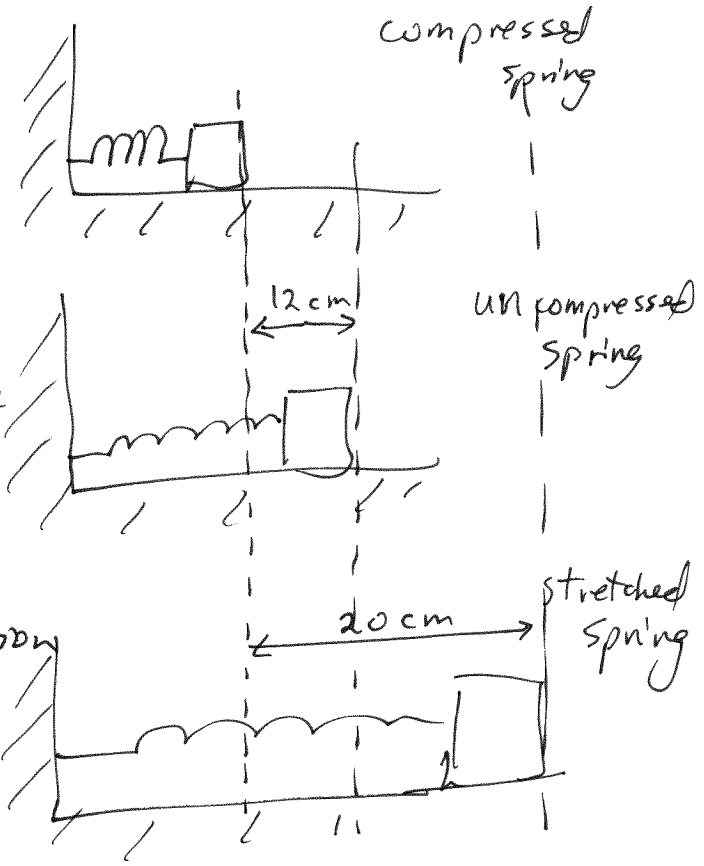
Chapter 8 Problem 78

$m = 0.30\,kg$ $k = 100\,\frac{N}{m}$



a) Initially the spring is compressed by

$x = 12\,cm = 0.12\,m$

Potential energy in the spring is

$$U_s = \frac{1}{2}kx^2 = \frac{1}{2}\left(100\frac{N}{m}\right)(0.12\,m)^2$$

$$\boxed{U_s = 0.72\,J}$$

b) The block moves without friction until the spring is no longer compressed. Find the velocity

$$E_0 = K_0 + U_0 = K_1 + U_1$$

$$0 + U_s = \tfrac{1}{2}mv_1^2 + 0 \longrightarrow v_1 = \sqrt{\frac{2U}{m}} = \sqrt{\frac{2(0.72\,J)}{0.30\,kg}}$$

$$\boxed{v_1 = 2.19\,m/s}$$

c) Block moves 0.20 m from its starting position. This corresponds to a stretch of $x_2 = 8\,cm = 0.080\,m$

Using conservation of energy

$$E_1 = K_1 + U_1 = K_2 + U_2$$

$$\tfrac{1}{2}mv_1^2 + 0 = \tfrac{1}{2}mv_2^2 + \tfrac{1}{2}kx_2^2$$

Solve for v_2 gives

$$\tfrac{1}{2}mv_2^2 = \tfrac{1}{2}mv_1^2 - \tfrac{1}{2}kx_2^2$$

$$v_2^2 = v_1^2 - \frac{k}{m}x_2^2$$

$$v_2 = \sqrt{v_1^2 - \frac{k}{m}x_2^2} = \sqrt{(2.19)^2 - \frac{100}{0.30}\cdot(0.080)^2} = \boxed{1.63\,m/s}$$