Oscillations

$$\boxed{\omega = \sqrt{\frac{k}{m}}}$$

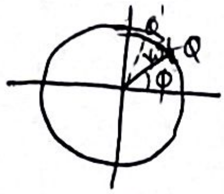
→ $\omega = 2\pi n$; rad/s

→ $f = -kx$

$a = \frac{f}{m} = \frac{-kx}{m}$

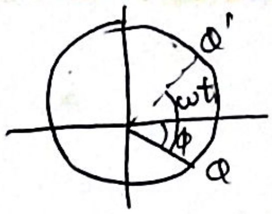
→ $a = -\omega^2 x$

→ $v = \omega\sqrt{A^2 - x^2}$



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

→ particle agae se chalu hua → mean se



$x = A\sin(\omega t - \phi)$

→ particle picha se chalu hua → mean se

max: $V_{max} = \omega A$ → at mean
$a_{max} = -\omega^2 A$ → at extreme

min: $V_{min} = 0$ → at extreme
$a_{min} = 0$ → at mean

Energy in S.H.M

$K.E = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2(A^2 - x^2) = \frac{1}{2}k(A^2 - x^2)$

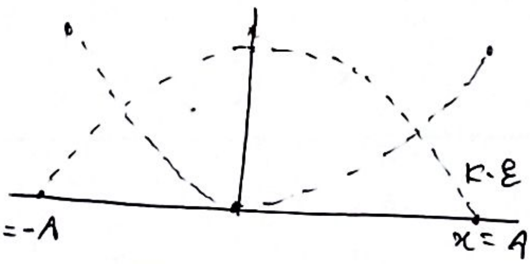
max, $x = 0$, mean: $K.E = \frac{1}{2}kA^2$

min, $x = A$, extreme: $K.E = 0$

$\boxed{P.E = \frac{1}{2}kx^2}$ → max $= \frac{1}{2}kA^2$; min $= 0$

$T.E = P.E + K.E = \frac{1}{2}kA^2$

→ GRAPH K.E v/s P.E w.r.t. x is always parabola.



Eq^n of S.H.M $= A\sin\omega t + B\cos\omega t$

Resultant amplitude $R = \sqrt{A^2 + B^2}$

Initial phase $(\phi) = \tan^{-1}\left(\frac{B}{A}\right)$
angle

disp $\xrightarrow{90^\circ}$ vel $\xrightarrow{90^\circ}$ acc

disp $\xrightarrow{180^\circ}$ acc

General eq^n

$$\boxed{\begin{aligned} x &= A\sin(\omega t + \phi) \\ x &= A\cos(\omega t + \phi) \end{aligned}}$$

ϕ → initial or epoch phase

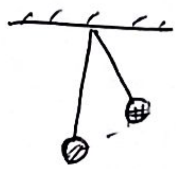
$\omega t + \phi$ → phase

Time period in liner S.H.M

$$\boxed{T = 2\pi\sqrt{\frac{m}{k}}}$$

Simple Pendulum

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



$$\boxed{\omega = \sqrt{\frac{g}{l}}}$$

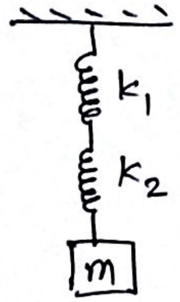
note:- (for <10%) only.

① Length of simple. P increase by x% ⇒ T↑ by x/2 %

② g↓ by y% ⇒ T↑ = y/2 %

Spring pendulum

(1)



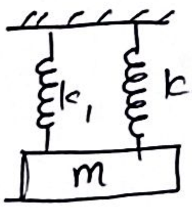
$$\frac{1}{k_e} = \frac{1}{k_1} + \frac{1}{k_2} = \frac{k_1+k_2}{k_1k_2}$$

$$\boxed{k_e = \frac{k_1k_2}{k_1+k_2}}$$

$$T = 2\pi\sqrt{\frac{m}{k_{eq}}} = 2\pi\sqrt{\frac{m(k_1+k_2)}{k_1k_2}}$$

$$\boxed{T = 2\pi\sqrt{\frac{m(k_1+k_2)}{k_1k_2}}}$$

(2)

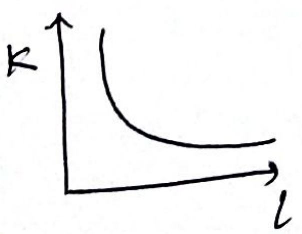


$$\boxed{k_e = k_1 + k_2}$$

$$T = 2\pi\sqrt{\frac{m}{k_{eq}}} = 2\pi\sqrt{\frac{m}{k_1+k_2}}$$

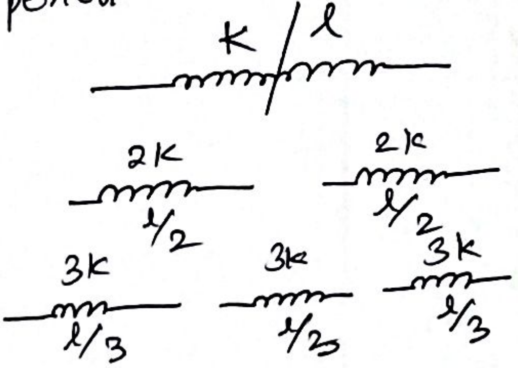
$$\boxed{T = 2\pi\sqrt{\frac{m}{k_1+k_2}}}$$

Note :- $k \propto \frac{1}{l}$



Note :- Spring of force constant k is cut in N equal parts & mass m is attached to one part then its period

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



Note :- spring of length l → cuted in l_1 & l_2 such that $l_1 = n l_2$ then $\boxed{k_1 = \frac{k(n+1)}{n}}$ $\boxed{k_2 = (n+1)k}$

Potential Energy stored : $\boxed{U = \frac{F^2}{2k}}$ $= \frac{1}{2}kx^2$ $\boxed{F = -kx}$

k = spring constant

Phase difference $= (\omega_1 - \omega_2)t$