2D Conservation of Momentum problem:

A **hockey puck** of mass *m = 2 kg* traveling at 4.5 m/s along the **x axis** hits another **identical hockey puck** at **rest**.

A) If after the collision the **second puck** travels at a speed of 3.5 m/s at an angle of 30° **above** the **x axis**, calculate the **final velocity** of the **first puck**?

B) Calculate the **change** in **kinetic energy**, ΔK. Is the **collision elastic**? Briefly explain.

Solution:

(**10 points**) A **hockey puck** of mass *m = 2 kg* traveling at 4.5 m/s along the **x axis** hits another **identical hockey puck** at **rest**.

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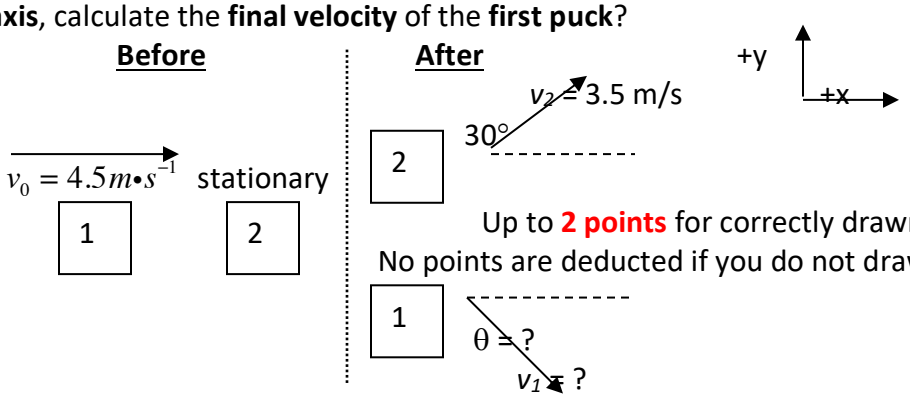

Up to **2 points** for correctly drawn diagram.
No points are deducted if you do not draw a diagram.

Use **conservation** of **momentum in 2D**

x-component:**Before** **After**

$$mv_0 = mv_{1x} + mv_{2x} \rightarrow 4.5m/s = v_{1x} + (3.5m/s)\cos 30^\circ$$

$$v_{1x} = 1.47m/s \quad \textbf{2 points}$$

y-component: **Before** **After**

$$0 = -mv_{1y} + mv_{2y} \rightarrow 0 = -v_{1y} + (3.5m/s)\sin 30^\circ$$

$$v_{1y} = 1.75m/s \quad \textbf{2 points}$$

magnitude of the **velocity** is $v_1 = \sqrt{(1.47m/s)^2 + (1.75m/s)^2} = 2.28m/s$ **1 point**

angle $\theta = \tan^{-1}(v_{1y}/v_{1x}) = 50^\circ$ **1 point**

Velocity: *v* = 2.28 m/s at 50° below the horizontal or $\vec{v} = 1.47\frac{m}{s}\hat{i} - 1.75\frac{m}{s}\hat{j}$

B) Calculate the **change** in **kinetic energy**, ΔK. Is the **collision elastic**? Briefly explain.

After **Before**

$$\Delta K = \left(\frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2\right) - \frac{1}{2}mv_0^2 = \left(\frac{1}{2}2kg\left(2.28\frac{m}{s}\right)^2 + \frac{1}{2}2kg\left(3.5\frac{m}{s}\right)^2\right) - \frac{1}{2}2kg\left(4.5\frac{m}{s}\right)^2 = -2.8J$$

Since $\Delta K \neq 0$ the **collision** is **not elastic**. **2 points**