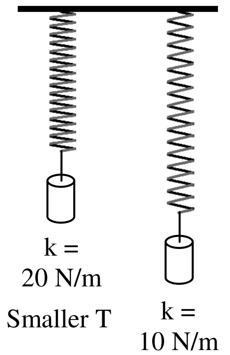
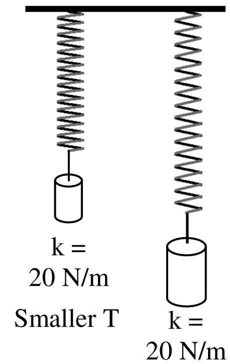
Spring-Mass Systems

Spring Constant (k) — The spring constant tells you how strong (stiff) a spring is. A stiffer spring has a higher k.



With the same mass the stronger spring (bigger k) will vibrate faster (smaller T).



With the same spring constant more mass causes a slower vibration (larger T).

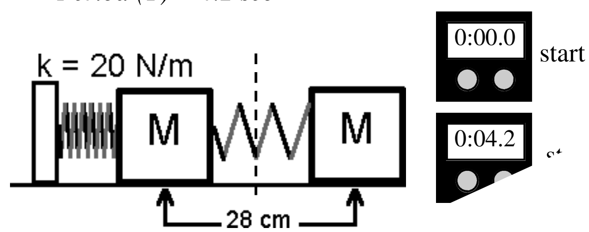
Harmonic Motion Basics

Amplitude (A) - maximum displacement from the equilibrium position. The amount of energy in a spring-mass system is determined ONLY by the amplitude.

Period (T) - time for one complete cycle.

Frequency (f) - number of cycles in one second.

Amplitude = 14 cm
Period (T) = 4.2 sec



Hooke's Law:

Spring Constant (in N/m): higher k = stiffer spring.

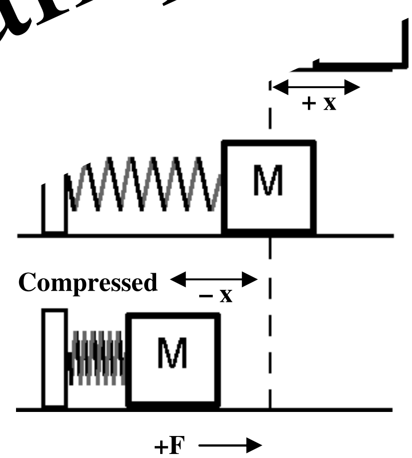
Force (in N) of the spring → $F = -kx$

displacement (in m) from the equilibrium posi

A spring-mass system is called Simple

Force and Position: As seen above in Hooke's Law F and x

The



x = +A; F = -max
a = -max; v = 0

x = 0; F = 0
a = 0; v = -max
$E_p = 0$; E_k = max

x = -A; F = +max
a = +max; v = 0
E_p = max; $E_k = 0$

Acceleration (a), Velocity (v), and Energy (E)

It should be obvious that where the force is zero (equilibrium position),

Period of a Mass-Spring System:

Period (in sec) → $T = 2\pi\sqrt{\frac{m}{k}}$ ← *Mass (in kg)*, *Spring constant (in N/m)*

Ex. A 350 g mass is attached to a spring that has a spring constant of 12 N/m. What is the period of vibration?

Variables:
m = .35 kg
(1000 g = 1 kg)
k = 12 N/m
T = ____

$T = 2\pi\sqrt{\frac{m}{k}}$

$T = 6.28\sqrt{\frac{.35}{12}}$

$T = 6.28\sqrt{.0292}$

$T = 6.28(.1709)$

$T = 1.07\,\text{sec}$