

# SPH4U UNIVERSITY PHYSICS

## ENERGY & MOMENTUM

- Conservation of Momentum (2D)  
(P.249-253)

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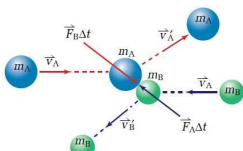
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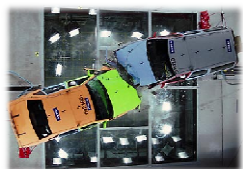
### Conservation of Momentum (2D)

Dealing with collisions in two dimensions involves the same basic ideas as dealing with collisions in one dimension. Now, however, you work in one dimension at a time, because, as was stated earlier, momentum is conserved in each dimension independently.



$$\Delta p_x = 0 \quad m_A v_{Ax_i} + m_B v_{Bx_i} = m_A v_{Ax_f} + m_B v_{Bx_f}$$

$$\Delta p_y = 0 \quad m_A v_{Ay_i} + m_B v_{By_i} = m_A v_{Ay_f} + m_B v_{By_f}$$




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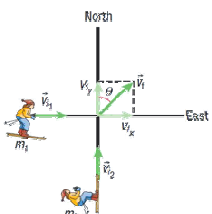
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### Conservation of Momentum (2D)

#### PRACTICE

- Two cross-country skiers are skiing as shown. Skier 1 has a mass of 84 kg and skier 2 has a mass of 72 kg. Both skiers have an initial speed of 5.1 m/s. One of the skier forgets to look, resulting in a right-angle collision with their skis locked together after the collision. Calculate the final velocity of the two skiers.



$$\Delta p_x = 0 \quad v_{fx} = 2.75 \text{ m/s[E]}$$

$$\Delta p_y = 0 \quad v_{fy} = 2.35 \text{ m/s[N]}$$

$$v_f = v_{fx} + v_{fy} \quad v_f = 3.6 \text{ m/s[E}41^\circ\text{N]}$$

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### Conservation of Momentum (2D)

**PRACTICE**

2. A billiard ball of mass 0.15 kg is rolling north at 3.5 m/s when it collides with a stationary golf ball of mass 0.050 kg. The billiard ball rolls off at an angle of 15° with a velocity of 3.1 m/s. What is the final velocity of the golf ball?

$\Delta p_x = 0$        $v_{gfx} = 2.41 \text{ m/s}[W]$   
 $\Delta p_y = 0$        $v_{gfy} = 1.52 \text{ m/s}[N]$   
 $v_{gf} = v_{gfx} + v_{gfy}$        $v_{gf} = 2.8 \text{ m/s}[W32^\circ N]$

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### Conservation of Momentum (2D)

**PRACTICE**

3. Two cars of identical mass are approaching the same intersection, one from the south and one from the west. They reach the intersection at the same time and collide. The cars lock together and move away at an angle of 55° as shown. Which car was travelling faster than the other before the collision? Explain your reasoning.

car A since it possesses more momentum (larger  $\theta$ )

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### Check Your Learning

**TEXTBOOK**  
P.253 Q.4,6 (Review)

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