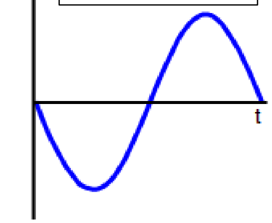
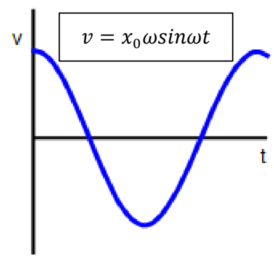
Variation with time, *t*

The graphs and equations vary with initial settings. (At t=0, x=0, v=0,)

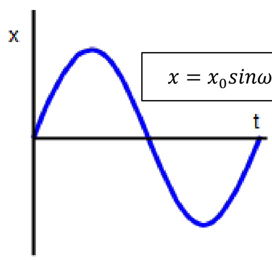
$$a = -x_0\omega^2 sin\omega t$$



$$v = x_0\omega sin\omega t$$



$$x = x_0 sin\omega t$$



$$KE = \frac{1}{2}m\omega^2 {x_0}^2 cos^2\omega t$$

$$TE = \frac{1}{2}m\omega^2 {x_0}^2$$

$$PE = TE - KE = \frac{1}{2}m\omega^2 {x_0}^2 sin^2\omega t$$

Simple Harmonic Motion:

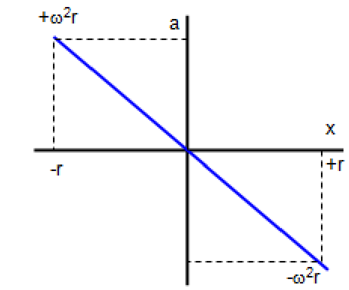
Simple Harmonic Motion: an oscillation motion whose acceleration is directly proportional to the displacement from its equilibrium point, and is always directed towards that point or is in opposite direction to displacement.

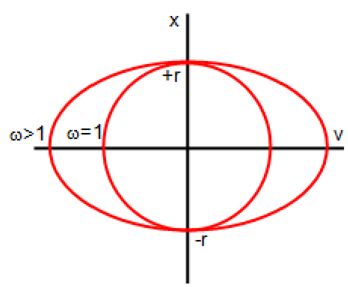
$$a = -\omega^2 x$$

$$v = \pm\omega\sqrt{{x_0}^2 - x^2}$$

Variation with displacement, *x*

The graphs and equations are unchanged with respect to the initial settings.





$$KE = \frac{1}{2}m\omega^2({x_0}^2 - x^2)$$

$$PE = \frac{1}{2}m\omega^2 x^2$$

$$TE = \frac{1}{2}m\omega^2 {x_0}^2$$

Angular Frequency

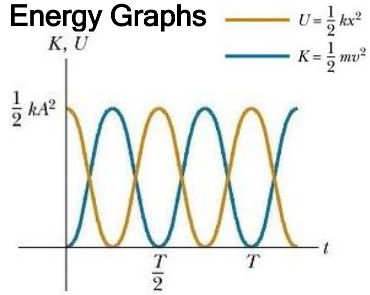
$$\omega = 2\pi f = \frac{2\pi}{t}\ rad\ s^{-1}$$

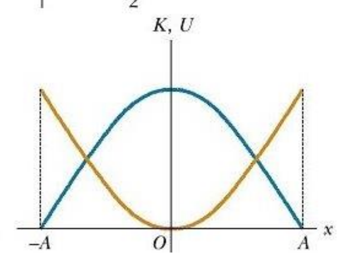
Where f is the natural frequency of the system that depends on system properties (e.g. f of a mass-spring system depends on mass m and spring constant k.

From N2L, Hooke's Law and SHM, we can derive that:

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

Energy Graphs





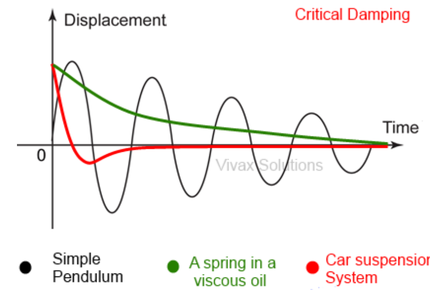
Free Oscillations:

A system that experiences its own restoring force (e.g. A mass-spring system experiencing only the spring force and gravitational pull, and no air resistance.)

Damped oscillations:

In which the amplitude of oscillation decreases with time.

Types of damping:



Forced oscillation:

Forced oscillation: occurs when the system is driven by periodic external force.

Resonance occurs when $f = f_0$. Max amplitude is achieved when the driver frequency is = natural frequency.