Oscillations - Part 01

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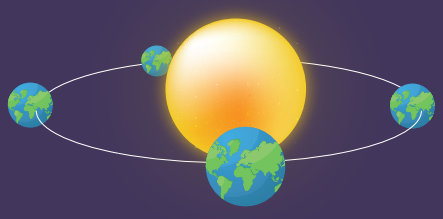
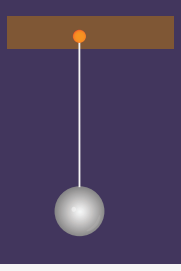
Periodic Motion Motion that repeats itself in equal intervals of time.





Time period (T) The time interval after which the motion repeats itself.

Frequency (ν) The number of repetitions per unit time. $\nu = \frac{1}{T}$

Oscillatory motion Repeated to and fro motion of an object.

Low frequency ➡ Oscillatory motion

High frequency ➡ Vibration

Simple Harmonic Motion (SHM)

- SHM is the simplest form of oscillatory motion.
- Force on the oscillating body

  α

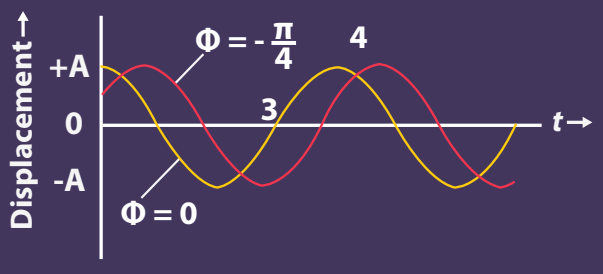
  Displacement from the mean position
- Direction of the force is always towards the mean position.

SHM is represented by the equation

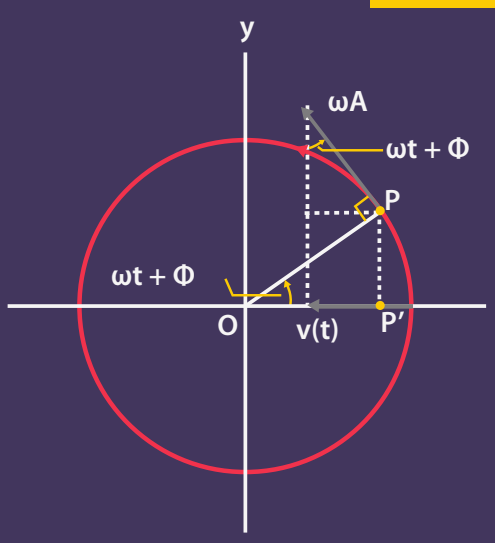
$$x(t) = A \cos (\omega t + \Phi)$$

x(t) = Displacement A = Amplitude

ω = Angular frequency = $\frac{\pi}{4}$ Φ = Phase constant



Velocity & Acceleration in SHM



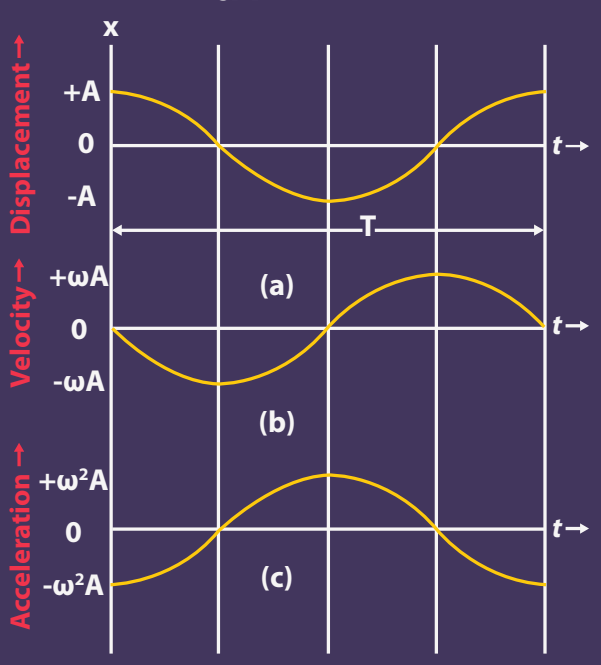
$$v(t) = -\omega A \cos (\omega t + \Phi) \qquad v(t) = \frac{d}{dT} x(t)$$

ωA = -Velocity Amplitude

$$a(t) = -\omega A^2 \cos (\omega t + \Phi) \qquad a(t) = \frac{d}{dT} v(t)$$

Velocity lags displacement by a phase angle of $\frac{\pi}{2}$.

Acceleration lags displacement by a phase angle of π.



Force acting on a particle executing SHM

$$F(t) = -kA \cos (\omega t + \Phi) \qquad k = m\omega^2$$

Represent Periodic function as sine and cosine functions

$$f(t) = A \sin \omega t + B \cos \omega t$$

$$f(t) = D \sin (\omega t + \Phi)$$

$$D = \sqrt{A^2 + B^2} \qquad \Phi = tan^{-1} \frac{B}{A}$$