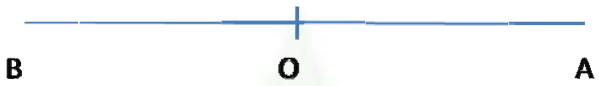
Energy of a particle executing SHM:

Considering a particle of mass m executing SHM along X axis.

T = Time period

a = amplitude



Let x be the displacement of the particle at an instant of time t then using displacement equation $x = a\sin\omega t$

Force acting on the particle $F = m(\omega^2 x)$

Force at mean position $x = 0$, $F = 0$

Therefore average force acting on the particle $= \dfrac{(0 + m\omega^2 x)}{2}$

Therefore the work done $= \dfrac{(m\omega^2 x)x}{2} = \dfrac{m\omega^2 x^2}{2}$

This work is stored in the form of potential energy $P.E = E_P = \dfrac{m\omega^2 x^2}{2}$

Velocity of the oscillating particle when displacement is $x = \omega\sqrt{a^2 - x^2}$

$\therefore$ Kinetic energy of the particle $= E_K = \dfrac{1}{2}mv^2 = \dfrac{1}{2}m\omega(a^2 - x^2)$

Total energy when displacement is x $E_T = E_P + E_K$

$$E_T = \frac{m\omega^2 x^2}{2} + \frac{1}{2}m\omega(a^2 - x^2)$$

$$E_T = \frac{m\omega^2 a^2}{2}$$