Engineering & Everyday Devices

Springs

Sample Problem:

The "stretchiness" of a spring or rubber bands depend on a constant *k*, known as the Spring constant. Springs obey *Hooke's Law*, which includes the parameter *k*. Hooke's law relates the spring constant with the distance the spring has been stretched, $\Delta x = x_f - x_i$; this tells us the force applied by the spring, *F*. (Figure 1)

$$F = k(x_f - x_i) = k\Delta x$$

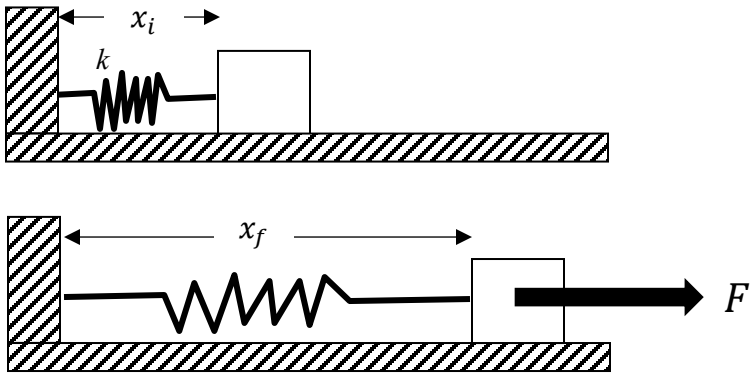

Figure 1: Ideal Mass and Spring

When a spring is compressed and held in place, it has potential energy: the compressed spring has the ability to do work if released. The potential energy in a compressed spring is

$$PE = \frac{1}{2}kx^2$$

One common area in which we find a spring is the release mechanism in a pinball machine. The launch mechanism is pulled back, compressing a spring. When the spring is released, the spring plunges into a steel ball, transferring kinetic energy to the ball. The kinetic energy of the ball can be expressed as:

$$KE = \frac{1}{2}mv^2$$

where *m* is the mass of the ball and *v* is the ball's velocity.

Finally, we should examine some units. PE and KE are energies, which are specified in Nm or J (Joules). Joules can use units of Nm, or can use $\frac{kg\ m^2}{s^2}$.

Question:

Assume the ball in a pinball game is solid steel with a mass of 80 grams. Assume the value of k in the launcher is 325 N/m. If the plunger is pulled a distance of 5.9 inches, what is the velocity of the ball when launched?