

# University Physics 1A

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## Conservation of Momentum

If there is zero net external force on a system:

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} + \dots = m_1 \vec{v}_{1f} + m_2 \vec{v}_{2f} + \dots$$

total initial momentum = total final momentum

$$m_1 v_{1ix} + m_2 v_{2ix} + \dots = m_1 v_{1fx} + m_2 v_{2fx} + \dots$$

$$m_1 v_{1iy} + m_2 v_{2iy} + \dots = m_1 v_{1fy} + m_2 v_{2fy} + \dots$$

### Example

Two pucks move on a horizontal air-hockey table. One puck has mass 3.00 kg and initially moves east at 4.00 m/s. The other puck has a mass of 6.00 kg and moves at 5.00 m/s at 60.0° north of east. The two pucks collide and stick together. Find the

velocity after the collision of the combined pucks.

$$\begin{aligned}m_1 v_{1ix} + m_2 v_{2ix} &= m_{12} v_{12fx} \\3(4) + 6(5 \cos(60)) &= (3 + 6)v_{12fx} \\v_{12fx} &= \frac{12 + 30 \cos(60)}{9} \\&= 3.00m/s\end{aligned}$$

$$\begin{aligned}m_1 v_{1iy} + m_2 v_{2iy} &= m_{12} v_{12fy} \\(3)(0) + 6(5 \sin(60)) &= (3 + 6)v_{12fy} \\v_{12fy} &= \frac{30 \sin(60)}{9} \\&= 2.89m/s \\v_{12f} &= 4.167m/s \\ \theta &= 43.8^\circ\end{aligned}$$

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