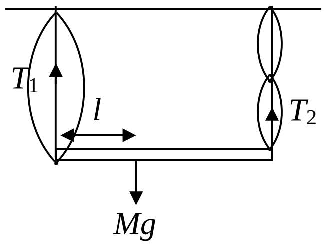
7. In the arrangement shown, calculate from where the mass should be hanged so that wire (2) vibrates in second harmonic and wire (1) in first harmonic?

(a) $\frac{L}{5}$ (b) $\frac{L}{4}$ (c) $\frac{4L}{5}$ (d) $\frac{3L}{4}$



Sol. $v = \lambda f$

$$\frac{\sqrt{\frac{T_1}{\mu}}}{\sqrt{\frac{T_2}{\mu}}} = \frac{2Lf}{Lf} \Rightarrow \frac{T_1}{T_2} = 4$$



$T_1 + T_2 = Mg$

$T_2 = Mg/5$

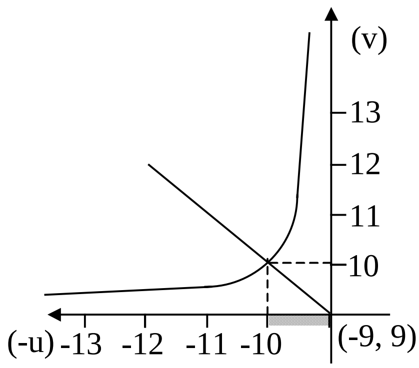
$\Sigma\tau_B = 0 \Rightarrow Mg \times l = (Mg/5) \times L$

$l = L/5$

$\therefore$ **(a)**

8. The graph between object distance (u) and image distance (v) is as shown in the figure. What is the focal length of the convex lens?

(a) 5.00 cm, ±0.05 cm (b) 5.00 cm, ±0.10 cm
(c) 0.5 cm, ± 0.05 cm (d) 0.5 cm, ±0.10 cm

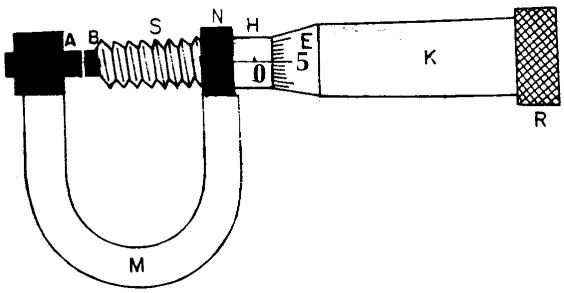


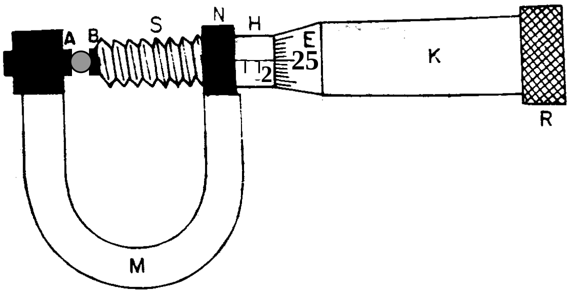
Sol. $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{2}{v} \Rightarrow f = \frac{v}{2}$

$$\Delta f = \frac{\Delta v}{2} = \frac{0.1}{2} = 0.05 \text{ cm}$$

$\therefore$ **(a)**

9. The circular scale of a screw gauge has 50 divisions and pitch of 0.5 mm. Find the diameter of sphere. Main scale reading is 2.

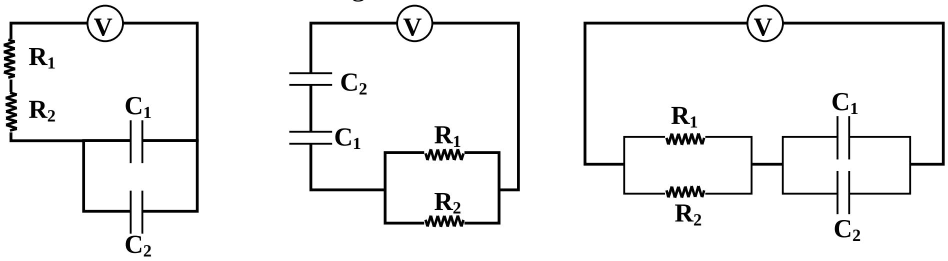




(a) 1.2 (b) 1.25 (c) 2.20 (d) 2.25

Ans. **(a)**

10. Find the time constant for the given RC circuits in correct order.



$R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$, $C_1 = 4\ \mu F$, $C_2 = 2\ \mu F$

(a) 18, 4, 8/9 (b) 18, 8/9, 4 (c) 4, 18, 8/9 (d) 4, 8/9, 18

Sol. $\tau_{eq} = R_{eq}.C_{eq}$

$$\tau_1 = (2 + 1)(2 + 4) = 18\ \mu s$$

$$\tau_2 = \frac{2\times1}{2+1}.\frac{2\times4}{2+4} = \frac{8}{9}\ \mu s$$

$$\tau_3 = \frac{2\times1}{2+1}.(4+2) = 4\ \mu s$$

∴ **(b)**

11. $^{221}_{87}Ra$ undergoes radioactive decay with half life 4 days. What is the probability that a nucleus undergoes decay in two half lives

(a) 1 (b) 1/2 (c) 3/4 (d) 1/4

Sol. Required probability $= 1 - e^{-\lambda t} = 1 - e^{-\lambda(2T)} = 1 - e^{-\frac{(\ln 2)}{T}(2T)} = 1 - e^{-2\ln 2} = 1 - \frac{1}{4} = \frac{3}{4}$

∴ **(c)**

12. A solid sphere of mass M and radius R having moment of inertia I about its diameter is recast into a solid disc of radius r and thickness t. The moment of inertia of the disc about an axis about the edge and perpendicular to the plane is I. The relation between radius R and r

(a) $r = \sqrt{\frac{2}{15}}R$ (b) $r = \frac{2}{\sqrt{15}}R$ (c) $r = \frac{2}{15}R$ (d) $r = \frac{\sqrt{2}}{15}R$

Sol. Moment of inertia of sphere $I = \frac{2}{5}MR^2$

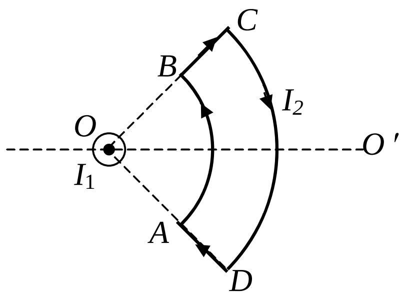
Moment of inertia of disc about an axis passing through its edge and perpendicular to its plane

$$I = I_{cm} + Mh^2 = \frac{Mr^2}{2} + Mr^2 = \frac{3}{2}Mr^2$$

$$\Rightarrow \quad \frac{2}{5}MR^2 = \frac{3}{2}Mr^2 \quad \text{or} \quad r = \frac{2}{\sqrt{15}}R$$

∴ **(b)**

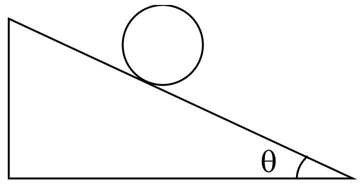
13. Current I_1 is flowing out from the plane of paper. A steady state current I_2 is flowing in the loop ABCD.
(a) The net force is zero
(b) The net torque is zero
(c) As seen from O, the loop will rotate in clockwise along OO′ axis
(d) As seen from O, the loop will rotate in anticlockwise direction along OO′ axis.



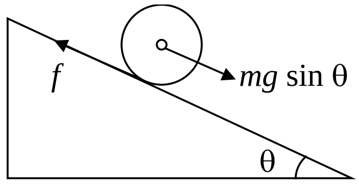
Sol. The magnetic force on AB and CD part of the loop will be zero because on this part $d\vec{l}$ and $\vec{B}$ are parallel and anti-parallel. The magnetic force on BC part will act upward and on DA part the force is of equal magnitude but in downward direction. These two forces will produce a torque in clockwise sense when viewed from O.

∴ **(a) & (c)**

14. A solid cylinder is rolling down the inclined plane without slipping. Which of the following is/are correct?
(a) The friction force is dissipative
(b) The friction force is necessarily changing
(c) The friction force will aid rotation but hinder translation
(d) The friction force is reduced if θ is reduced



Sol. Acceleration of center of mass of cylinder



$$a_{cm} = \frac{g\sin\theta}{1+\frac{I_{cm}}{MR^2}} = \frac{g\sin\theta}{1+\frac{MR^2/2}{MR^2}} = \frac{2g\sin\theta}{3}$$

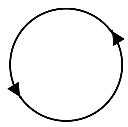
Since $Mg\sin\theta - f = Ma_{cm} = M\frac{2g\sin\theta}{3}$

$\Rightarrow \quad f = \frac{Mg\sin\theta}{3}$

So, if θ is reduced friction f will also decrease.
The work done by friction will be zero since point of application of friction force is instantaneously at rest. Hence frictional force is not dissipative. Since frictional force is static, its value can lie from 0 to $\mu mg\cos\theta$ but not necessarily equal to $\mu mg\cos\theta$.
The frictional force will provide torque for rotation but it will oppose translation.

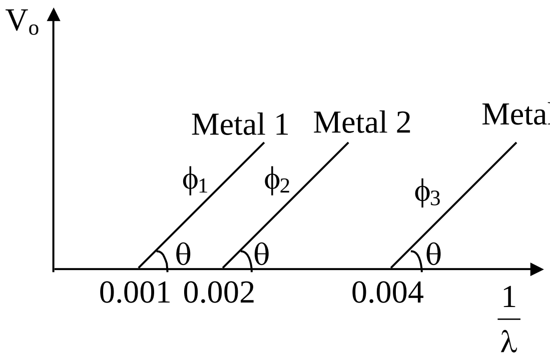
∴ **(c), (d)**

15. The following field line do not represent
(a) induced electric field
(b) magnetostatic field
(c) Gravitational field of a mass at rest
(d) electrostatic field



Sol.(c), (d)

16. The graph between the stopping potential (V_o) and wave number ($1/\lambda$) is as shown in the figure. ϕ is the work function, then
(a) $\phi_1 : \phi_2 : \phi_3 = 1 : 2 : 4$
(b) $\phi_1 : \phi_2 : \phi_3 = 4 : 2 : 1$
(c) $\tan\theta \propto hc/e$ where θ is the slope
(d) ultraviolet light can be used to light photoelectrons from metal 2 and metal 3 only



Sol. $\phi_1 : \phi_2 : \phi_3 = \frac{hc}{\lambda_{o_1}} : \frac{hc}{\lambda_{o_2}} : \frac{hc}{\lambda_{o_3}} = \frac{1}{\lambda_{o_1}} : \frac{1}{\lambda_{o_2}} : \frac{1}{\lambda_{o_3}} = 1 : 2 : 4$

From Einstein's photoelectric equation

$$\frac{hc}{\lambda} = \phi + eV_s \qquad \Rightarrow \qquad V_s = \frac{hc}{e\lambda} - \frac{\phi}{e}$$

Therefore slope $\tan\theta = \frac{hc}{e}$

$$\frac{1}{\lambda_{o_1}} = 0.001\ \text{nm}^{-1} \qquad \Rightarrow \qquad \lambda_{o_1} = 1000\ \text{nm} = 10000\ \text{Å}$$

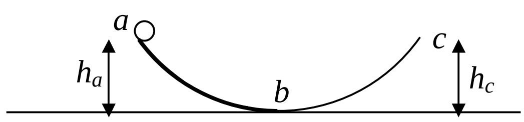
$$\frac{1}{\lambda_{o_2}} = 0.002\ \text{nm}^{-1} \qquad \Rightarrow \qquad \lambda_{o_2} = 500\ \text{nm} = 5000\ \text{Å}$$

$$\frac{1}{\lambda_{o_3}} = 0.004\ \text{nm}^{-1} \qquad \Rightarrow \qquad \lambda_{o_3} = 250\ \text{nm} = 2500\ \text{Å}$$

Hence UV light can be used to eject photoelectrons from all the metals 1, 2 and 3.

$\therefore$ **(a), (c)**

17. The ball rolls down without slipping (which is at rest at a) along ab having friction. It rolls to a maximum height h_c where bc has no friction. K_a, K_b and K_c are kinetic energies at a, b and c.

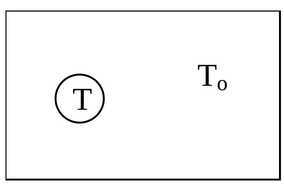


(a) $K_a = K_c$, $h_a = h_c$ (b) $K_b > K_c$, $h_a = h_c$
(c) $K_b > K_c$, $h_a < h_c$ (d) $K_b > K_c$, $h_a > h_c$

Sol. Since part bc is frictionless, torque on the ball on this part is zero and hence its angular velocity will be constant on this part. Further from conservation of mechanical energy $h_c < h_a$.

$\therefore$ **(d)**

18. A black body of temperature T is inside chamber of T_o temperature initially. Now the closed chamber is slightly opened to sun such that temperature of black body (T) and chamber (T_o) remains constant.



(a) Black body will absorb more radiation.
(b) Black body will absorb less radiation
(c) Black body emit more energy
(d) black body emit energy equal to energy absorbed by it

Sol. Since the temperature of the black body is constant. So heat absorbed = heat radiated.

$\therefore$ **(d)**

19. $y = A\sin^2\omega t + B\cos^2\omega t + C\sin\omega t\cos\omega t$.
For what value of A, B and C it will represent SHM
(a) for all value of A, B and C ($C \neq 0$) (b) $A = B$, $C = 2B$
(c) $A = -B$, $C = 2B$ (d) $A = B$, $C = 0$

Sol. $y = A\sin^2\omega t + B\cos^2\omega t + C\sin\omega t\cos\omega t$.

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

$$y = \frac{A}{2} + \frac{B}{2} + \left(\frac{B-A}{2}\right)\cos 2\omega t + \frac{C}{2}\sin 2\omega t$$

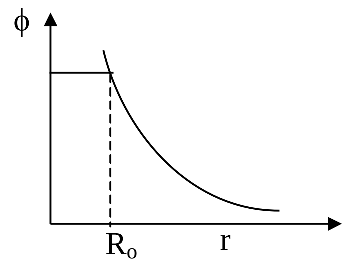
By the above equation, we can find that option (a), (b) and (c) are correct for represent SHM.

∴ **(a), (b) & (c)**

20. Spherical symmetric charge system centered at origin.

Electric potential $\phi = \dfrac{Q}{4\pi\varepsilon_o R_o}$ $r \le R_o$

$\phi = \dfrac{Q}{4\pi\varepsilon_o r}$ $r > R_o$



(a) A spherical symmetry at $r = 2R_o$ encloses a net charge Q
(b) Electric field is discontinued at $r = R_o$
(c) Change is only present at $r = R_o$
(d) Electrostatic energy is zero for $r < R_o$

Sol. For $r > R_o$, $E = -\dfrac{d\phi}{dr} = \dfrac{Q}{4\pi\varepsilon_o r^2}$

Charge enclosed by the concentric spherical surface of $r = 2R_o$

$$= \varepsilon_o\phi_C = \varepsilon_o E \times 4\pi \times r^2 = \varepsilon_o \frac{Q}{4\pi\varepsilon_o r^2} 4\pi r^2 = Q$$

For $r < R_o$, $E = -\dfrac{d\phi}{dr} = 0$ (Θ c = constant)

For $r > R_o$, $E = -\dfrac{d\phi}{dt} = \dfrac{Q}{4\pi\varepsilon_o r^2}$

Since for $r < R_o$, $E = 0$, hence charge will be only on the spherical surface of $r = R_o$.

For $r < R_o$, $E = 0 \Rightarrow$ energy density $\dfrac{1}{2}\varepsilon_o E^2 = 0$

∴ **(a), (b), (c) and (d)**

∴

Passage I

$y_1 = A\cos(0.5\pi x - 100\pi t)$
$y_2 = A\cos(0.46\pi x - 92\pi t)$

21. How many time is a second does a stationary observer hears loud sound (maximum intensity)

(a) 4 (b) 8 (c) 10 (d) 12

Sol. $\omega_1 = 100\pi$

$f_1 = \dfrac{\omega}{2\pi} = 50$ Hz, $f_2 = \dfrac{92\pi}{2\pi} = 46$ Hz

Beat frequency = $f_1 - f_2 = 4$

∴ **(a)**

22. What is velocity of sound wave?

(a) 200 m/s (b) 180 m/s (c) 100 m/s (d) 194 m/s

Sol. $v = \omega/K = 100\pi/(0.5\pi) = 200$

∴ **(a)**

23. At x = 0, how many times does the net amplitude between 0 in 1 s

(a) 46 (b) 42 (c) 50 (d) 100

Sol. At x = 0,

$y = y_1 + y_2 = 2A \cos 96\pi t \cos 4\pi t$

For y = 0, $\cos 96\pi t = 0$ or $\cos 4\pi t = 0$

$\Rightarrow$ $96\pi t = (2n + 1)(\pi/2)$ and $4\pi t = (2m + 1)\pi/2$

For $0 < t < 1$

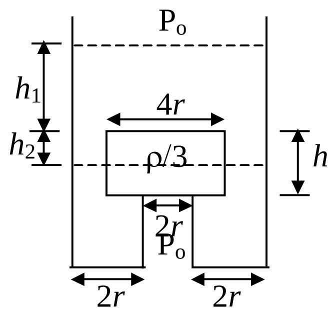
$-\frac{1}{2} < n < 95.5$ and $-\frac{1}{2} < m < 3.5$

Here n and m are integers, therefore net amplitude becomes zero 100 times.

$\therefore$ **(d)**

Passage II

The density of block is $\rho/3$ and is used to block a hole H.

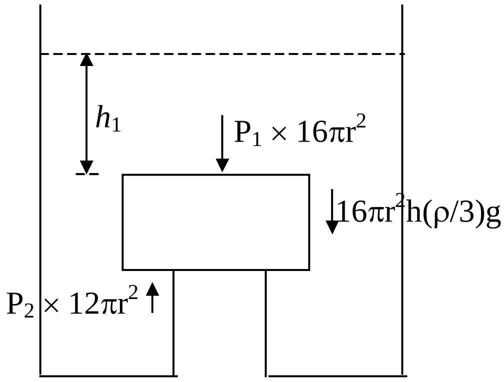


24. If liquid of density ρ is filled in the apparatus find out h_1 (h_1 is the height of upper surface of water level from the top of the block) so that cylinder just starts rising.

(a) $h_1 = \frac{2}{3}h$ (b) $h_1 = \frac{5}{3}h$

(c) $h_1 = \frac{5}{2}h$ (d) $h_1 = \frac{2}{5}h$

Sol. The net upward force on block due to pressure



$P_2 \times 12\pi r^2 - P_1 \times 16\pi r^2$

$= \rho g(h_1 + h)12\pi r^2 - \rho g h_1 \times 16\pi r^2$

$= \rho g h \times 12\pi\rho^2 - \rho g h_1 \times 4\pi r^2$

The block will rise if

$\rho g \times 4\pi r^2 (3h - h_1) > 16\pi r^2 h(\rho/3)g$

$(3h - h_1) > \frac{4}{3}h$

$\frac{5h}{3} > h_1$

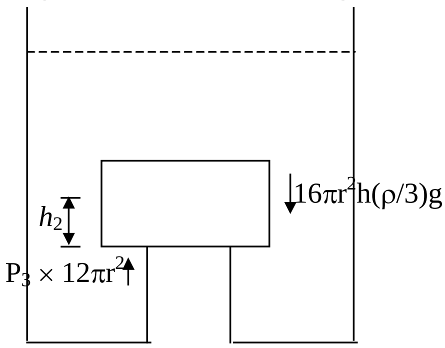
$h_1 = \frac{5h}{3}$

$\therefore$ (b)

25. If the water level is lowered such that it comes below the top of the block keeping the block constant at which height h_2 (h_2 is depth of the upper surface of water level from the top of the block) will the block be at a stable condition?

(a) $h_2 = \frac{4h}{9}$ (b) $h_2 = \frac{h}{3}$ (c) $h_2 = \frac{2h}{9}$ (d) $h_2 = \frac{2h}{3}$

Sol. The upward force on block due to pressure



$P_3 \times 12\pi r^2 + (2h_2) = \rho g h_2 \times 12\pi r^2$

$\rho g h_2 \times 12\pi r^2 = 16\pi r^2 h(\rho/3)g$

$$h_2 = \frac{16h}{12 \times 3} = \frac{4h}{9}$$

$\therefore$ (a)

26. If water level is lowered below h_2, then

(a) the block will not rise (b) the block will start rising again at $h_2 = h/3$

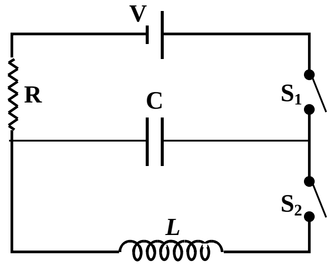
(c) the block will start rising again at $h_2 = h/2$ (d) the block will start rising again at $h_2 = h/5$

Sol.If water level is further decrease below h_2 the upward force on block due to pressure will become less that the weight of block, therefore, the block will not rise.

∴ ∴ **(a)**

Passage III

27. In the given circuit, initially S_1 is closed and S_2 is open then if maximum charge is Q_o



(a) Charge $Q = \frac{Q_o}{2}$ in time $t = \tau$

(b) Charge $Q = Q_o(1 - e^{-2})$ in time $t = 2\tau$

(c) work done by battery = $\frac{1}{2}$ energy dissipated in resistor.

(d) Charge $Q = Q_o(1 - e^{-1})$ in time $t = 2\tau$

Sol. In one time constant the charge on capacitor is 63% of maximum charge.

At $t = 2\tau$, $Q = Q_o(1 - e^{-2\tau/\tau}) = Q_o(1 - e^{-2})$

∴ **(b)**

28. In the above L-C circuit the charge Q on capacitor at any time can hold a value

(a) $Q = Q_o \cos\left(\frac{\pi}{2} - \omega t\right)$ (b) $Q = Q_o \cos\left(\frac{\pi}{2} + \omega t\right)$

(c) $Q = -LC\frac{d^2Q}{dt^2}$ (d) $Q = \frac{1}{\sqrt{LC}}\frac{d^2Q}{dt^2}$

Sol. $Q = Q_o \cos \omega t$

and $\frac{d^2Q}{dt^2} = -\frac{Q}{LC}$ (from KVL)

∴ **(c)**

29. After S_2 is closed, then which one is correct?

(a) The current always flows in one direction

(b) The energy is exchanged between the capacitor and the inductor

(c) The energy initially is magnetic

(d) The value of a maximum instantaneous current $I = V\sqrt{\frac{L}{C}}$

Sol. From energy conservation,

$$\frac{1}{2}LI^2 = \frac{1}{2}CV^2 \quad \Rightarrow \quad I = \sqrt{\frac{C}{L}}V$$

∴ **(b)**

Passage IV

Passage was very lengthy and could not be retrieved.

33. If 0.05 kg steam at 373 K is mixed with 0.45 kg ice at -20°C then find the resultant temperature.

Sol. Heat required to melt the entire ice

$= ms\Delta T \times mL = 0.45 \times 0.5 \times 20 + 0.45 \times 80 = 40.5$ k cal.

Maximum heat which can be supplied by steam

$= mL + ms\Delta T = 0.05 \times 540 + 0.05 \times 1 \times 100 = 27 + 5 = 32$ kcal

Therefore the entire ice will not melt hence the resultant temperature of mixture will be 0°C.

34. Determine the value of n for which the de-Broglie wavelength corresponding to nth orbit is equal to wavelength of nth line of Lymann series. Given Z = 11.

Sol. de Broglie wavelength of electron in the nth orbit is given by

$2\pi r = n\lambda_1$

$\Rightarrow \quad \lambda_1 = \frac{2\pi r}{n} = \frac{2\pi}{n} \times 0.53 \frac{n^2}{Z} \times 10^{-10}$ m

Wavelength of nth line of Lymann series is given by

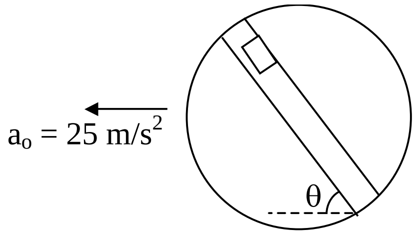
$$\frac{1}{\lambda_2} = RZ^2\left(1 - \frac{1}{(n+1)^2}\right) = 1.097 \times 10^7 \times 11^2 \times \frac{(n^2 + 2n)}{(n+1)^2}$$

Since $\lambda_1 = \lambda_2$

$$\Rightarrow \quad \frac{2\pi}{n} \times 0.53 \times \frac{n^2}{Z} \times 10^{-10} = 1 / \left\{ 1.097 \times 10^7 \times 11^2 \left(\frac{n^2 + 2n}{(n+1)^2}\right)\right\}$$

Solving this we get $n = 25$

35. A disc is kept on a smooth horizontal plane with its plane parallel to horizontal plane. A groove is made in the disc as shown in the figure. The coefficient of friction between a mass m inside the groove and the surface of the groove is 2/5 and sin θ = 3/5. Find the acceleration of mass with respect to the frame of reference of the disc.



Sol.

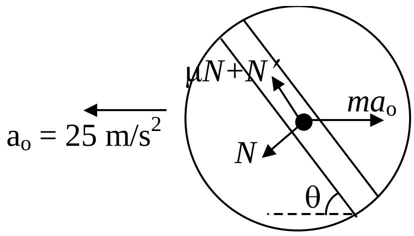
$$f = \mu(N + N')$$

$$f = \frac{2}{5} m(a \sin\theta + g)$$

and $\quad a' = a\cos\theta - \frac{f}{m}$

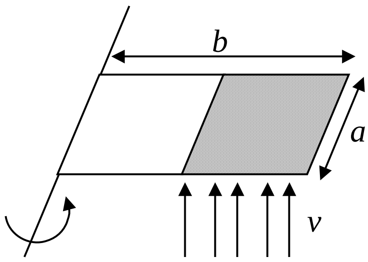
$$= 25 \times \frac{4}{5} - \frac{2}{5}\left(25 \times \frac{3}{5} + 10\right)$$

$= 20 - 6 - 4 = 10$ m/s^2



36. If n number of balls each of mass m collide elastically with the plate of mass M per second with a velocity v elastically and reflect back. Find the velocity of balls such that plate is at equilibrium.

Given: n = 100, m = 0.01 kg, M = 3 kg



Sol. Force applied by striking balls = rate of change of momentum = n × 2mv

For equilibrium net torque should be zero.

$$\Rightarrow \quad Mg \times \frac{b}{2} = n \times 2mv \times \frac{3b}{4}$$

$$\Rightarrow \quad v = \frac{Mg}{3nm} = \frac{3 \times 10}{3 \times 100 \times 0.01} = 10 \text{ m/s}$$

Match the following

37.

Column 1	Column 2
(a) Angular magnification	(P) Dispersion of lenses
(b) Sharpness of the image	(Q) f_o and f_e
(c) Light gathering power	(R) Aperture of lenses

(d) Length of telescope | (S) Spherical aberration

Sol.

(a) P **Q** R S   (b) **P** Q R **S**

(c) P Q **R** S   (d) P **Q** R S

38.

Column 1	Column 2
(a) Fission	(P) Matter - energy
(b) Fusion	(Q) In atoms of high atomic number only
(c) β - decay	(R) In atoms of low atomic number only
(d) Exothermic nuclear	(S) Involves weak nuclear forces

Sol.

(a) **P** **Q** R S   (b) **P** Q **R** S

(c) P Q R **S**   (d) **P** Q R S

39.

Column 1	Column 2
(a) Uniformly charged ring	(P) Electric field is present
(b) A dielectric ring with uniformly distributed charge is rotating with constant angular velocity.	(Q) Magnetic field is present
(c) A wire carrying constant current	(R) Induced electric field is present
(d) $I = I_o \cos \omega t$	(S) Magnetic moment is present.

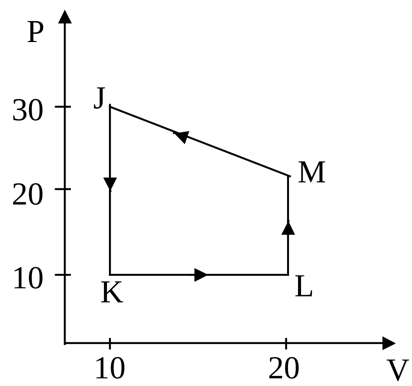
Sol.

(a) **P** Q R S   (b) **P** **Q** R **S**

(d) P **Q** R S   (d) P **Q** **R** S

40.

Column 1	Column 2
(a) JK process	(P) $\Delta W > 0$
(b) KL process	(Q) $\Delta W < 0$
(c) LM process	(R) $\Delta Q > 0$
(d) MJ process	(S) $\Delta Q < 0$



Sol.

(a) P Q R **S**   (b) **P** Q **R** S

(c) P Q **R** S   (d) P **Q** R **S**