EoC Week 4

6.30: The work can be found by finding the area under the graph, being careful of the sign of the force. The area under each triangle is 1/2 base × height.

a) 1/2 (8 m)(10 N) = 40 J.

b) 1/2 (4 m)(10 N) = +20 J.

c) 1/2 (12 m)(10 N) = 60 J.

6.82: The total work done is the sum of that done by gravity (on the hanging block) and that done by friction (on the block on the table). The work done by gravity is $(6.00\ \text{kg})gh$ and the work done by friction is $-\mu_k(8.00\ \text{kg})gh$, so

$$W_{\text{tot}} = (6.00\ \text{kg} - (0.25)(8.00\ \text{kg})(9.80\ \text{m/s}^2)(1.50\ \text{m}) = 58.8\ \text{J}.$$

This work increases the kinetic energy of both blocks;

$$W_{\text{tot}} = \frac{1}{2}(m_1 + m_2)v^2,$$

so

$$v = \sqrt{\frac{2(58.8\ \text{J})}{(14.00\ \text{kg})}} = 2.90\ \text{m/s}.$$

7.12: Tarzan is lower than his original height by a distance $l(\cos 30 - \cos 45)$, so his speed is

$$v = \sqrt{2gl(\cos 30° - \cos 45°)} = 7.9\ \text{m/s},$$

a bit quick for conversation.

EoC week 5

7.66: Denote the distance the truck moves up the ramp by x. $K_1 = \frac{1}{2}mv_0^2$, $U_1 = mgL\sin\alpha$, $K_2 = 0$, $U_2 = mgx\sin\beta$ and $W_{\text{other}} = -\mu_r mgx\cos\beta$. From $W_{\text{other}} = (K_2 + U_2) - (K_1 + U_1)$, and solving for x,

$$x = \frac{K_1 + mgL\sin\alpha}{mg(\sin\beta + \mu_r\cos\beta)} = \frac{(v_0^2/2g) + L\sin\alpha}{\sin\beta + \mu_r\cos\beta}.$$

EoC week 6

8.36: a) The final speed of the bullet-block combination is

$$V = \frac{12.0 \times 10^{-3}\ \text{kg}}{6.012\ \text{kg}}(380\ \text{m/s}) = 0.758\ \text{m/s}.$$

Energy is conserved after the collision, so $(m+M)gy = \frac{1}{2}(m+M)V^2$, and

$$y = \frac{1}{2}\frac{V^2}{g} = \frac{1}{2}\frac{(0.758\ \text{m/s})^2}{(9.80\ \text{m/s}^2)} = 0.0293\ \text{m} = 2.93\ \text{cm}.$$

b) $K_1 = \frac{1}{2}mv^2 = \frac{1}{2}(12.0 \times 10^{-3}\ \text{kg})(380\ \text{m/s})^2 = 866\ \text{J}.$

c) From part a), $K_2 = \frac{1}{2}(6.012\ \text{kg})(0.758\ \text{m/s})^2 = 1.73\ \text{J}.$

8.42: a) Using Eq. (8.24), $\frac{v_A}{v} = \frac{1\ \text{u} - 2\ \text{u}}{1\ \text{u} + 2\ \text{u}} = \frac{1}{3}$. b) The kinetic energy is proportional to the square of the speed, so $\frac{K_A}{K} = \frac{1}{9}$ c) The magnitude of the speed is reduced by a factor of $\frac{1}{3}$ after each collision, so after N collisions, the speed is $\left(\frac{1}{3}\right)^N$ of its original value. To find N, consider

$$\left(\frac{1}{3}\right)^N = \frac{1}{59{,}000}, \quad \text{or}$$

$$3^N = 59{,}000$$

$$N \ln(3) = \ln(59{,}000)$$

$$N = \frac{\ln(59{,}000)}{\ln(3)} = 10.$$

to the nearest integer. Of course, using the logarithm in any base gives the same result.