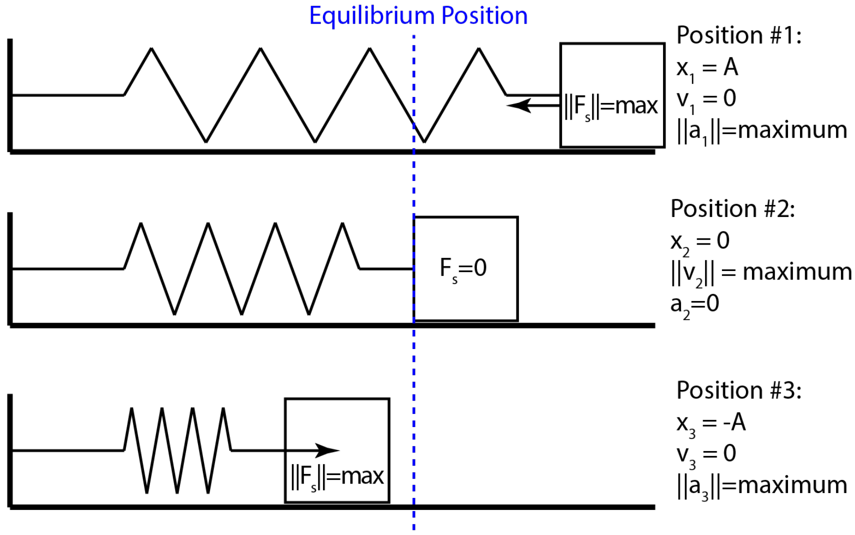
Flipping Physics Lecture Notes:
AP Physics 1 Review of *Simple Harmonic Motion*
https://www.flippingphysics.com/ap1-shm-review.html

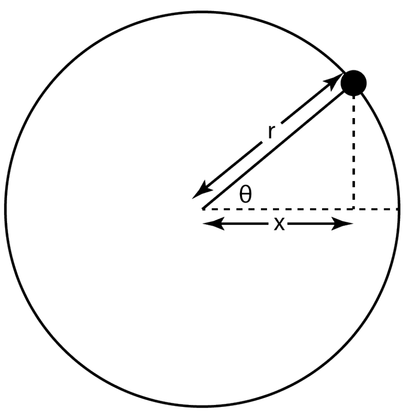
The mass-spring system shown at right is in simple harmonic motion. The mass moves through the following positions: 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, 2, etc.



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

- A Restoring Force is always:
  - Towards the equilibrium position.
  - 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.



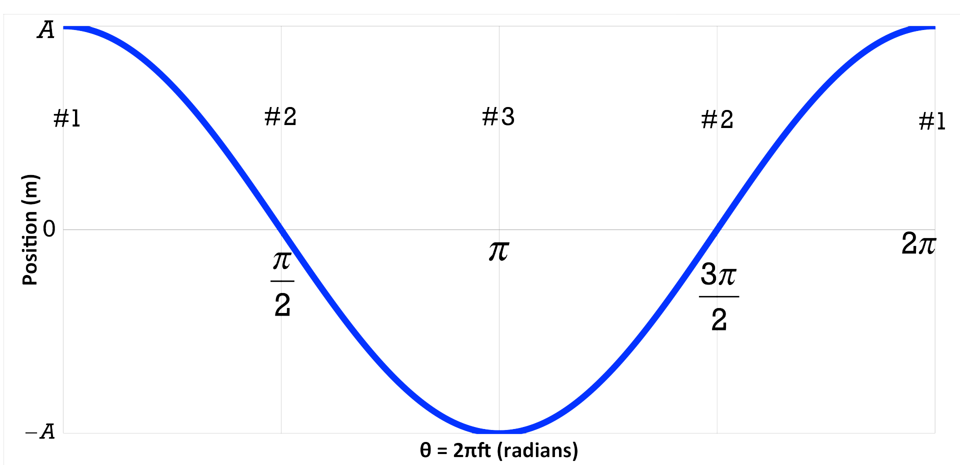
$$\cos\theta = \frac{A}{H} = \frac{x}{r} \Rightarrow x = r\cos\theta \;\&\; T = \frac{2\pi}{\omega} = \frac{1}{f} \Rightarrow \omega = 2\pi f$$

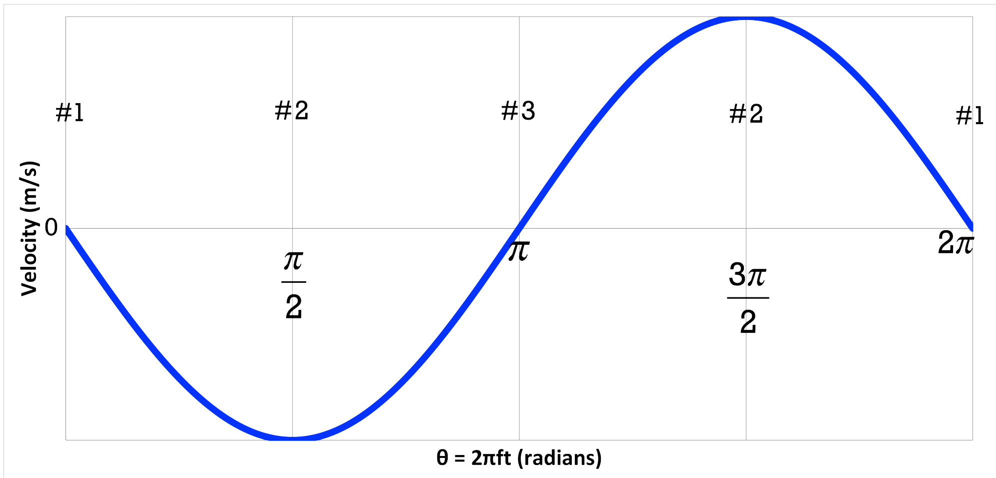
$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{\theta_f - \theta_i}{t_f - t_i} = \frac{\theta_f - 0}{t_f - 0} = \frac{\theta}{t} \Rightarrow \theta = \omega t$$

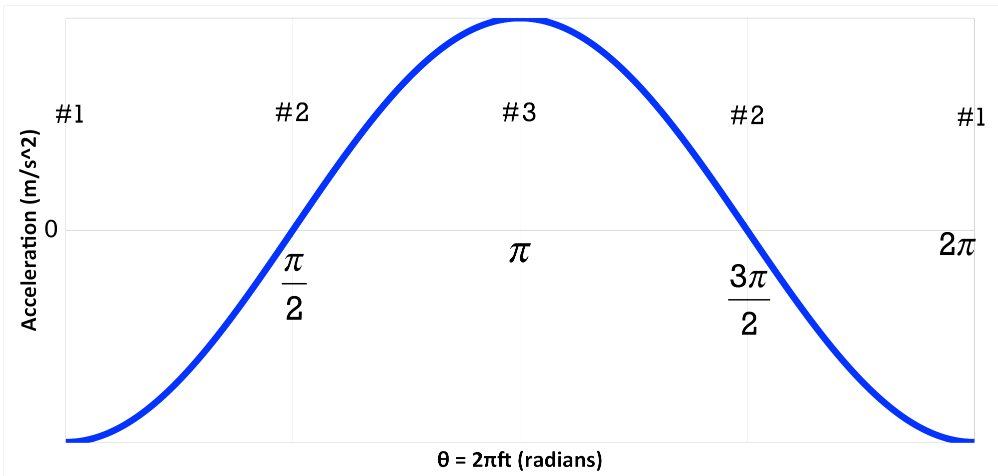
$$x = r\cos\theta = r\cos(\omega t) = r\cos\left[(2\pi f)(t)\right] = A\cos\left[(2\pi f)(t)\right]$$

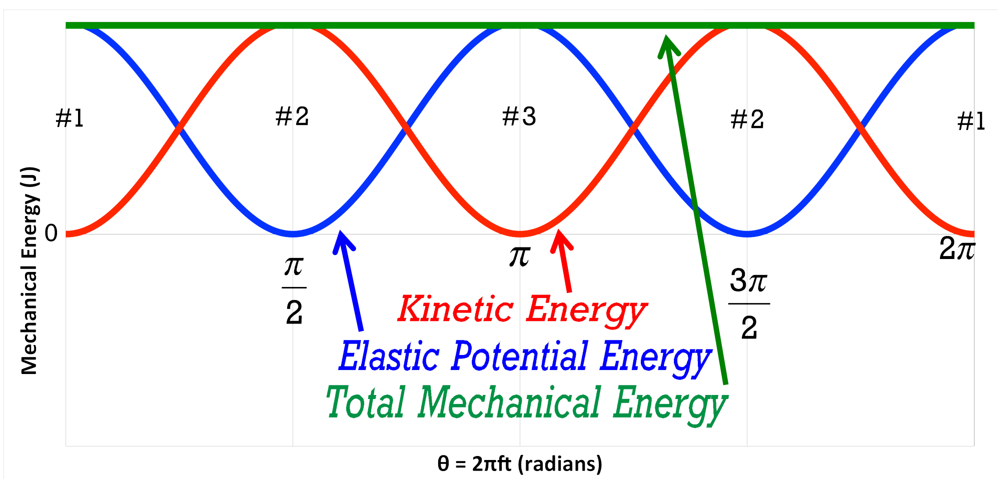
(letting r = A)

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.