OSCILLATORY MOTION

A periodic (or oscillatory) motion is one in which an object vibrates or oscilates back and forth, over the same path. Examples of periodic motion include an object on the end of a spring, a tuning fork, a pendulum etc. The following terms are used in describing oscillatory motion

1. Displacement: The distance x of the oscillating object from the equilibrium point at any moment
2. Amplitude
3. Cycle
4. Period: Time taken to complete 1 cycle
5. Frequency: f
6. Angular frequency: $\omega = 2\pi f$
7. Restoring force: This is the force that restores the object to the equilibrium position. It always acts in opposite direction to the motion of the object

SIMPLE HARMONIC MOTION

A body is said to be undergoing simple harmonic motion if the net restoring force F is directly proportional to the negative of the displacement.

$F = -cx$

A body that undergoes SHM is called a **harmonic oscillator**.

For a body of mass m, attached to a string of constant k

When a body is at equilibrium, the net force acting on the body at that point is zero.

$F = -kx$

$ma = -kx$

$m\frac{d^2x}{dt^2} = -kx$

$a = \frac{d^2x}{dt^2} = \frac{-kx}{m}$

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

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

$\frac{dx}{dt} = -\omega A\sin(\omega t + \phi)$

$\frac{d^2x}{dt^2} = -\omega^2 A\cos(\omega t + \phi)$

$\omega^2 = \frac{k}{m}$

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

Maximum Velocity, $v_{max} = \omega A$ occurs when the oscillating body is passing through its equilibrium point, x = 0.

The phase angle tells us at what point in the cycle the motion was at t=0

Recall,

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

$$v = \frac{dx}{dt} = -\omega A \sin(\omega t + \phi)$$