SIMPLE HARMONIC MOTION

Time Period

(i) Simple pendulum: $T = 2\pi\sqrt{\frac{l}{g}}$

(ii) Physical pendulum: $T = 2\pi\sqrt{\frac{I}{mgl}}$

(iii) Torsional pendulum: $T = 2\pi\sqrt{\frac{I}{c}}$

Equation of SHM

(i) Linear : $a = -\omega^2 x$

(ii) Angular : $\alpha = -\omega^2\theta$

Mass Spring system

(i) $T = 2\pi\sqrt{\frac{m}{k}}$

(ii) Two bodies system $T = 2\pi\sqrt{\frac{\mu}{K}}$

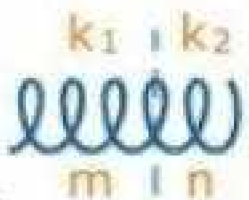
Where $(\mu) = \frac{m_1 m_2}{m_1 + m_2}$

Combination of Springs

(i) Series : $\frac{1}{k_{eff}} = \frac{1}{k_1} + \frac{1}{k_2}$

(ii) Parallel : $k_{eff} = k_1 + k_2$

(iii) Spring cut into two parts in ratio m:n



$k_1 = \frac{(m+n)k}{m}$, $k_2 = \frac{(m+n)k}{n}$

Composition of 2 SHM

$x_1 = A_1 \sin \omega t$

$x_2 = A_2 \sin(\omega t + \phi)$

$x = A \sin(\omega t + \delta)$ Where

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

and $\tan\delta = \frac{A_2\sin\phi}{A_1 + A_2\cos\phi}$

SHM

Linear SHM

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

(ii) Velocity : $\frac{dx}{dt} = A\omega\cos(\omega t + \phi)$

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

(iii) Acceleration : $\frac{d^2x}{dt^2} = -A\omega^2\sin(\omega t + \phi)$

$= -\omega^2 x$

(iv) Phase : $\omega t + \phi$

(v) Phase Constant : ϕ

Energy in SHM

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

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

(iii) $E = K + U = \frac{1}{2}m\omega^2A^2$

= Constant.

Angular SHM

(i) Displacement : $\theta = \theta_0\sin(\omega t + \phi)$

(ii) Angular Velocity : $\frac{d\theta}{dt} = \theta_0\omega\cos(\omega t + \phi)$

(iii) Acceleration : $\frac{d^2\theta}{dt^2} = -\theta_0\omega^2\sin(\omega t + \phi)$

$= -\omega^2\theta$

(iv) Phase : $\omega t + \phi$

(v) Phase Constant : ϕ