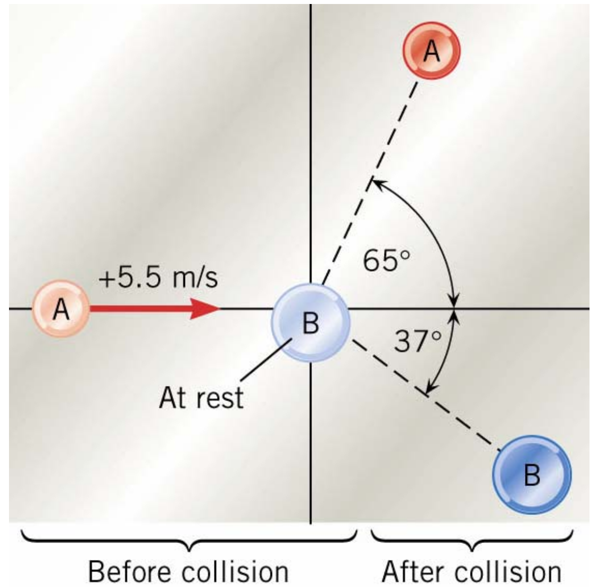
Physics 151 Class Exercise: Momentum II-KEY

1. A 0.43 kg red hockey puck slides at 5.5 m/s into a 0.62 kg blue hockey puck that is at rest on the ice as is shown in the diagram. Find the velocities of the pucks after the inelastic collision.



$$p_{xi} = p_{xf}$$

$$m_A v_A = m_A v_A' \cos 65° + m_B v_B' \cos 37°$$

$$p_{yi} = p_{yf}$$

$$0 = m_A v_A' \sin 65° - m_B v_B' \sin 37°$$

Let's solve the p_y equation for $v_{A'}$ and substitute into the p_x equation where we will solve for v_B'.

$$0 = m_A v_A' \sin 65° - m_B v_B' \sin 37°$$

$$v_A' = \frac{m_B v_B' \sin 37°}{m_A s\text{in} 65°}$$

$$m_A v_A = m_A v_A' \cos 65° + m_B v_B' \cos 37°$$

$$m_A v_A = m_A \frac{m_B v_B' \sin 37°}{m_A s\text{in} 65°} \cos 65° + m_B v_B' \cos 37°$$

$$m_A v_A = v_B' \left(\frac{m_B \sin 37°}{\sin 65°} \cos 65° + m_B \cos 37° \right)$$

$$v_B' = \frac{m_A v_A}{m_B \left(\frac{\sin 37°}{tan 65°} + \cos 37° \right)} = \frac{(0.43kg)\left(5.5\frac{m}{s}\right)}{(0.62kg)(1.079)} = 3.53\frac{m}{s} \approx 3.5\frac{m}{s}$$

Now plug this value back into the p_y equation and solve for v_A'.

$$0 = m_A v_A' \sin 65° - m_B v_B' \sin 37°$$

$$v_A' = \frac{m_B v_B' \sin 37°}{m_A \sin 65°} = \frac{(0.62kg)\left(3.53\frac{m}{s}\right)\sin 37°}{(0.43kg)\sin 65°} = 3.38\frac{m}{s} \approx 3.4\frac{m}{s}$$

2. A 0.430-kg block is attached to a horizontal spring that is at its equilibrium length, and whose force constant is 20.0 N/m. The block rests on a frictionless surface. A 0.0500-kg wad of putty is thrown horizontally at the block, hitting it with a speed of 2.30 m/s and sticking.

(a) How far does the putty-block system compress the spring?

Use momentum conservation to determine the speed of the puddy-block system just after the collision.

$$m_b(0) + m_p v_p = (m_b + m_p) v_f$$

$$v_f = \left(\frac{m_p}{m_p + m_b} \right) v_p$$

Use v_f to determine K_f and equate K_f with the spring potential energy.

$$\frac{1}{2}(m_p + m_b)\left(\frac{m_p}{m_p + m_b} \right)^2 v_p{}^2 = \frac{1}{2} k \Delta x^2$$

$$\Delta x = \sqrt{\frac{m_p{}^2 v_p{}^2}{k(m_p + m_b)}} = \sqrt{\frac{(0.0500\text{ kg})^2 \left(2.30\ \frac{\text{m}}{\text{s}}\right)^2}{\left(20.0\ \frac{\text{N}}{\text{m}}\right)(0.0500\text{ kg} + 0.430\text{ kg})}} = \boxed{3.71\text{ cm}}$$