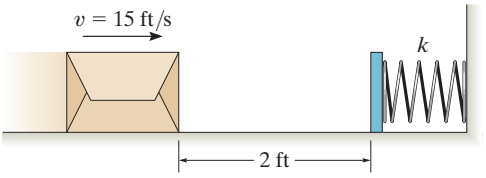
15–82.

The 20-lb box slides on the surface for which $\mu_k = 0.3$. The box has a velocity $v = 15$ ft/s when it is 2 ft from the plate. If it strikes the smooth plate, which has a weight of 10 lb and is held in position by an unstretched spring of stiffness $k = 400$ lb/ft, determine the maximum compression imparted to the spring. Take $e = 0.8$ between the box and the plate. Assume that the plate slides smoothly.

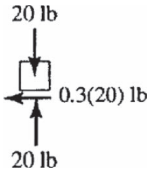


SOLUTION

$$T_1 + \sum U_{1-2} = T_2$$

$$\frac{1}{2}\left(\frac{20}{32.2}\right)(15)^2 - (0.3)(20)(2) = \frac{1}{2}\left(\frac{20}{32.2}\right)(v_2)^2$$

$$v_2 = 13.65 \text{ ft/s}$$



$$(\stackrel{+}{\rightarrow}) \qquad \sum m v_1 = \sum m v_2$$

$$\left(\frac{20}{32.2}\right)(13.65) = \left(\frac{20}{32.2}\right) v_A + \frac{10}{32.2} v_B$$

$$e = \frac{(v_B)_2 - (v_A)_2}{(v_A)_1 - (v_B)_1}$$

$$0.8 = \frac{v_P - v_A}{13.65}$$

Solving,

$$v_P = 16.38 \text{ ft/s}, \quad v_A = 5.46 \text{ ft/s}$$

$$T_1 + V_1 = T_2 + V_2$$

$$\frac{1}{2}\left(\frac{10}{32.2}\right)(16.38)^2 + 0 = 0 + \frac{1}{2}(400)(s)^2$$

$$s = 0.456 \text{ ft} \qquad \textbf{Ans.}$$

Ans:
$s = 0.456$ ft