Flipping Physics Lecture Notes:

Demonstrating What Changes the Period of Simple Harmonic Motion

The period of simple harmonic motion is the time it takes to complete one full cycle.

- The units for period are typically seconds or seconds per cycle, however, they could also be in minutes, hours, days, fortnights, decades, millenniums, etc.
- The symbol for period is T.

Using our previously defined postions of 1 and 3 where the object is at its maximum displacement from equilibirum position and position 2 is at the equilibrium position, recall that the simple harmonic motion pattern is 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, 2, 1, 2, 3, …

One full cylce in terms of position could be:

- 1, 2, 3, 2, 1 or 3, 2, 1, 2, 3 or 2, 1, 2, 3, 2 or 2, 3, 2, 1, 2
- or starting and ending somewhere between one of the positions as long as:
    1. the object starts and ends at the same location
    2. the object is moving in the same direction at the end as at the start

The equations for the period of simple harmonic motion are:

- For a mass-spring system: $T = 2\pi\sqrt{\frac{m}{k}}$
    - m is the mass in the mass-spring system.
    - k is the spring constant of the spring.
- For a pendulum: $T = 2\pi\sqrt{\frac{L}{g}}$
    - L is the "pendulum length" which is the distance from the center of suspension to the center of mass of the pendulum bob.
        - Center of suspension is the top, fixed end of the pendulum.
        - Pendulum bob is the mass at the bottom of the pendulum.
    - g is the acceleration due to gravity in which the pendulum is located.
        - On Earth that would be 9.81 m/s^2.
    - This is called a *simple pendulum*. Meaning the rod/string is of negligible mass therefore the center of mass of a simple pendulum is the center of mass of the pendulum bob.

What affects the period of a pendulum and a mass-spring system?

- Amplitude is ***not*** in either period equation.
    - Amplitude does ***not*** affect the period of a pendulum or the period of a mass-spring system.
- Acceleration due to gravity is ***not*** in the period equation for a mass-spring system.
    - g does ***not*** affect the period of a mass-spring system.
- Mass is ***not*** in the period equation for a pendulum.
    - The mass of the pendulum bob does ***not*** affect the period of a pendulum.
- Increasing the mass in a mass-spring system increases its period.
    - $m \uparrow \Rightarrow T \uparrow$ for a mass-spring system.
- Increasing the spring constant in a mass-spring system decreases its period.
    - $k \uparrow \Rightarrow T \downarrow$ for a mass-spring system.
- Increasing the "pendulum length" increases its period.
    - $L \uparrow \Rightarrow T \uparrow$ for a pendulum.
- Increasing the acceleration due to gravity decreases the period of a pendulum.
    - $g \uparrow \Rightarrow T \downarrow$ for a pendulum.