Oscillations Mindmap..

Simple Harmonic Motion →

- **Periodic Motion**: motion that repeats itself after regular interval of time.
- **Oscillation**: motion in which body moves to and fro or back and forth about a fixed point.
- **Simple Harmonic Motion**: accⁿ of an oscillating body is directly proportional to displacement of body from the mean position.

$$\boxed{a = -Ky}$$

- **Displacement in S.H.M.** → $\boxed{y = A\sin(\omega t + \phi)}$

$A \rightarrow$ amplitude $\quad \boxed{\omega = \frac{2\pi}{T}}$

$\omega \rightarrow$ angular Velocity

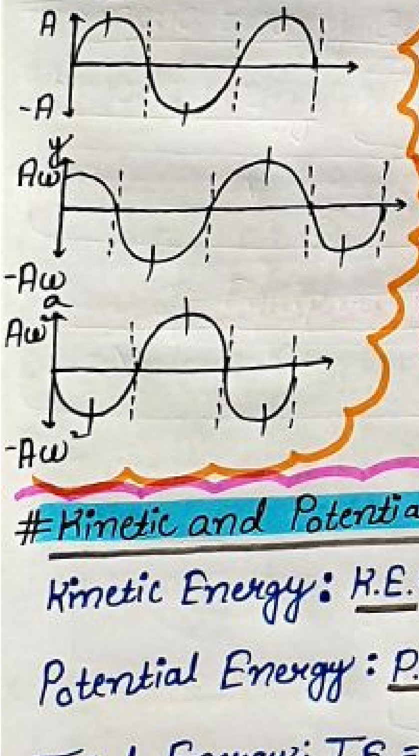
$\phi \rightarrow$ initial phase.

- **Velocity of a body in S.H.M.** →

$$\boxed{v = \frac{dy}{dt} = A\omega\cos(\omega t + \phi) = \omega\sqrt{A^2 - y^2}}$$

- **Acceleration of a body in S.H.M.** →

$$\boxed{a = \frac{dv}{dt} = -A\omega^2\sin(\omega t + \phi) = -\omega^2 y}$$



Simple Pendulum and Physical Pendulum →

- **Time period of a simple pendulum**:— $\boxed{T = 2\pi\sqrt{\frac{l_{eff}}{g_{eff}}}}$

If length is comparable to radius of Earth: →

$$\boxed{T = 2\pi\sqrt{\frac{R_e}{(1 + R_e/l)g}}}$$

- **Physical Pendulum**:—

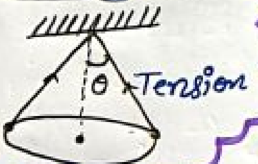
$\underline{I_0}$ = M.O.I. of body about the axis passing through point of suspension.

$\underline{l}$ = distance of C.O.M from point of suspension.

$$\boxed{T = 2\pi\sqrt{\frac{I_0}{mgl}}}$$

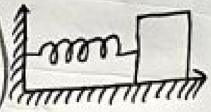
- **Conical Pendulum**:—

Time period $\boxed{T = 2\pi\sqrt{\frac{l\cos\theta}{g}}}$



Other Systems: →

- Torsional Pendulum: $\boxed{T = 2\pi\sqrt{\frac{I}{K}}}$ K = Tortional Constant.
- Spring Block System: $\boxed{T = 2\pi\sqrt{\frac{m}{K_{eff}}}}$



- Combination of Springs:

In Series: $\underbrace{\frac{1}{K_{eff}} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3} + \ldots}$

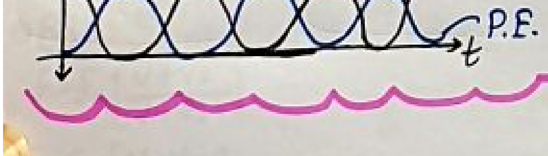
In parallel: $\underline{K_{eff} = K_1 + K_2 + K_3 + \ldots}$

Kinetic and Potential Energy in SHM →

Kinetic Energy: $\underline{K.E.} = \frac{1}{2}m\omega^2(A^2 - y^2)$

Potential Energy: $\underline{P.E.} = \frac{1}{2}m\omega^2 y^2$

Total Energy: $\underline{T.E.} = \frac{1}{2}m\omega^2 A^2$



Forced Oscillations and Resonance :—

(a) For small damping: $\boxed{A = \frac{F_0}{m(\omega^2 - \omega_d^2)}}$ (driving frequency far from natural frequency).

(b) Driving frequency close to Natural frequency (Resonance): →

$$\boxed{A = \frac{F_0}{\omega_0 b}}$$

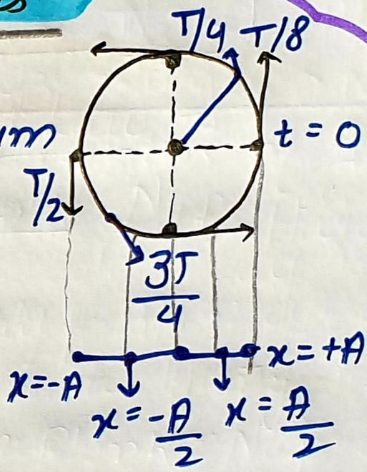
ω = natural frequency

ω_d = driving frequency

Circle Diagram and Damped Oscillations →

- **Analogy b/w SHM and Circular Motion:**

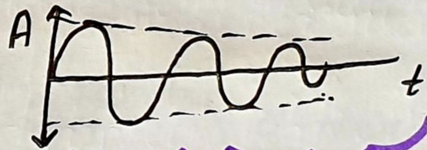
→ The projection of particle doing uniform circular motion on x-axis or y-axis does S.H.M.



- **Damped Oscillations →**

Damped Frequency, $\boxed{\omega' = \sqrt{\frac{K}{m} - \frac{b^2}{4m^2}}}$

Amplitude, $\boxed{A = A_0 e^{\frac{-bt}{2m}}}$



NEET SLAYER