P. 309 #78, 79 in text
P. 154 #59, 60 in handout

78. A railroad car with a mass of 5.0X105kg collides with a stationary railroad car of equal mass. After the collision, the two cars lock together and move off at 4.0 m/s.
a.) Before the collision, the first car was moving at 8.0 m/s. What was its momentum?
b.)What was the total momentum of the two cars after the collision?
c.)What were the KEs of the two cars before and after the collision?
d.) Account for the loss of KE.

a) $P_i = m_1 v_i = 5\times10^5 kg (8 m/s)$
$= 4\times10^6 kg\,m/s$

b) $P_f = P_i$ let's check $(m_1+m_2)v_f =$
✓ $(10\times10^5 kg)(4 \frac{m}{s}) = 4\times10^6 \frac{kg\,m}{s}$

c) $KE_i = \frac{1}{2} m_1 v_i^2 = \frac{1}{2}(5\times10^5 kg)(8 \, m/s)^2$
$= 1.6\times10^7 J$

$KE_f = \frac{1}{2}(m_1+m_2)(v_f)^2 = \frac{1}{2}(10\times10^5 kg)(4 \frac{m}{s})^2$
$KE_f = 8\times10^6 J$

½ of the Energy went to...
friction, sound, heat, ...

79. From what height would a compact car have to be dropped to have the same kinetic energy that it has when being driven at 100 km/hr?

$$v_f = \frac{100\,km}{hr} \cdot \frac{1000\,m}{1\,km} \cdot \frac{1\,hr}{3600\,s}$$

$$v_f = 27.8\ m/s$$

$$v_f^2 = v_i^2 + 2ad \quad (v_i = 0)$$

$$v_f^2 = 2ad$$

$$d = \frac{v_f^2}{2a} = \frac{(27.8\,\frac{m}{s})^2}{2(9.8\,m/s^2)}$$

$$d = 39.4\ m$$

~ 10 story bldg

using conservation of energy

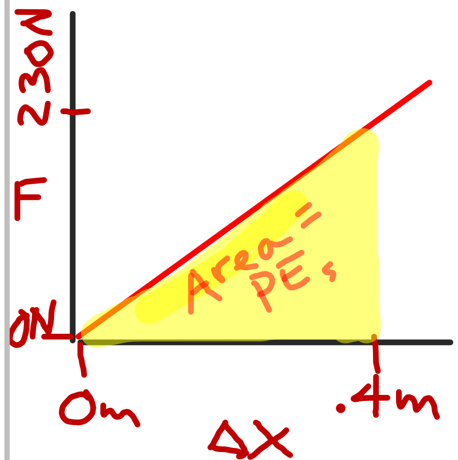
$$\Delta KE = \Delta PE$$

$$\frac{1}{2} m v_f^2 = m g h$$

$$h = \frac{v_f^2}{2g} = \frac{(27.8\,m/s)^2}{2(9.8\,\frac{m}{s^2})}$$

$$h = 39.4\ m$$

59. An archer pulls her bowstring back 0.40m by exerting a force that increases uniformly from zero to 230N.
a.)What is the equivalent spring constant of the bow?
b.) How much work does the archer do in pulling the bow?



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

$$k = \frac{230\,N}{.4\,m} = 575\,\frac{N}{m}$$

By area method

$$PE_s = \frac{1}{2} F \Delta x$$

$$= \frac{1}{2}(230N)(.4m)$$

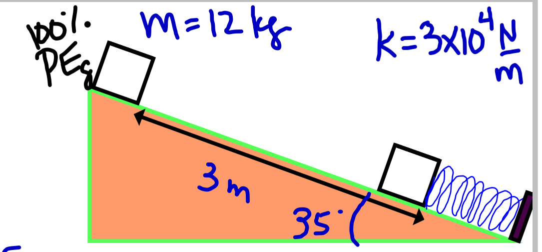
$$PE_s = 46\,J$$

By $PE_s = \frac{1}{2}kx^2$

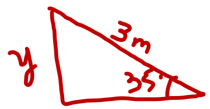
$$= \frac{1}{2}\left(575\frac{N}{m}\right)(.4m)^2$$

$$PE_s = 46\,J$$

60. Block slides down FRICTIONLESS incline (35°)



It stops 3 m from its release point by compressing a spring



$y = 3m \sin 35°$
$y = 1.7m$

$PE_i = mgh$
$= 12kg(9.8\frac{m}{s^2})(1.7m)$
$= 200J$ of Gravitational PE initially

Since its frictionless, $\Delta PE_{grav} = \Delta PE_s$

$k = 3 \times 10^4 \frac{N}{m}$

$PE_s = PE_g = 200J = \frac{1}{2}kx^2$ ↑?

$$\frac{2(200J)}{k} = x^2$$

$$\frac{400J}{3 \times 10^4 N/m} = x^2 = .01\overline{33}$$

$$x = .115m$$