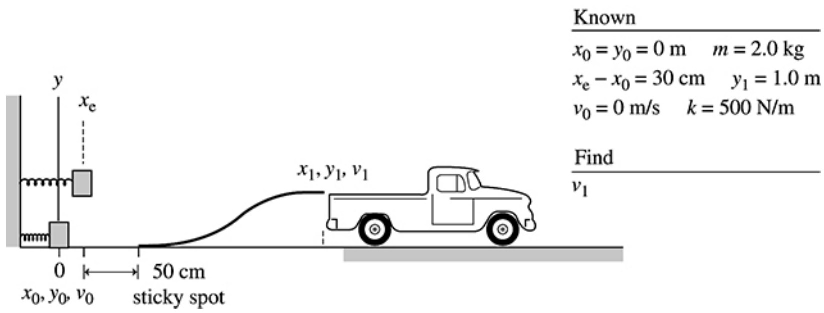
11.49. Model: We will use the spring, the package, and the ramp as the system. We will model the package as a particle.
Visualize:



We place the origin of our coordinate system on the end of the spring when it is compressed and is in contact with the package to be shot.
Model: **(a)** The energy conservation equation is

$$K_1 + U_{g1} + U_{s1} + \Delta E_{th} = K_0 + U_{g0} + U_{s0} + W_{ext}$$

$$\frac{1}{2}mv_1^2 + mgy_1 + \frac{1}{2}k(x_e - x_e)^2 + \Delta E_{th} = \frac{1}{2}mv_0^2 + mgy_0 + \frac{1}{2}k(\Delta x)^2 + W_{ext}$$

Using $y_1 = 1$ m, $\Delta E_{th} = 0$ J (note the frictionless ramp), $v_0 = 0$ m/s, $y_0 = 0$ m, $\Delta x = 30$ cm, and $W_{ext} = 0$ J, we get

$$\frac{1}{2}mv_1^2 + mg(1\text{ m}) + 0\text{ J} + 0\text{ J} = 0\text{ J} + 0\text{ J} + \frac{1}{2}k(0.30\text{ m})^2 + 0\text{ J}$$

$$\frac{1}{2}(2.0\text{ kg})v_1^2 + (2.0\text{ kg})(9.8\text{ m/s}^2)(1\text{ m}) = \frac{1}{2}(500\text{ N/m})(0.30\text{ m})^2$$

$$\Rightarrow v_1 = 1.70\text{ m/s}$$

(b) How high can the package go after crossing the sticky spot? If the package can reach $y_1 \geq 1.0$ m before stopping ($v_1 = 0$), then it makes it. But if $y_1 < 1.0$ m when $v_1 = 0$, it does not. The friction of the sticky spot generates thermal energy

$$\Delta E_{th} = (\mu_k mg)\Delta x = (0.30)(2.0\text{ kg})(9.8\text{ m/s}^2)(0.50\text{ m}) = 2.94\text{ J}$$

The energy conservation equation is now

$$\tfrac{1}{2}mv_1^2 + mgy_1 + \Delta E_{th} = \tfrac{1}{2}k(\Delta x)^2$$

If we set $v_1 = 0$ m/s to find the highest point the package can reach, we get

$$y_1 = \left(\tfrac{1}{2}k(\Delta x)^2 - \Delta E_{th}\right)/mg = \left(\tfrac{1}{2}(500\text{ N/m})(0.30\text{ m})^2 - 2.94\text{ J}\right)/(2.0\text{ kg})(9.8\text{ m/s}^2) = 0.998\text{ m}$$

The package does not make it. It just barely misses.