A simple harmonic oscillator is characterized by three independent parameters: amplitude, angular frequency, and that phase constant thing. Now imagine a spring that is oscillating back and forth through a certain range of motion. If you start the oscillations over again but pull back twice as far before releasing, how does the time for each oscillation change from its initial value? Don't simply state an answer, justify it with a qualitative discussion of the physics involved.

Does everything simply double?

If the spring is pulled back twice as far as it was before, the springs factors of **amplitude, angular frequency, and phase constant will double with it as well.** Considering amplitude is the distance in which it will double, angular frequency is the speed in which it will double, and phase constant where it in a particular part of the cycle in which you will have more to observe since it doubled.

Key is that the three parameters are independent!

The time period is independent of the amplitude; making the mass twice the length and releasing it does not effect the time period over oscillation. Because **time is more connected to angular frequency in a sense that no matter the amplitude time and angular frequency will determine the time period.** Hence, f=1/T frequency equals 1 divided by seconds per beat.

Equation for period implies it immediately

T = 1/f = 2*pi/w = 2*pi* sq rt (k/m).

The time period is independent of the amplitude of the oscillation. Pulling the mass to twice the length and releasing does not change the time period of the oscillation of the spring and mass.

But how does this work intuitively?!

Amplitude is the maximum of x and goes back and forth between A and -A. If the spring was pulled back twice as far, A would be twice as large because the maximum of x was twice as large. Amplitude does not effect the time of oscillation since A is only dependent upon x. The angular frequency of the oscillation does depend on time and is calculated by [2(Pie)]/T where T is the period of motion. While the amplitude of the object is doubled in this situation, the frequency remains the same. As a result, the object takes the same amount of time as the initial state to complete its motion. **While the object will have more of a distance to travel, it will be going faster and both changes will offset each-other in regards to time.** This can also be supported mathematically by the equation x = Acos(wt). Since x doubles, something on the right must also double for them to remain equal. Since A increases proportionally to the increase in x, the relations remain equal without any other alterations to the variables. It can be concluded that changes in amplitude do not effect time of the movement.

A 1.0 Newton weight is hung vertically from a spring, which stretches 10 centimeters. The spring is now reoriented horizontally with the same mass on a flat, frictionless surface, and the mass is set into oscillation. Estimate how much time is required for the mass to complete one full oscillation. Explain your chain of logic, and yes, I'm expecting a numerical answer (though an approximate one!).

Good example, just some unit trouble

Hooke's Law states F=-K*X. In this case we are given F for force or 1 Newton and X for displacement which is 10 cm. In which 1 Newton will be divided by 10 cm but needs to changed to meters, so 0.1 m. In this case the answer will be **K= 10 N*m.** From here you need the mass of weight which is equal to mass times gravity. But in this case we need mass so weight divided by gravity, **1 Newton divided by 9.8 which approximately .1 Kg.** The equation for time "T" is 2pi*sqrt of mass divided by "k" constant. **2pi*sqrt .1/10 can be broken down into 2*pi which is approximately 6 multiplied by the sqrt of .01 which will produce approximately .6 seconds**.

Nicely laid out, one error readily apparent

First, the spring constant needs to be found. The force of the weight on the spring is 1.0 Newton, and the delta x is 10 cm. K can be found using the equation:

F = -k * x   k = -F/x   **k = -1N / 10cm = -0.1 N/cm = -0.001 N/m**

Now that K is known, it can be applied to find the time it will take to complete an oscillation (period) with the following equation:

T = 2pi x √(m/k)   **T = 2pi x √(0.1kg/-0.001N/m) = 20pi ≈ 62.8 sec**

Correct response, well documented

Applied Force = 1.0 N

x(max) = 10 cm or 0.1 m

Using **Hooke's Law F equals kx**, rearranging k equals F/x. Plugging in, k equals 1.0N / 0.1m. This allows **k equals 10 N/m**.

Need to find the mass of the weight. Using force of gravity equals mass times gravity, rearranging mass equals force / gravity or 1.0N / 10 (N/kg). This means **mass equals 0.1 kg.**

Using the k constant and the mass, we can find the time period or T. Using T = 2pi(mass / k)^(1/2), **T equal to 2pi(0.1kg / 10 N/m)^(1/2). T would then equal 0.2pi seconds**.