Phys 10154 - Fall 2006 - Exam #6B

Be sure to answer with the proper units and significant figures. Indicate your answers clearly with boxes. SHOW ALL WORK. Even if your answer is correct, I will deduct points if I can't see how you solved the problem. Both problems are worth 50 points.

1. Car A (2500 kg) is moving 35° North of East at 45 miles/hr, and it collides with car B (3500 kg) moving due West at 65 miles/hr. After the collision, the two cars move together.

What is the magnitude and direction of the final velocity, in mks units?

How much kinetic energy is lost in the collision?

$45\frac{mi}{hr} = 20.1\ m/s$ $\quad 65\frac{mi}{hr} = 29.1\ m/s$

$m_1 = 2500\ kg$ $\quad m_2 = 3500\ kg$

$V_{1i,x} = 20.1\cos 35^\circ = 16.5$ $\quad V_{2i,x} = -29.1\ m/s$

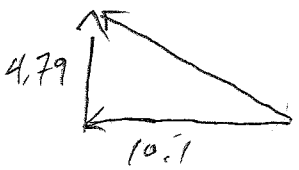
$V_{1i,y} = 20.1\sin 35^\circ = 11.5$ $\quad V_{2i,y} = 0$

$x: (2500)(16.5) + (3500)(-29.1) = 6000\,V_{f,x}$

$V_{f,x} = \frac{-60600}{6000} = -10.1\ m/s$

$y: (2500)(11.5) + 0 = 6000\,V_{f,y}$

$V_{f,y} = \frac{28750}{6000} = 4.79\ m/s$



$|\vec{V}_f| = \sqrt{10.1^2 + 4.79^2} = \boxed{11\ m/s}$

$\theta = \tan^{-1}\left(\frac{4.79}{10.1}\right) = \boxed{25^\circ\ N\ of\ W}$

$-\Delta K = \frac{1}{2}(2500)(20.1)^2 + \frac{1}{2}(3500)(29.1)^2 - \frac{1}{2}(6000)(11)^2$

$= \boxed{-1.6 \times 10^6\ J}$

2. A small block slides across a frictionless table with a speed of 6.5 m/s and collides elastically with a 2nd block that is twice as massive as the small block. Both masses move in a straight line throughout their motion in this problem.

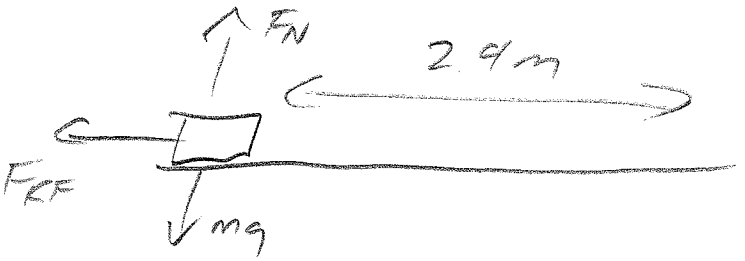
After the collision, the 2nd mass slides onto a rough part of the table, coming to a stop 2.4 meters after the point at which it entered the rough part of the table. What is the coefficient of kinetic friction between the block and the rough part of the table?

$m_1 = m \qquad v_{1i} = 6.5\ m/s \qquad v_{1f} = ?$

$m_2 = 2m \qquad v_{2i} = 0 \qquad v_{2f} = ?$

$$v_{2f} = \frac{2m_1}{m_1 + m_2} v_{1i} = \frac{2m}{3m}(6.5)$$

$$v_{2f} = 4.33\ m/s$$



$$\Sigma W_E = W_{KF} = 0 - \tfrac{1}{2} m (4.33)^2$$

$$+\mu_K m g \Delta s = +\tfrac{1}{2} m (4.33)^2$$

$$\mu_K = \frac{(4.33)^2}{2g\Delta s} = \frac{(4.33)^2}{2(9.8)(2.4)}$$

$$= \boxed{0.40}$$