1) $\varepsilon_0 = M^{-1} L^{-3} T^4 I^2$

$L = L$

$\Delta V = M L^2 T^{-3} I^{-1}$

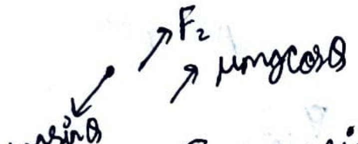
$\Delta t = T$

$\varepsilon_0 L \frac{\Delta V}{\Delta t} = I$

2)

3)

$F_1 = mg\sin\theta + \mu mg\cos\theta$

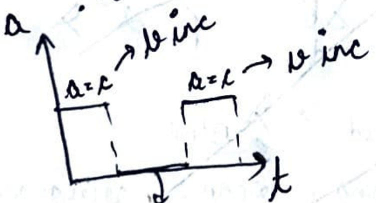


$F_2 = mg\sin\theta - \mu mg\cos\theta$

$\frac{F_1}{F_2} = \frac{\tan\theta + \mu}{\tan\theta - \mu}$ $(\tan\theta = 2\mu)$

$\frac{F_1}{F_2} = 3$

4)

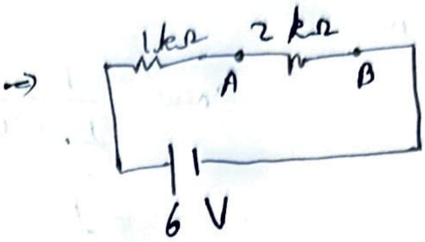


$a = 0 \rightarrow v =$ constant

5) Direct formula

$\left(\frac{1+e^2}{1-e^2}\right) h$

6) steady state $\Rightarrow$ capacitor broken wire



$3k\Omega \; i = 6$

$i = 2\,mA$

$V_{AB} = 2\,mA \times 2k\Omega$

$= 4$ Volt

$q = CV$

$q_1 = 1\,\mu F \times 4$ volt

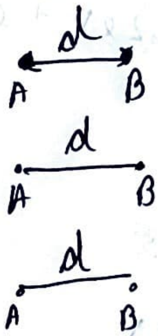
$q_1 = 4\,\mu C$

$q_2 = 2\,\mu F \times 4$ volt

$q_2 = 8\,\mu C$

7) Forward Bias

8)



$d = v_1 t_1$

$d = v_2 t_2$

$d = (v_1 + v_2) t$

$\Rightarrow t = \frac{d}{v_1 + v_2} = \frac{d}{\frac{d}{t_1} + \frac{d}{t_2}}$

$\Rightarrow t = \frac{t_1 t_2}{t_1 + t_2}$

9) $a_{max} = A\omega^2$

$= 2 \times \left(\frac{\pi}{2}\right)^2 = \frac{\pi^2}{2} cm/s^2$

10) $L = m r^2 \omega$ $\quad i = \frac{q}{T} = \frac{q\omega}{2\pi}$

$B = \frac{\mu_0 i}{2r} = \frac{\mu_0 q \omega}{2\pi r}$

$\frac{B}{L} = \frac{\mu_0 q \omega}{2\pi r m r^2 \omega} \propto \frac{q}{m}$

11)

$m v = \frac{m' v}{2}$

$m' = 2m$

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

$\lambda_{new} = \frac{h}{\frac{m}{2} \times 2v}$

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

Same

12) $B \to C \to PV = \text{constant}$

Rectangular Hyperbola

only in option (c)

as Temp constant

$PV = nRT$

13) $\Delta E = 13.6\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$n_1 = 1 \quad n_2 = 2$

$V_e = KE$

$\Delta E = 10.2$

~~10.2 =~~ $E = \phi + KE$

$10.2\, eV = 4.2\, eV + eV$

$V = 6$ Volt

15) ~~14)~~ $\frac{1}{\lambda_{min}} = R\left(1 - \frac{1}{\infty}\right)$

$\lambda_{min} = \frac{1}{R}$

$\frac{1}{\lambda_{max}} = R\left(1 - \frac{1}{4}\right)$

$\lambda_{max} = \frac{4}{3R} = \frac{4P}{3}$

14) $R = \frac{V}{I}$

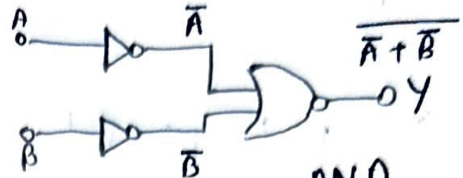
$\frac{\Delta R}{R}\% = \frac{\Delta V}{V}\% + \frac{\Delta I}{I}\%$

$= \frac{0.4}{25} \times 100 + \frac{3}{200} \times 100$

$= 1.6 + 1.5$

$= 3.1\%$

16)



AND

17) $\vec{F} = a\hat{i} + b\hat{j} + c\hat{k}$

$a = \frac{a}{m}\hat{i} + \frac{b}{m}\hat{j} + \frac{c}{m}\hat{k}$

$u = 0$
↓
initial velocity

$s = \frac{1}{2}at^2$

$s = \frac{at^2}{2m}, \frac{bt^2}{2m}, \frac{ct^2}{2m}$

18) $\delta = 30°$
$i = 15°$
$e = 60°$

$\delta = i + e - A$

$30 = 15 + 60 - A$

$A = 45°$

19) $\frac{\Delta l}{l} = \cancel{8}\frac{T}{AY}$

$\frac{\Delta l}{l} = \frac{mg}{AY} = \frac{10 \times \cancel{10}\, 12}{2 \times 10^{-4} \times 2 \times 10^{11}}$

$\frac{\Delta l}{l} = 3 \times 10^{-6}$

20) $A = \lambda N$

$A \propto N$

st line graph

21) $P = Vi$

$\frac{1}{4} = \frac{56}{10} i$

$i = \frac{10}{4 \times 56}$

V across resistor $= 10 - 5.6$
$= 4.4$

$V = iR$

$4.4 = R_s \times \frac{10}{4 \times 56}$

$R_s = 98.56\,\Omega$

22) $a = \frac{dv}{dt} \rightarrow$ slope

$a = -5$

$v = u + at$

$v = 50 - 5(2) = 40\ m/s$

$W = \Delta KE$ (Work Energy Theorem)

$W = \frac{1}{2}m(v_f^2 - v_i^2)$

$W = \frac{1}{2} \times 10 (40^2 - 50^2)$

$W = -4500 J$

23) $g_{eff} = \frac{GM}{r^2} = \frac{GM}{4R^2} = \frac{\pi^2}{4}$

$T = 2\pi \sqrt{\frac{l}{g_{eff}}} = 2\pi \sqrt{\frac{4 \times 4}{\pi^2}}$

$T = 2 \times 4 = 8$ sec

24) $V_0 = 220\sqrt{2}$

V_{peak} $\quad V_{rms} \times \sqrt{2}$

$f = 50$ Hz

$\omega = 2\pi f = 100\pi$

$V = V_0 \cos(\omega t)$

$V = 220\sqrt{2} \cos(100\pi t)$

25) $\beta = \frac{\lambda D}{d} \quad \beta \propto \lambda$

$\lambda_{red} > \lambda_{Blue}$

$\Rightarrow$ fringes become narrower

26) Work done by external agent $= \Delta V q$

$V_C = 0$

$V_D = \frac{k(-q)}{l} + \frac{k(+q)}{3l}$

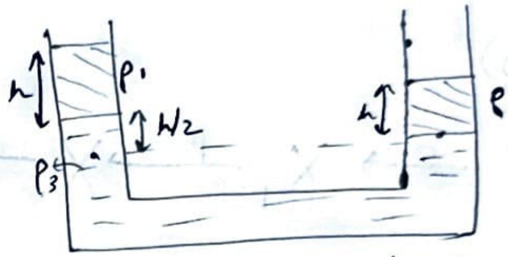
$V_D = -\frac{2kq}{3l}$

$\Delta V = -\frac{2kq}{3l} = \frac{-q}{6\pi\epsilon_0 l}$

$Q\Delta V = \frac{-Qq}{6\pi\epsilon_0 l}$

(in both the cases)

27)



In a continuous liq pressure is same at same height level.

$P_0 + h\rho_1 g + \frac{h}{2}\rho_3 g = P_0 + h\rho_2 g$

$\rho_3 = 2(\rho_2 - \rho_1)$

28) $x_{com} = \frac{\int dm\, x}{\int dm}$

$dm = \rho\, dV$

$dm = \rho_0 \frac{x^2}{L^2} a\, dx$

$x_{com} = \frac{\int_0^L \frac{\rho_0 x^3}{L^2} a\, dx}{\int_0^L \frac{\rho_0 x^2}{L^2} a\, dx}$

$x_{com} = \frac{3l}{4}$

29) $E_t = 2 \sin(\omega t)$ N/C

$F = Eq$

$F = 2 \sin(\omega t)$ N

$a = 2 \times 10^{-3} \sin(\omega t)$ m/s²

~~$x = x \sin \omega t$~~

$a = \omega^2 x \rightarrow$ SHM

$v_{max} = A\omega$

$A\omega^2 = 2 \times 10^{-3}$

$A\omega \times 10^3 = 2 \times 10^3$

$A\omega = 2$ m/s

30)

$X \xrightarrow{\alpha} X_1 \xrightarrow{\beta} X_2 \xrightarrow{\alpha} X_3 \rightarrow X_4$

$X_4 \Rightarrow 172, 69$

$X_3 \rightarrow$ (Same γ no diff in mass no. & atomic no.)

$X_2 = 172+4, 69+2$

${}_2\alpha^4 \Rightarrow X_2 = 176, 71$

$X_1 = 176, 70$

$({}_{-1}\beta^0)$

$X = 176+4, 70+2$

$X = 180, 72$

31) $E_{total} = \left(\frac{hc}{\lambda}\right)^N \Rightarrow E/1sec = \frac{hc}{\lambda}(N/sec)$

$\therefore E/sec = \boxed{P = \frac{hc}{\lambda}(N/sec)}$ $\because$ Power $= \frac{Energy}{time}$

$$P = \frac{6.6 \times 10^{-34}(3 \times 10^{8})(10^{20})}{660 \times 10^{-9}}$$

$= 30W$

(A)

---

32) when θ is close to θ_0 (surrounding), Newton's Law of cooling is applicable.

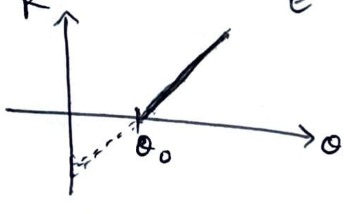
i.e. $\underbrace{\frac{dQ}{dt}}_{\text{Rate of cooling}} = R \propto (\theta - \theta_0)$

(or)

$\boxed{\begin{array}{l} R = K\theta - K\theta_0 \\ Y = mX - c \end{array}}$

after, $\theta = \theta_0$ reaches, rate becomes 0

i.e. no further 'cooling' occurs.



Rate of cooling $\rightarrow$ (−ve) means it will heat

i.e. θ (body) increases which will not happen.

Hence, the part below x-axis won't exist.

Ans:- (B)

~~Ques~~ Application.

33) Buoyant Force $(F_b) = dVg$

$d \rightarrow$ density of liquid ~~/gas~~

$V \rightarrow$ Volume of liquid displaced

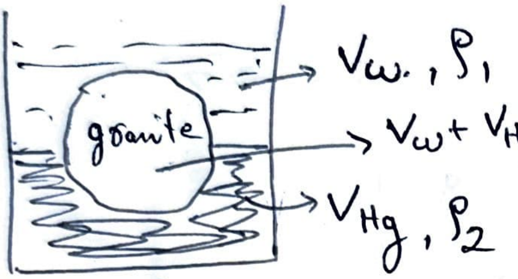
$\because$ The granite body is at equilibrium,

$\therefore \; mg = (F_b)_{net}$ —— (1)

$\left[d = \dfrac{m}{V} \right]$

$\Downarrow$

$(m = Vd)$



using eqn (1),

$$\therefore \underbrace{(V_w + V_{Hg})\rho \cancel{g}}_{mg} = \underbrace{\rho_1 V_w \cancel{g}}_{\text{Buoyant force due to water}} + \underbrace{\rho_2 V_{Hg} \cancel{g}}_{\text{due to Hg.}}$$

Dividing by V_{Hg},

$\left[\text{let } \dfrac{V_w}{V_g} = x \text{ (required)} \right]$

$$(x+1)\rho = \rho_1 x + \rho_2$$

$$\Rightarrow x\rho + \rho = \rho_1 x + \rho_2$$

$$\Rightarrow \rho - \rho_2 = x(\rho_1 - \rho)$$

$$\Rightarrow x = \frac{\rho - \rho_2}{\rho_1 - \rho} \Rightarrow \boxed{x = \frac{\rho_2 - \rho}{\rho - \rho_1}}$$

(A)

34) $C = \gamma_{liq} - 3A$ — (I)

$S = \gamma_{liq} - 3X$ — (II)

X ← linear coefficient of expansion of silver.

Using Both eq^n,

$S - C = -3X + 3A$

$\Rightarrow 3X = 3A + C - S$

$\Rightarrow \boxed{X = \dfrac{3A + C - S}{3}}$ (B)

---

3 $\propto (A)^{1/3}$

35) $y = 5\sin\left(\frac{\pi}{3}x\right)\cos(40\pi t)$

$k = \frac{2\pi}{\lambda} = \frac{\pi}{3}$

$\hookrightarrow \boxed{\lambda = 6\,cm}$

b/w 2 adjacent nodes,
$\lambda/2$ separation is there

$\therefore \boxed{\frac{\lambda}{2} = 3\,cm}$ Ans.

39) $v_{rms} = \sqrt{\frac{3RT}{M}}$

$v_{avg} = \sqrt{\frac{8}{\pi}\frac{RT}{M}}$

$v_{m.p.} = \sqrt{\frac{2RT}{M}}$

(by solving from maxwell Boltzmann distribution curve.

$\therefore \boxed{v_{mp} < v_{avg} < v_{rms}}$ (C)

~~avg KE = $\frac{1}{2}m\left(\frac{8RT}{\pi M}\right) = \frac{1}{2}mV$~~

avg. KE $= \frac{1}{2}m V_{rms}^2 = \frac{1}{2}m\left(\sqrt{\frac{3}{2}}V_p\right)^2$

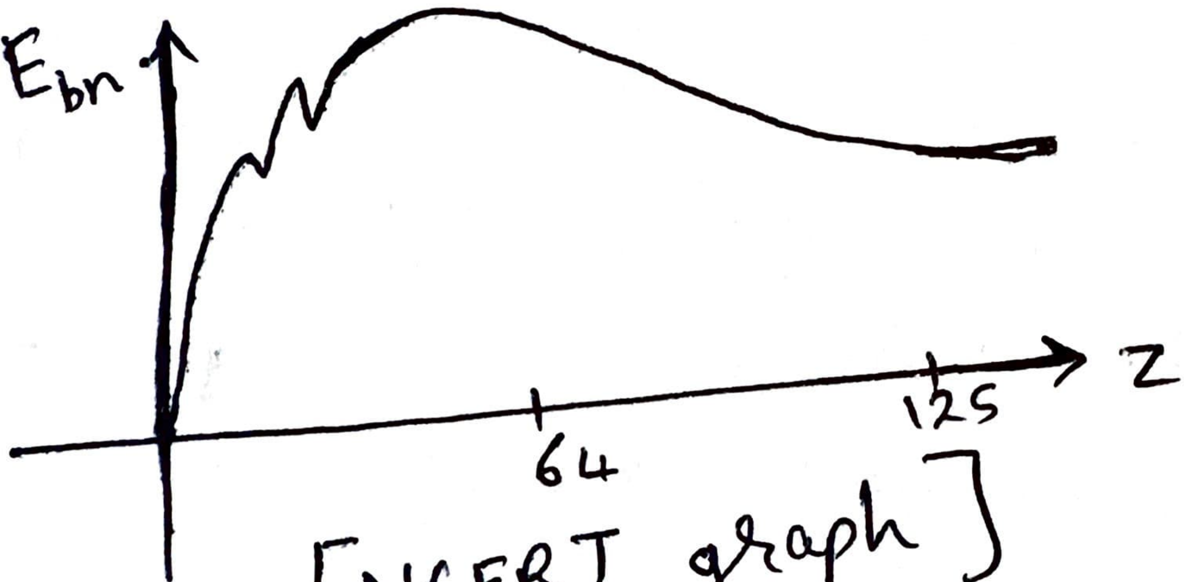
$= \boxed{\frac{3}{4}mv_p^2}$ (D)

$\left[\because v_{rms} = \sqrt{\frac{3}{2}}\,v_p\right]$

5) $r \propto (A)^{1/3}$

$$\therefore \frac{r_A}{r_B} = \left(\frac{64}{125}\right)^{1/3} = \frac{4}{5}$$

$$\Rightarrow r_A = \frac{4 r_B}{5} \Rightarrow \text{clearly, } \boxed{r_B > r_A} \text{ (A)}$$



[NCERT graph]

Hence, $\boxed{E_{bn}A > E_{bn}B}$ (C)

$k\sqrt{\;}$ $\sqrt{10x}$

Q37) at $x = 0.15\ m$ $y = 0$ $\therefore$ node

at $x = 0.3$ $y = -0.02\cos(50\pi t + \ldots$

$\therefore$ anti-node

$\lambda = \frac{2\pi}{k} = \frac{2\cancel{\pi}}{10\cancel{\pi}} = 0.2$

$\therefore$ Ans : (A, B, D)

38) $G \rightarrow M^{-1}L^{3}T^{-2}$

$c \longrightarrow LT^{-1}$

$h \longrightarrow ML^{2}T^{-1}$

$$L = (M^{-1}L^{3}T^{-2})^{x}(LT^{-1})^{y}(ML^{2}T^{-1})^{z}$$

$\therefore$ $-x+z=0 \longrightarrow \boxed{x=z}$ — (i)

$\boxed{3x+y+2z=1}$ — (ii)

$\boxed{+2x+y+z=0}$ — (iii)

(ii) − (iii) : $x+z=1$

Using (i), $2x=1 \Rightarrow \boxed{x=\frac{1}{2}=z}$

Using it in (ii),

$$\frac{3}{2} + y + \cancel{\frac{x}{2}} = \cancel{x}$$

$$\rightarrow \boxed{y = \frac{-3}{2}}$$

Hence,

$$x = z = \frac{1}{2} \quad , \quad y = \frac{-3}{2}$$

(B) (D)

39) $v_{rms} = \sqrt{\frac{3RT}{M}}$

$v_{avg} = \sqrt{\frac{8}{\pi}\frac{RT}{M}}$

$v_{m.p.} = \sqrt{\frac{2RT}{M}}$

(by solving) from maxwell Boltzmann distribution curve.

$\therefore \boxed{v_{mp} < v_{avg} < v_{rms}}$ (C)

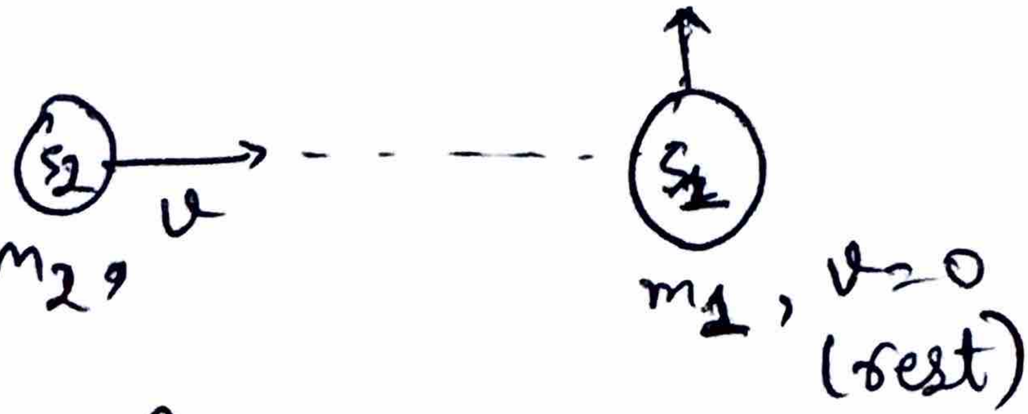
~~avg KE = $\frac{1}{2} m \left(\frac{8RT}{\pi M}\right) = \frac{1}{2} m V$~~

$avg \cdot KE = \frac{1}{2} m V_{rms}^2 = \frac{1}{2} m \left(\sqrt{\frac{3}{2}} V_p\right)^2$

$\left[\because v_{rms} = \sqrt{\frac{3}{2}} v_p\right]$

$= \boxed{\frac{3}{4} m V_p^2}$ (D)

40)



LMC

$$m_2 v \hat{i} = m_1 \bar{u} + \cancel{\frac{m_2 v}{2}} \frac{m_2 v}{2}\hat{j}$$

$$\Rightarrow \quad \frac{m_2 v}{m_1}\left(\hat{i} - \frac{\hat{j}}{2}\right) = \bar{u}$$

$$|u| = \frac{m_2 v}{m_1}\left|i - \frac{j}{2}\right| = \frac{v\sqrt{5}}{2}\cdot\frac{m_2}{m_1}$$

$$\& \quad \tan\theta = \frac{1}{2} \text{ or } -\frac{1}{2}$$

(A)

(C)