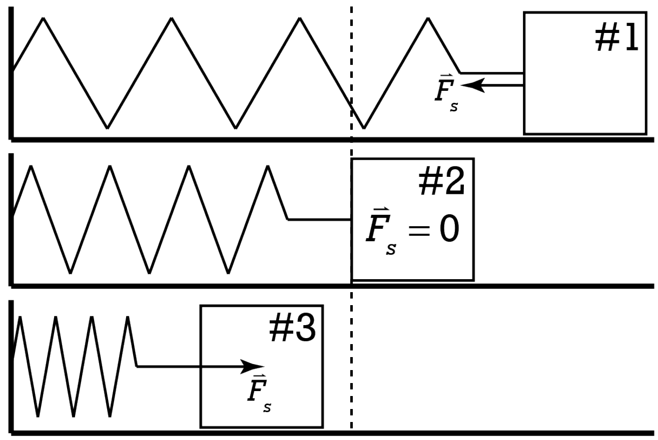
Flipping Physics Lecture Notes:

Simple Harmonic Motion - Force, Acceleration, and Velocity at 3 Positions



We previously defined three locations for an object in simple harmonic motion. Positions 1 and 3 are at the maximum displacement from and on either side of equilibrium position. Position 2 is when the mass is at rest position. Now let's determine some basics about the *magnitudes* of the velocities and accelerations at those positions.

Notice that at positions 1 and 3, the velocity of the mass changes directions. This means the velocities at 1 and 3 are zero. This is just like the velocity at the top is zero for an object in free fall. This means the magnitude of the velocity halfway in between those two positions, in other words at position 2, will have a maximum value.

At positions 1 and 3, displacement from equilibrium position, x, will have a maximum magnitude. That means, according to Hooke's Law, $\vec{F}_s = -k\vec{x}$, the spring force will also have it's maximum magnitude at positions 1 and 3. If we sum the forces in the x direction, $\sum F_x = F_s = ma_x$, we can see the acceleration will also have its maximum magnitude at positions 1 and 3.

Please realize that the spring force changes as a function of position, therefore, the net force in the x-direction changes as a function of position, therefore the acceleration of the mass changes as a function of position, therefore simple harmonic motion is not uniformly accelerated motion. In simple harmonic motion the **acceleration is not constant**, therefore, you **cannot** use the uniformly accelerated motion equations.

$$\sum F_x = F_s = ma_x \Rightarrow kx = ma_x \Rightarrow x \neq \text{constant} \text{ therefore } a \neq \text{constant}.$$ ♥

♥ Yes, I am ignoring whether the spring force is to the left or right in this equation. It does not matter. I am simply showing that simple harmonic motion is **not** uniformly accelerated motion.