Section II: Conservation of Momentum

1. A 16 kg canoe traveling at 12 m/s makes a head-on collision with a 4 kg raft moving in the opposite direction at 6 m/s. After the collision the raft moves ***backwards*** at 22.7 m/s. Determine the speed of the canoe after the collision.

i	f
$m_A = 16kg$	$v_{Bf} = 22.7 m/s$
$v_{Ai} = 12 m/s$	$v_{Af} = ?$
$m_B = 4kg$	
$v_{Bi} = -6 m/s$	

$$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$$
$$(16kg)(12m/s) + (4kg)(-6m/s) = (16kg)\,v_{Af} + (4kg)(22.7m/s)$$
$$v_{Af} = 4.83 m/s$$

2. A 2 kg ball traveling at 5 m/s collides with a 1 kg ball at rest. After the collision the 1 kg ball moves off with a speed of 7 m/s. Find the final speed of the 2 kg ball.

i	f
$m_A = 2kg$	$v_{Bf} = 7 m/s$
$v_{Ai} = 5 m/s$	$v_{Af} = ?$
$m_B = 1kg$	
$v_{Bi} = 0 m/s$	

$$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$$
$$(2kg)(5m/s) = (2kg)\,v_{Af} + (1kg)(7m/s)$$
$$v_{Af} = 1.50 m/s$$

3. A 63 kg ice skater finishes her performance and crossed the finish line with a speed of 10.8 m/s. Suppose she accepts a huge 4.4 kg bouquet of flowers. Find her new speed.

i	f
$m_A = 63kg$	$v_f = ?$
$v_{Ai} = 10.8 m/s$	
$m_B = 4.4kg$	
$v_{Bi} = 0 m/s$	

$$m_A v_{Ai} + m_B v_{Bi} = (m_A + m_B) v_f$$
$$(63kg)(10.8m/s) = (63kg + 4.4kg)\,v_f$$
$$v_f = 10.1 m/s$$

4. A 15,000 kg railroad car moving at 7 m/s collides and sticks to a 2nd car with a mass of 17,000 kg that is moving in the ***same*** direction at 1.5 m/s. What is the speed of the joined cars after the collision?

i	f
$m_A = 15000kg$	$v_f = ?$
$v_{Ai} = 7 m/s$	
$m_B = 17000kg$	
$v_{Bi} = 1.5 m/s$	

$$m_A v_{Ai} + m_B v_{Bi} = (m_A + m_B) v_f$$
$$(15000kg)(7m/s) + (17000kg)(1.5m/s) = (15000kg + 17000kg)\,v_f$$
$$v_f = 4.08 m/s$$