HT Momentum Lab
PSI Physics

Name___________________________________

Objective:

1. Confirm conservation of momentum
2. Observe elastic and inelastic collisions.

Materials:

- One dynamics rail and two carts
- PASCO interface
- Two Motion sensors (if possible, set to wide beam)
- Computer with PASCO capstone software

Preparing the PASCO Capstone Software:

1. Connect the motion sensors to the PASCO interface (the yellow plug goes into digital input port 1, and the black plug goes into port 2. The second motion sensor uses plugs 3 and 4). Turn on the interface.

2. Open the Capstone software on the computer. On the left sidebar, click “Hardware Setup.” Then, click the yellow circle that represents the first digital port (where the yellow plug is), and select “Motion Sensor II.” Do this again for port 3.

3. On the right sidebar, double click the “Graph” icon. Then, add one more graph by clicking the “Add Display” button.

4. Make the first graph measure velocity from “Motion Sensor (Ch. 1 & 2)”, and the second graph measure velocity from “Motion Sensor (Ch. 3 & 4)”.

Procedure:

1. Slide one motion sensor into one end of the dynamics rail, then slide the last motion sensor into the other end of the dynamics rail. Take the mass of both carts and place their values in the chart below.

2. Place both dynamics carts on the rail so that their spring-plungers are facing each other.
    a. To prevent confusion when reading the graphs, start recording data on Capstone. Move one cart back and forth, then stop the recording. Whichever graph shows changes in velocity is the one that will measure the velocity of the cart you moved.

3. Make sure the carts look like Diagram I below. Then, start the Capstone software so it begins recording data. Pick one cart, and lightly push it into the other cart, so that their spring-plungers collide. Stop recording. Use the point tool to record the initial velocity of each cart, as well as the velocity of the carts after the collision in the chart below.

4. Reset the carts, except push the plungers into the carts so that they are no longer sticking out. Velcro should be on both carts, but if not place tape on the carts so that they will stick together when they collide. They should look like <u>Diagram II</u>.

5. Start recording data, then push one cart into the other. Stop recording a little while after the carts stick together. Use the point-tool to record the initial velocity of each cart, as well as the velocity of the carts after the collision in the chart below.

6. For a final collision, with the spring plungers out start recording on the Capstone software and move both carts towards each other at different velocities. The carts should follow <u>Diagram III.</u> Use the point tool to record the initial velocity of each cart, as well as the velocity of the carts after the collision in the chart below.

<u>Note: When examining the graphs on Capstone, fully smooth the data using the smoothing tool</u>

<u>Diagrams:</u>

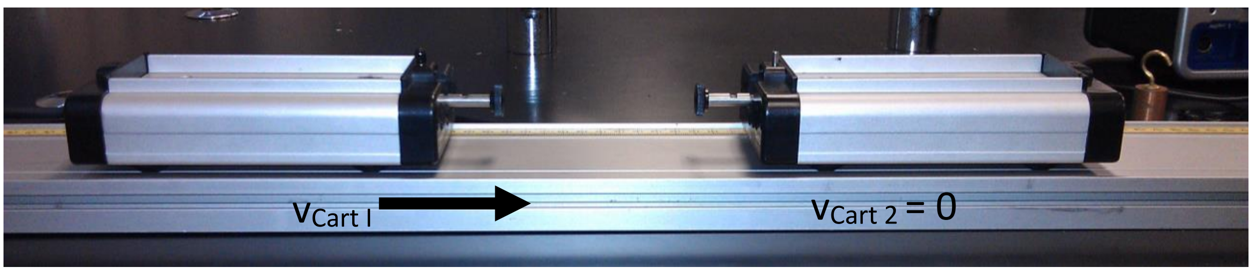

Diagram I: The spring plungers are sticking out towards each other. One cart is initially at rest.

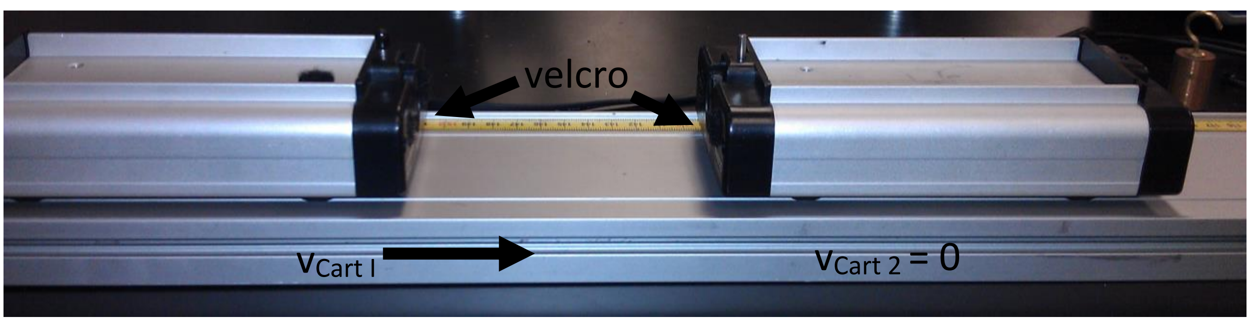

Diagram II: The carts have Velcro pads that are facing each other. One cart is initially at rest.

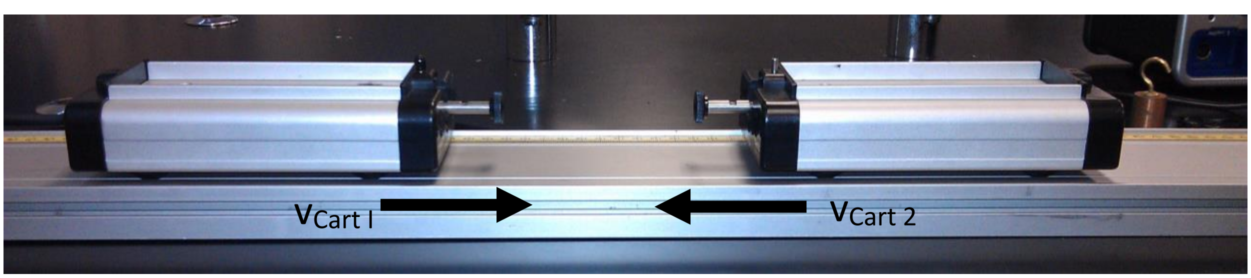

Diagram III: The carts follow Diagram I, but move towards each other at different velocities

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Data:

		Collision 1 (Diagram I)		Collision 2 – (Diagram II)		Collision 3 – (Diagram III)	
Cart	**Mass (kg)**	**Initial v (m/s)**	**Final v (m/s)**	**Initial v (m/s)**	**Final v (m/s)**	**Initial v (m/s)**	**Final v (m/s)**
1 (Motion Sensor Ch. 1 & 2)							
2 (Motion Sensor Ch. 3 & 4)							

Equations:

$$p = mv$$

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$$

$$KE = \frac{1}{2}mv^2$$

Analysis:

1. Determine the initial and final net momentum for before and after collision 1, 2, and 3. Is momentum conserved for each collision?

Collision 1 | Collision 2 | Collision 3

2. Can we consider collisions 1, 2, and 3 to be either elastic or inelastic? Why? Use the value of Kinetic Energy before and after the collision to support your answer.

Collision 1 | Collision 2 | Collision 3

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Interpretation and Application Questions:

1. If you add a 1kg mass to only one of the carts for any of the collisions, would momentum still be conserved? Why? If possible, repeat any of the collisions after adding a 1kg mass to a cart while using the Capstone software to record data, and use your findings to support your answer.

2. A cart weighing .500 kg moves at 4.68 m/s and collides with a stationary cart of the same mass. Assuming the collision is elastic, what are the final velocities of both carts?

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3. Two carts are moving in the same direction. One cart with a mass of 0.70 kg moving at 18 m/s strikes another cart with a mass of 1.40 kg moving at 6.00 m/s (in the same direction). After they collide, they stick to each other. Find the velocity of the cart combination after they collide.

4. What could have led to the discrepancy between each of your momentum values?