Phys 10154 - Fall 2006 - Exam #6A

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 (1500-kg) is moving South at 43 m/s, and car B (2200-kg) is moving in a direction 34° North of East at 17 m/s. The cars collide and car A moves off in a direction 22° South of East at a speed of 23 m/s.

What is the magnitude and direction of the velocity of car B after the collision?

How much kinetic energy is lost in the collision?

$V_{1i,x} = 0$ $\quad V_{2i,x} = 17\cos 34 = 14.1$

$V_{1i,y} = -43$ $\quad V_{2i,y} = 17\sin 34 = 9.51$

$V_{1f,x} = 23\cos 22° = 21.3$ $\quad V_{2f,x} = ?$

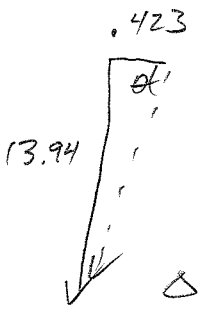
$V_{1f,y} = -23\sin 22° = -8.61$ $\quad V_{2f,y} = ?$

$x: (1500)(0) + (2200)(14.1) = (1500)(21.3) + 2200\,V_{2f,x}$

$$V_{2f,x} = \frac{31020 - 31950}{2200} = -0.423$$

$y: (1500)(-43) + (2200)(9.51) = (1500)(-8.61) + 2200\,V_{2f,y}$

$$V_{2f,y} = \frac{-64500 + 20922 + 12915}{2200} = -13.94$$



$|\vec{V}_{2f}| = \sqrt{.423^2 + 13.94^2} = \boxed{14\ m/s}$

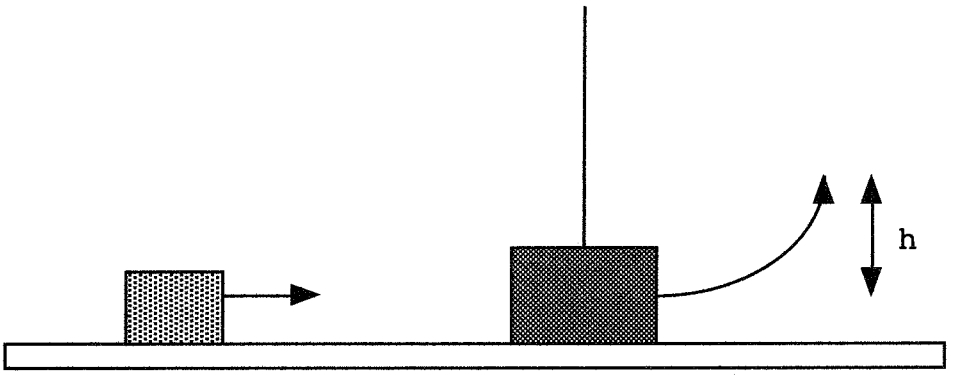
$\theta = \tan^{-1}\left(\frac{13.94}{.423}\right) = \boxed{88°\ S\ of\ W}$

$\Delta K = \frac{1}{2}(1500)(23)^2 + \frac{1}{2}(2200)(14)^2 - \frac{1}{2}(1500)(43)^2 - \frac{1}{2}(2200)(17)^2$

$= 396750 + 215600 - 1386750 - 317900 = \boxed{-1.1 \times 10^6\ J}$

2. A 2.80-kg block slides across a frictionless table with a speed of 4.50 m/s. It collides elastically with a 6.40-kg block initially at rest. The 6.40-kg block is connected to a massless vertical string, and so it acts like the weight on the end of a pendulum, as shown in the diagram below.

To what maximum height, h, does the 6.40-kg block rise after the collision?



$m_1 = 2.80\ kg \quad v_{1i} = 4.50\ m/s \quad v_{1f} = ?$

$m_2 = 6.40\ kg \quad v_{2i} = 0 \quad v_{2f} = ?$

$$v_{2f} = \frac{2m_1}{m_1+m_2} v_{1i} + 0 = \frac{2(2.80)(4.50)}{9.20} =$$

$$= 2.74\ m/s$$

$$\Sigma W_F = W_{grav} = -mgh = 0 - \frac{1}{2}mv_0^2$$

$$h = \frac{v_0^2}{2g} = \frac{(2.74)^2}{2(9.8)}$$

$$= \boxed{0.383\ m}$$