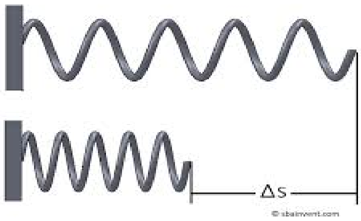
6.2 - Introduction to Springs and Energy



Field Assinment Results

Who found a spring yesterday? What was its purpose?

Pass our springs.

Variable Force

So far we have dealt with constant forces; variable forces change with displacement.

Springs are variable – compression or extension will make them have a greater opposing force.
Pass out springs Demo.

Compression/Extension (Linear) Spring

Spring force acts in the opposite direction as applied force.

Later we will study torsion springs: those that are twisted during operation.

Torsion Spring

Spring Details

Elastic Limit: Maximum extension a spring can bear, beyond which deformation results.

As the old saying goes: one's spring is sprung.

Springs and Force

Every spring has a resistance constant 'k': a measure of force needed to compress or extend a spring.

$F_s = kx$	F_s = Spring Force (N) k = spring constant (N/m) x = displacement (m)
$\left\|\vec{F}_s\right\| = k\left\|\vec{x}\right\|$ AP Equation	

This relation is called Hooke's Law, after Robert Hooke, an English physicist.

Note: it is common to consider spring force as a negative value: it ALWAYS opposes an applied force. This perspective is accounted for in the AP equation.

1. Spring Constant Example

A spring is pulled with a tension of 14 N, causing it to move 2.4 cm.

What is the spring constant (k)?

Convert cm to m first: 2.4 cm = 0.024 m.

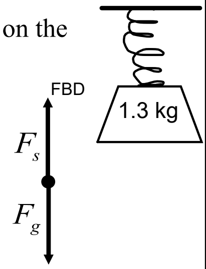
$$F_s = kx$$

$$k = \frac{F_s}{x} = \frac{14.0\,N}{0.024\,m} = 580\,N/m$$

2. Stretching Example

A spring (k = 42 N/m) has a 1.3 kg mass hung from it. How much is it stretched?

Realize: the force of gravity acting on the mass stretches the spring:



$$F_g = mg = 1.3kg \cdot 9.81\frac{m}{s^2} = 12.753N$$

Then, by Hooke's Law:

$$F_g = F_s = kx$$

$$x = \frac{F_s}{k} = \frac{12.753\,N}{42\,N/m} = 0.30\,m$$

Introduction to Energy

Energy is the 'oomph' possessed by a system that allows it to do work (a force exerted over distance).

Energy can be in the form of motion, called kinetic energy, or potential energy (energy of position).

Kinetic Example: A moving object can do work on something it collides with by moving it.

Potential Example: An object suspended over the ground can be dropped, and collide with something on the ground and move it.

Energy will be explored more next semester.

Units of Energy

The unit of energy is a Joule (J) after James Prescott Joule - an English physicist, and at its simplest is force exerted over a distance: it takes energy to accelerate a mass.

$$\begin{aligned} Energy &= F \cdot d \\ &= N \cdot m \\ &= \frac{kg \cdot m}{s^2} \cdot m \\ &= \frac{kg \cdot m^2}{s^2} \\ &= J \end{aligned}$$

Homework

Please DON'T preview 6.3

6.2 Problems
Due: Next Class