P

p.196 #2; p.205 #1-5

p.196 #2 $F = 220N$

$x = 0.14m$

$E_E = ?$

$F = kx \Rightarrow k = \frac{F}{x}$

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

$= \frac{1}{2}\frac{F}{x}x^2 = \frac{1}{2}Fx$

$E_E = \frac{1}{2}(220N)(0.14m)$

$= 15.4\ J$

$= 15J$

p.205 #1 A frictionless ramp will result in a greater compression. This is because $F = kx^2 \rightarrow x = \sqrt{\frac{F}{k}}$
A frictionless ramp means greater F.

2. $m = 3.5kg$

$d_y = 2.7m = h$

$x = 26cm$

$= 0.26m$

$k = ?$

$E_T = mgh$ (at the top of the ramp)

$= (3.5kg)(9.8N/kg)(2.7m)$

$= 92.61\ J$

By the Law of Conservation of Energy, E_T is constant.

$E_T = \frac{1}{2}kx^2$ (at compression)

$k = \frac{2E_T}{x^2}$

$= \frac{2(92.61J)}{(0.26m)^2}$

$= 2739.9\ N/m$

$= 2.7 \times 10^3\ N/m$

p. 196 #2; p. 205 # 1-5

3. $m = 43\,kg$

$k = 3.7\,kN/m$

$= 3.7 \times 10^3\,N/m$

$x = 37\,cm$

$= 0.37\,m$

$h = ?$

At compression:

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

$$= \frac{1}{2}(3.7 \times 10^3\,N/m)(0.37\,m)^2$$

$$= 253.265\,J$$

At maximum height:

$$E_T = mgh \Rightarrow h = \frac{E_T}{mg}$$

$$h = \frac{253.265\,J}{(43\,kg)(9.8\,N/kg)}$$

$$h = 0.60\,m.$$

4. $m = 0.35\,kg$

$h = 2.6\,m$

$x = 0.14\,m$

$k = ?$

Before: $E_T = E_g + \cancel{E_K}^{0} + \cancel{E_E}^{0}$

$= mgh$

$= (0.35\,kg)(9.8\,m/s^2)(2.6\,m)$

$= 8.918\,J$

At Compression: $E_T = \cancel{E_g}^{0} + \cancel{E_K}^{0} + E_E$

$$E_T = E_E = \frac{1}{2}kx^2$$

$$k = \frac{2E_T}{x^2}$$

$$k = \frac{2(8.918\,J)}{(0.14\,m)^2}$$

$$k = 9.1 \times 10^2\,N/m$$

p. 196 #2; p. 205 #1-5

5a) $m_2 = 4.0\,kg$
$K = 250\,N/m$
$x = 0.22\,m$
$m_1 = 2.0\,kg$
$\theta = 30.0°$
$v = ?$

To find height, $\Delta y = h$, using m_1

$E_T = 6.05\,J$ (from the example)

$\therefore$ at maximum height:

$$E_T = E_g = mgh \Rightarrow h = \frac{E_T}{m_1 g}$$

$$h = \frac{6.05\,J}{(2.0\,kg)(9.8\,N/kg)}$$

$$h = 0.309\,m$$

When the mass is doubled, energy is added to the system. $\therefore$ re-calculate E_T.

At maximum height:

$$E_T = E_g = m_2 gh$$
$$= (4.0\,kg)(9.8\,N/kg)(0.309\,m)$$
$$= 12.1\,J$$

During:
$$E_T = E_K + \cancel{E_g}^{\,0} + \cancel{E_e}^{\,0}$$
$$E_T = \tfrac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2E_T}{m}}$$

$$v = \sqrt{\frac{2(12.1\,J)}{4.0\,kg}}$$

$$v = 2.5\,m/s.$$

p. 196 # 2; p. 205 # 1-5

5b. The block does not have the same kinetic energy. The added mass increased the mass of the system. It now has double the kinetic energy

$E_K = \frac{1}{2}mv^2$ but with $2m$ $E_K' = \frac{1}{2} 2mv^2$

$E_K' = mv^2$

c) The block will compress it more, but not two times.

$E_T = 12.1J$
$x_{before} = 0.22m$
$K = 250N/m$
$x' = ?$

$E_T = \frac{1}{2}Kx'^2 \Rightarrow x' = \sqrt{\frac{2E_T}{K}}$

$x' = \sqrt{\frac{2(12.1J)}{250N/m}}$

$x' = 0.31m$

Although the total energy was doubled, it does not mean x is doubled

$2E_T = \frac{1}{2}Kx^2$

$x^2 = \frac{4E_T}{K}$

$x = \sqrt{\frac{4E_T}{K}}$ vs. $x = \sqrt{\frac{2E_T}{K}}$

$\therefore$ x is only increased by a factor $\sqrt{2}$.

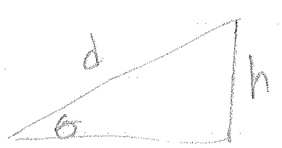
Check $\sqrt{2}(0.22m) = 0.31m$

p.196 #2; p.205 # 1-5

5d) The presence of a coefficient of friction will mean that energy is lost from the system as the block travels down the ramp.

At the top of the ramp, with $m = 4.0\,kg$, $E_T = 12.1\,J = E_g$

As the block moves down the ramp, a distance of d, the force of friction does work, which is where the energy is lost.



$\sin\theta = \frac{h}{d} \Rightarrow d = \frac{h}{\sin\theta}$

$W = F_f d$
$= F_f \left(\frac{h}{\sin\theta}\right)$

But is an inclined plane, so $F_f = \mu_k F_n$ where $F_n = mg\cos\theta$

$\therefore W = (\mu_k mg\cos\theta)\left(\frac{h}{\sin\theta}\right)$
$= (0.15)(4.0\,kg)(9.8\,N/kg)(\cos 30.0°)\left(\frac{0.309\,m}{\sin 30.0°}\right)$
$= 3.15\,J$

$\therefore$ at the bottom of the ramp, $E_T = E_g - W = 8.95\,J$

To solve for x: $E_T = E_E = \frac{1}{2}kx^2$

$x = \sqrt{\frac{2E_T}{k}}$
$= \sqrt{\frac{2(8.95\,J)}{250\,N/m}}$
$= 0.27\,m$