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ENERGY IN SIMPLE HARMONIC MOTION (SHM)

Simple harmonic oscillators are systems that exhibits periodic motion, like a mass on a spring. Energy in these systems constantly shifts between kinetic and potential forms, with the total energy remaining constant throughout the oscillation. Energy in simple harmonic motion is crucial for analyzing oscillating systems.

A particle executing S.H.M. possesses two types of energy - potential energy and kinetic energy.

1. Potential energy : $U = \frac{1}{2} m\omega^2 a^2 \sin^2 \omega t$

(i) $U_{max} = \frac{1}{2} Ka^2 = \frac{1}{2} m\omega^2 a^2$, when $y = \pm a$;

$\omega t = \pi/2$; $t = T/4$

(ii) $U_{min} = 0$, when $y = 0$, $\omega t = 0$; $t = 0$

2. Kinetic energy :

$K = \frac{1}{2} ma^2 \omega^2 \cos^2 \omega t$ or $K = \frac{1}{2} m\omega^2 (a^2 - y^2)$

(i) $K_{max} = \frac{1}{2} m\omega^2 a^2$, when $y = 0$, $t = 0$; $\omega t = 0$

(ii) $K_{min} = 0$, when $y = a$; $t = T/4$, $\omega t = \pi/2$

3. Total energy → Total mechanical energy
= Kinetic energy + Potential energy.

$E = \frac{1}{2} m\omega^2 a^2$