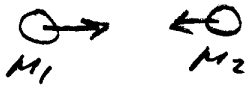
Momentum Problems Ch. 6

1. Two particles collide head-on in a perfectly inelastic collision. If $m_1 = 0.5$ kg, $m_2 = 0.25$ kg, $v_1 = 4$ m/s, and $v_2 = -3$ m/s, find the final velocity after the collision.

$M_1 = 0.5\text{kg}$
$V_{1i} = 4\ \frac{m}{s}$
$M_2 = 0.25\text{kg}$
$V_{2i} = -3\ \frac{m}{s}$
$V_f = \_\_\_\ \frac{m}{s}$



$$M_1V_{1i} + M_2V_{2i} = (M_1 + M_2)V_f$$

$$V_f = \frac{M_1V_{1i} + M_2V_{2i}}{M_1 + M_2}$$

$$= \frac{0.5\text{kg}(4\frac{m}{s}) + (0.25\text{kg})(-3\frac{m}{s})}{0.5\text{kg} + 0.25\text{kg}}$$

$\boxed{V_f = +1.67\ \frac{m}{s}}$ The two masses are moving to the right.

11. A 175 g overweight baseball heading right at 15 m/s hits a 400 g super-superball going 2.5 m/s to the left. After the elastic collision the super-superball is going 8.15 m/s to the right. Find the velocity and direction of the baseball.

$M_1 = 175\text{g}$
$V_{1i} = +15\ \frac{m}{s}$
$M_2 = 400\text{g}$
$V_{2i} = -2.5\ \frac{m}{s}$
$V_{2f} = +8.15\ \frac{m}{s}$
$V_{1f} = \_\_\_\ \frac{m}{s}$

$$M_1V_{1i} + M_2V_{2i} = M_1V_{1f} + M_2V_{2f}$$

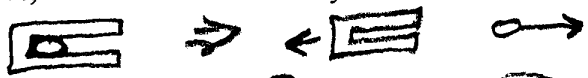
$$V_{1f} = \frac{M_1V_{1i} + M_2V_{2i} - M_2V_{2f}}{M_1}$$

$$= \frac{175\text{g}(15\frac{m}{s}) + (400\text{g})(-2.5\frac{m}{s}) - (400\text{g})(+8.15\frac{m}{s})}{175\text{g}}$$

$\boxed{V_{1f} = -9.34\ \frac{m}{s}}$ Baseball is moving to the left.

2. A 3000 kg cannon rests on a frozen pond. It fires a 30 kg cannon ball horizontally. If the cannon recoils to the right with a velocity of 1.8 m/s, what is the final velocity of the cannon?

$M_c = 3000\text{kg}$
$V_{ci} = 0\ \frac{m}{s}$
$M_b = 30\text{kg}$
$V_{bi} = 0\ \frac{m}{s}$
$V_{bf} = 1.8\ \frac{m}{s}$
$V_{cf} = \_\_\_\ \frac{m}{s}$



$$M_cV_{ci} + M_bV_{bi} = M_cV_{cf} + M_bV_{bf}$$

$$V_{cf} = -\frac{M_bV_{bf}}{M_c}$$

$$= -\frac{30\text{kg}(1.8\frac{m}{s})}{3000\text{kg}}$$

$\boxed{V_{cf} = -0.018\ \frac{m}{s}}$ cannon is moving to the left.