



Flipping Physics Lecture Notes: AP Physics 1 Review of *Simple Harmonic Motion*

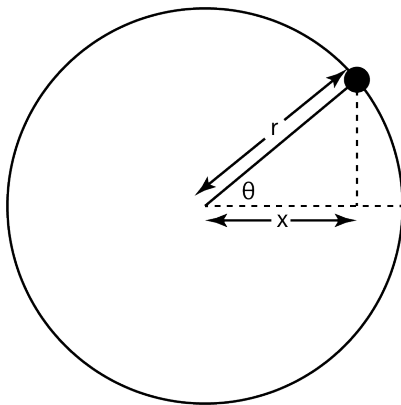
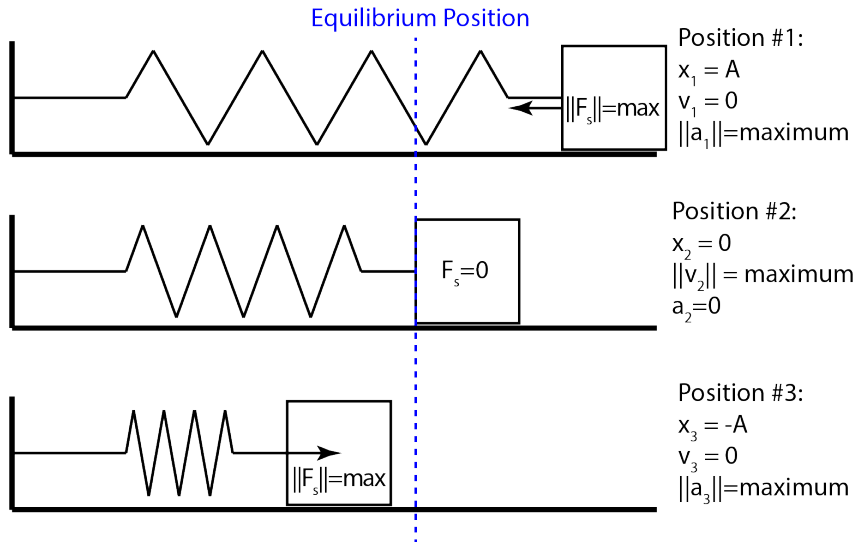
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The mass-spring system shown at right is in simple harmonic motion. The mass moves through the following positions: 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, 2, etc.

Simple Harmonic Motion (SHM) is caused by a Restoring Force:

- A Restoring Force is always:
 - o Towards the equilibrium position.
 - o Magnitude is proportional to distance from equilibrium position.

To derive the equation for position in SHM, we start by comparing simple harmonic motion to circular motion.



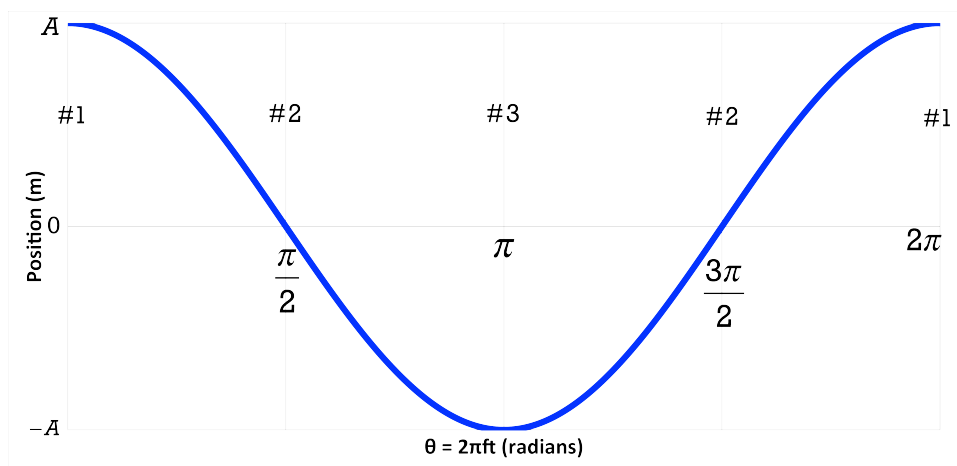
$$\cos \theta = \frac{A}{H} = \frac{x}{r} \Rightarrow x = r \cos \theta \text{ \& } T = \frac{2\pi}{\omega} = \frac{1}{f} \Rightarrow \omega = 2\pi f$$

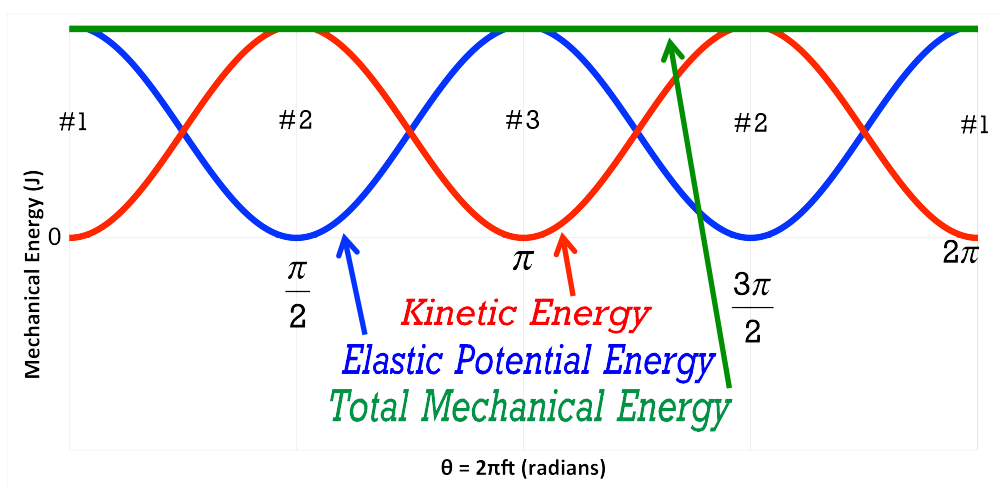
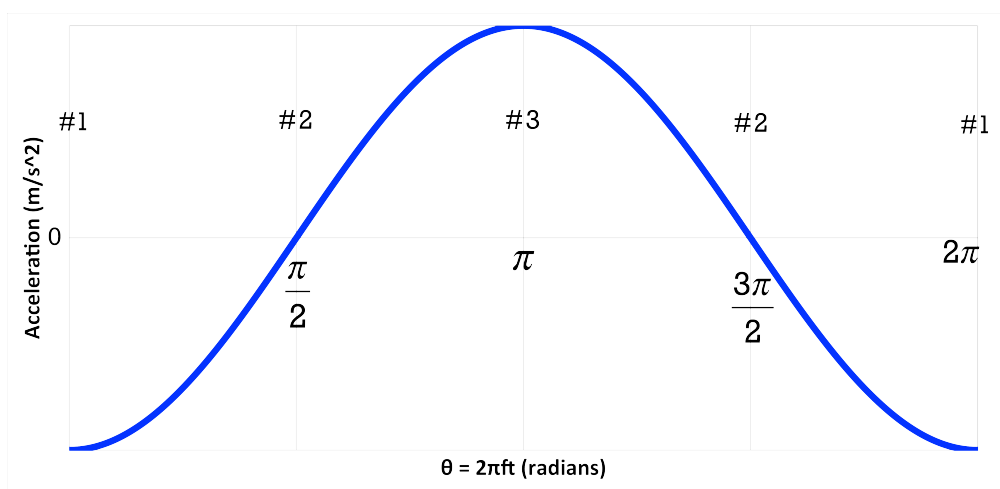
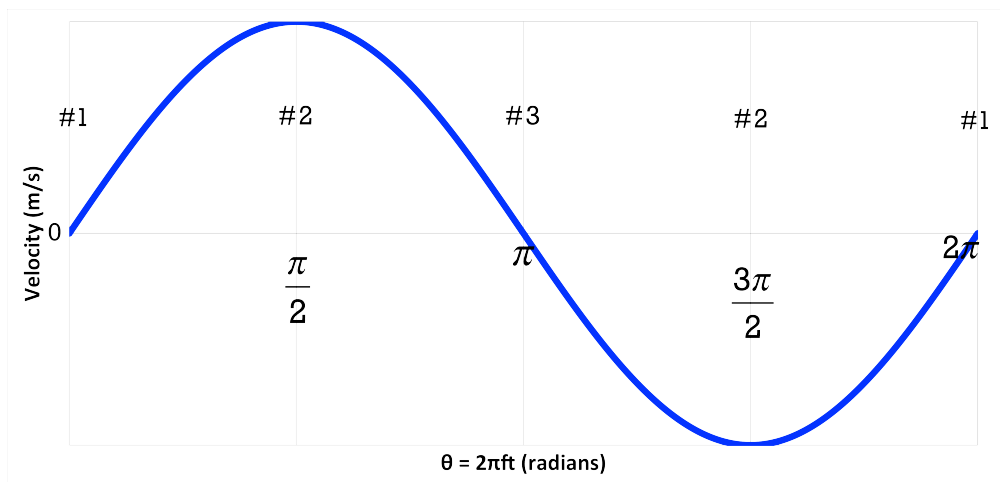
$$\omega = \frac{\Delta \theta}{\Delta t} = \frac{\theta_f - \theta_i}{t_f - t_i} = \frac{\theta_f - 0}{t_f - 0} = \frac{\theta}{t} \Rightarrow \theta = \omega t$$

$$x = r \cos \theta = r \cos(\omega t) = r \cos[(2\pi f)(t)] = A \cos[(2\pi f)(t)]$$

(letting $r = A$)

Looking at the graphs ...





The period of a mass-spring system: $T_s = 2\pi\sqrt{\frac{m}{k}}$ Is independent of amplitude and acceleration due to gravity.

The period of a pendulum: $T_p = 2\pi\sqrt{\frac{L}{g}}$ Is independent of amplitude and mass.