Springs

Hooke's Law

British scientist Robert Hooke determined that the amount of deformation of an elastic object is proportional to the force applied to it.

$$F \alpha x$$

$$F = kx$$

where: F = force (N)
x = deformation of spring (m)
k = spring constant (N/m)

Sign convention for springs:

compression is negative, x is – and F_s is –
expansion (stretch) is positive, x is + and F_s is +
* k is always +

ex.

A spring with a spring constant of 48 N/m has a 0.25 kg mass suspended from it, what is the extension of the spring?

Spring Potential Energy

Besides gravitational potential energy, there is elastic potential energy. Elastic energy is energy that can be stored in an object that temporarily becomes deformed, by applying a force to it, and then returns to its original shape, releasing the energy.
Springs are elastic objects and can possess spring potential energy.

The amount of energy stored in a spring can be determined from a force vs. deformation (displacement) graph:

$$PE_s = \tfrac{1}{2}kx^2$$

ex.
A Hooke's law spring is compressed 10 cm when a force of 5 N is applied to it. If the spring is used to project a 20 gram marble straight up in the air, calculate (a.) the maximum velocity as it is fired up and (b.) the maximum height the marble reaches.

Hooke's Law Springs	vs.	Non-Hooke's Law Springs
$F = kx$		no equation
k is constant		k is not constant
$PE_s = \frac{1}{2}kx^2$		PE_s = area under curve
or		
area under curve		