HW 6

30) First, we must find the speed of the block (with bullet) as it leaves the table.

$$y = \frac{1}{2}gt^2 \longleftrightarrow 1m = \frac{1}{2}gt^2 \Longrightarrow t = .45\,s$$

$$x = V_{Bb}t \longleftrightarrow 2m = V_{Bb}(.45s) \Longrightarrow V_{Bb} = 4.4\,m/s$$

Now use conservation of momentum:

$$(.008\,kg)V_{bullet} + 0 = (.008\,kg + .250\,kg)(4.4\,m/s)$$

$$\Longrightarrow V_{bullet} = 141.9\,m/s$$

31) By conservation of momentum:

$$(50\,kg)(4.00\,m/s) + 0 = (50\,kg + 5\,kg)V_{Gayle+sled_i}$$

$$\Longrightarrow V_{Gayle+sled_i} = 3.64\,m/s$$

After descending 5 m, the velocity of Gayle and the sled is given by:

$$\frac{1}{2}(55kg)(3.64\,m/s)^2 + (55\,kg)g(5\,m) = \frac{1}{2}(55\,kg)V_{GS_f}^2$$

$$\Longrightarrow V_{GS_f} = 10.5\,m/s$$

By conservation of momentum,

$$(55\,kg)(10.5\,m/s) = (55\,kg + 30\,kg)V_{GS+B_i}$$

$$\Longrightarrow V_{GS+B_i} = 6.82\,m/s$$

At the bottom of the hill, the velocity of Gayle and her brother on the sled is given by:

$$\frac{1}{2}(85\,kg)(6.82\,m/s)^2 + (85\,kg)g(10\,m) = \frac{1}{2}(85\,kg)v^2$$

$$\Longrightarrow v = 15.6\,m/s$$

32) $(1200\ \text{kg})(25\ \text{m/s}) + (9000\ \text{kg})(20\ \text{m/s})$

$= (1200\ \text{kg})(18\ \text{m/s}) + (9000\ \text{kg})\, V_{truck}$ (by cons. of momentum)

$\Longrightarrow V_{truck} = 20.9\ \text{m/s}$

$\Delta KE = \frac{1}{2}(1200\ \text{kg})(18\ \text{m/s})^2 + \frac{1}{2}(9000\ \text{kg})(20.9)^2$

$- \frac{1}{2}(1200\ \text{kg})(25\ \text{m/s})^2 - \frac{1}{2}(9000\ \text{kg})(20\ \text{m/s})^2$

$= -8680\ \text{J}$ ("lost" to bumper deformation)

40) a) $m(1.5\ \text{m/s}) + 0 = mV_1 + mV_2$ (momentum)

$\frac{1}{2}m(1.5\ \text{m/s})^2 = \frac{1}{2}mV_1^2 + \frac{1}{2}mV_2^2$ (energy)

$\Longrightarrow V_1 = 0\ \text{m/s}\ ;\ V_2 = 1.5\ \text{m/s}$

b) $m(1.5\ \text{m/s}) + m(-1.0\ \text{m/s}) = mV_1 + mV_2$

$\frac{1}{2}m(1.5\ \text{m/s})^2 + \frac{1}{2}m(-1.0\ \text{m/s})^2 = \frac{1}{2}mV_1^2 + \frac{1}{2}mV_2^2$

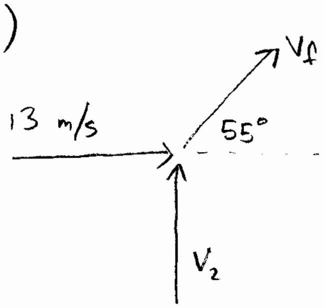
$\Longrightarrow V_1 = -1.0\ \text{m/s}\ ;\ V_2 = 1.5\ \text{m/s}$

c) $m(1.5\ \text{m/s}) + m(1.0\ \text{m/s}) = mV_1 + mV_2$

$\frac{1}{2}m(1.5\ \text{m/s})^2 + \frac{1}{2}m(1.0\ \text{m/s})^2 = \frac{1}{2}mV_1^2 + \frac{1}{2}mV_2^2$

$\Longrightarrow V_1 = 1\ \text{m/s}\ ;\ V_2 = 1.5\ \text{m/s}$

44)



$\cancel{m}(13\ \text{m/s}) = 2\cancel{m}(\cos 55°)V_f$

$\cancel{m}V_2 = 2\cancel{m}(\sin 55°)V_f \Longrightarrow V_f = \frac{V_2}{2(\sin 55°)}$

$\Longrightarrow V_2 = (\tan 55°)(13\ \text{m/s})$

$= 18.5\ \text{m/s} < 35\ \text{m/s}$

60) a) from problem 40 a), $V_{red} = 0$ m/s and $V_{blue} = 3$ m/s immediately after collision

b) By conservation of energy,

$$\frac{1}{2}(.250\text{ kg})(3\text{ m/s})^2 = \frac{1}{2}(50\text{ N/m})(x_{max})^2$$

$$\Longrightarrow x_{max} = .212\text{ m}$$