$K = m\omega^2$

Const. force does not change time period. It shift mean position by $\frac{F}{K}$

$V = \omega\sqrt{A^2 - x^2}$

$|f'(0) = K|$

$T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\sqrt{\frac{I}{K}}$

$F = -Kx$ $\qquad \tau = -K\theta = I\alpha$

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

$a = -\omega^2 x$

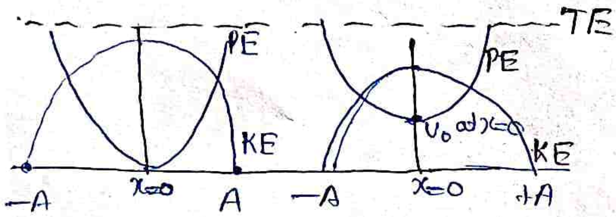
$KE(x) = \frac{1}{2}m\omega^2(A^2 - x^2)$

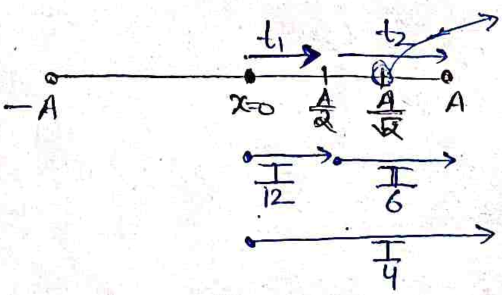
$PE(x) = \frac{1}{2}m\omega^2 x^2$

$TE = \frac{1}{2}m\omega^2 A^2 = \text{const.}$

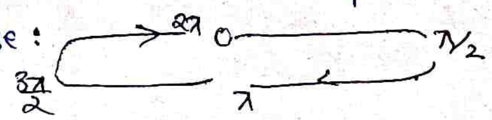
$\frac{d^2x}{dt^2} + \frac{K}{m}x = 0$

$\hookrightarrow x = A\sin(\omega t + \phi)$





Phase :

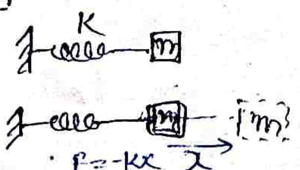


$x = A\sin\omega t$

Phase : 0 → Right side जा रहा है

Phase : π → left side जा रहा है।

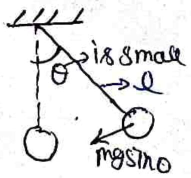
3.



$\Rightarrow ma = -Kx$

$a = -\left(\frac{K}{m}\right)x$ $\;(\omega^2)$

$T = 2\pi\sqrt{\frac{m}{K}}$



$\tau = -K\theta$

$I\alpha = -mg\sin\theta \approx \theta$

$I\alpha = \tau = -(mg\sin\theta)l$

$ml^2\alpha = mg\theta l$

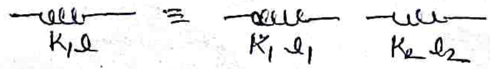
$ml\alpha = -mg\theta$

$\alpha = -\left(\frac{mg}{ml}\right)\theta$

$\alpha = -\left(\frac{g}{l}\right)\theta$ $\;(\omega)$

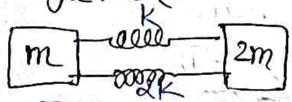
$T = 2\pi\sqrt{\frac{l}{g}}$

6. Spring cut ($Kl = \text{Const.}$)



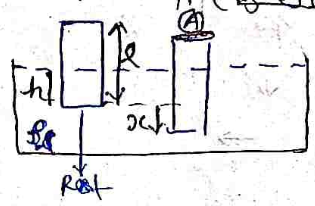
$Kl = K_1 l_1 = K_2 l_2$

7. Two Block system (reduced mass, $\mu_{sys} = \frac{m_1 m_2}{m_1 + m_2}$)



$T = 2\pi\sqrt{\frac{\mu_{red}}{K_{eq}}}$

8. Block in liq. ($\rho_s < \rho_L$)



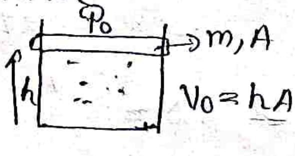
At eqm

$\frac{\rho_s}{\rho_L} = \frac{h}{L}$

$T = 2\pi\sqrt{\frac{h}{g}} = 2\pi\sqrt{\frac{m}{A\rho_L g}}$

9. SHM of piston in cylinder

Piston given small displacement → Isothermal / Adiabatic



$V_0 = hA$

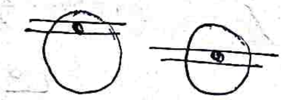
Isothermal: $T = 2\pi\sqrt{\frac{mV_0}{P_0A^2}}$

Adiabatic: $T = 2\pi\sqrt{\frac{mV_0}{\gamma P_0 A^2}}$

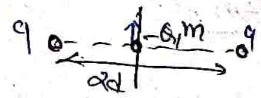
10 SHM in Tunnel in a planet :

both case it same

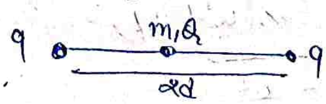
$T = 2\pi\sqrt{\frac{R}{g}}$



11. SHM of charge



$T = 2\pi\sqrt{\frac{md^3}{2KQq}}$



$T = 2\pi\sqrt{\frac{md^3}{4KQq}}$

12. Physical pendulum

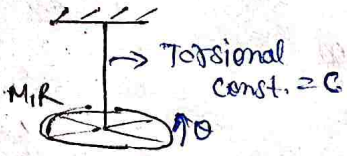
$T = 2\pi\sqrt{\frac{I}{mgd}}$ → about (hinge pt.) (लटके होने वाले hinge pt.) की दूरी

$\frac{2MR^2}{MgR}$

$T = 2\pi\sqrt{\frac{2R}{g}}$

$\frac{MR^2 + MR^2}{2}$

13. TORSional pendulum



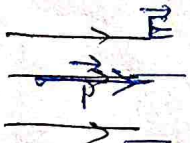
$\tau = -C\theta$

$I\alpha = -C\theta$

$\alpha = -\frac{C}{I}\theta$

$$T = 2\pi\sqrt{\frac{I}{C}}$$

14. SHM of Dipole in field



$$T = 2\pi\sqrt{\frac{I}{PE}}$$

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

$$T = 2\pi\sqrt{\frac{L}{g_{eff}}}$$

$g_{eff} = g + a$ ↑a

$g_{eff} = g - a$ ↓a

$g_{eff} = \sqrt{a^2 + g^2}$ →a

16. $Y = A_1 \sin\omega t + A_2 \sin(\omega t + \phi)$

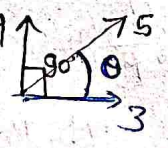
$= A_{res} \sin(\omega t + \theta)$

$A_{res} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$

$\theta = \tan^{-1}\left(\frac{A_2\sin\phi}{A_1 + A_2\cos\phi}\right)$

Ex $Y = \overset{A_1}{3}\sin(\omega t + 30°) + \overset{A_2}{4}\sin(\omega t + 120°)$ $\Delta\phi = 90°$

$y = 5\sin(\omega t +$



$\theta = \tan^{-1}\left(\frac{A_2\sin 90°}{A_1 + A_2\cos 90°}\right)$

$= \tan^{-1}\frac{A_2}{A_1} = \tan\frac{4}{3}$

$$\theta = \tan^{-1}\frac{4}{3}$$

$$A(t) = A_0 e^{-bt/2m}$$

$y = A(t)\cos(\omega' t + \phi)$

$\omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$