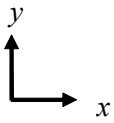
Name: _____

RECITATION HANDOUT #9: **Collisions and Conservation of Momentum**

Two blocks are moving on a frictionless, horizontal table. Block #1 (5 kg) has an **initial velocity** $\vec{v}_{1i} = (3\hat{i} - 4\hat{j})$ m/s and block #2 (5 kg) has an **initial velocity** $\vec{v}_{2i} = (3\hat{i} + 6\hat{j})$ m/s .The two blocks then collide and stick together in a **perfectly inelastic collision**.

(a) Draw diagrams of the blocks below for **before** and **after** the collision. Label the blocks and draw the relevant momentum vectors $\vec{p}_{1i}, \vec{p}_{2i}, \vec{p}_f$ in each picture.

Before Collison



After Collison

	Block #1 (m)	Block #2 (m)	System of Blocks ($2m$)
Before	$\vec{p}_{1i}$	$\vec{p}_{2i}$	$\vec{p}_{sys,i}$
After	$\vec{p}_{1f}$	$\vec{p}_{2f}$	$\vec{p}_{sys,f}$
Change	$\Delta\vec{p}_1$	$\Delta\vec{p}_2$	$\Delta\vec{p}_{sys}$
	1 div = 5 kg m/s	1 div = 5 kg m/s	1 div = 5 kg m/s

(b) Draw the **initial momenta** $\vec{p}_i$ for each block and the system on the grids and write their values below.

$\boxed{\vec{p}_{1i}} = m\vec{v}_{1i} = (5\text{ kg})(3\hat{i} - 4\hat{j})\text{ m/s} = \boxed{15\hat{i} - 20\hat{j}\text{ kg m/s}}$ (1st calculation done as an example!)

$\vec{p}_{2i} =$ $\qquad$ $\vec{p}_{2i} =$ $\boxed{}$

$\vec{p}_{sys,i} =$ $\qquad$ $\vec{p}_{sys,i} =$ $\boxed{}$

(c) Draw the **final momenta** $\vec{p}_{\mathrm{f}}$ for each block and the system on the grids and write their values below.

$\vec{p}_{1\mathrm{f}} =$

$\vec{p}_{2\mathrm{f}} =$

$\vec{p}_{\mathrm{sys,f}} =$

(d) Draw the **change in momenta** $\Delta\vec{p}$ for each block and the system on the grids and write their values below.

$\Delta\vec{p}_1 =$

$\Delta\vec{p}_2 =$

$\Delta\vec{p}_{\mathrm{sys}} =$

(e) What observation can you make about **changes in momenta** $\Delta\vec{p}_1$ and $\Delta\vec{p}_2$? How does this relate to the forces on each block and Newton's 3rd Law pairs?

(f) Find the **initial kinetic energies** K_{i} of both blocks. Remember $K = \frac{m}{2}(v_{\mathrm{x}}^2 + v_{\mathrm{y}}^2) = \frac{1}{2m}(p_{\mathrm{x}}^2 + p_{\mathrm{y}}^2)$.

$K_{1\mathrm{i}} =$

$K_{2\mathrm{i}} =$

(g) Find the **final kinetic energies** K_{f} of both blocks.

$K_{1\mathrm{f}} =$

$K_{2\mathrm{f}} =$

(h) Find the **change in kinetic energy** of the system of blocks.

$\Delta K_{\mathrm{sys}} =$

2. Block #1 (1 kg) moves **right** at 8 m/s on a frictionless surface and collides with block #2 (1 kg) which is moving **left** at 4 m/s. After the collision, if block 1 moves right at 2 m/s, **how fast** is block #2 moving to the right?

3. Cart #1 (1 kg) travels at +3 m/s and hits a **stationary** Cart #2 (4 kg). After the collision, cart #1 travels at –1 m/s and cart #2 travels at +1 m/s. The **collision type** is:

4. Box #1 (mass m) slides on a frictionless surface and collides and sticks to a stationary box #2 (mass $2m$). What is the **ratio** between the final **kinetic energy** K_f of the system and its initial K_i?