Lab 4: Conservation of Momentum in Collisions

Introduction

The purpose of this experiment is to show that momentum is conserved in collisions.

When two carts collide with each other, the total momentum (**p = mv**) of both carts is conserved regardless of the type of collision. An elastic collision is one in which the two carts bounce off of each other with no loss of kinetic energy—accomplished in this experiment, through the use of the carts' magnetic bumpers. A completely inelastic collision is one in which the two carts hit and stick to each other—accomplished in this experiment using the Velcro patches on one end of each cart.

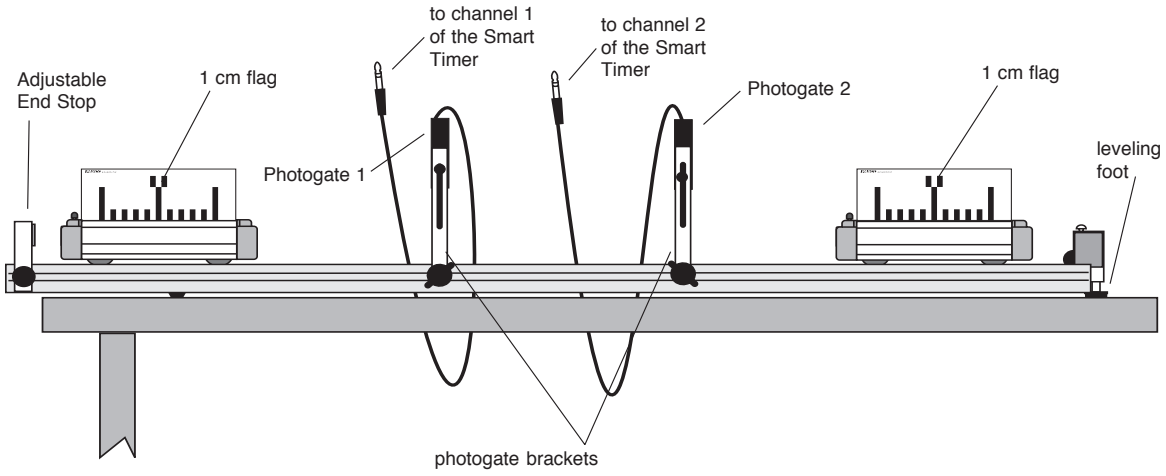
Regardless of the type of collision the total momentum of the system is always conserved and thus the equation below should hold.

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

Procedure

1. Level the track by setting a cart on the track to see which way it rolls. Adjust the leveling screw at the end of the track to raise or lower that end until a cart placed at rest on the track will not move.

2. Put a Picket Fence into the slots in the top of each cart and place the Collision Carts so the Velcro patches face each other. Position the two photogates just far enough apart so the collision can take place between the photogates. Adjust the height of the photogate so the 1 cm fence will block the photogate beams. Connect the photogates to the Smart Timer (see Figure below).



3. Set up the Smart Timer to measure Speed: collision (cm/s). Press to activate the Smart Timer.

   ➤ **Note**: If the flags of both carts do not go through the photogate beams twice, the Smart Timer will not complete the timing cycle and display velocities automatically. You will need to push **3** to stop timing. The completed timing measurements will be displayed, and the uncompleted measurements will be registered as 0. Press **1** or **2** to view the velocities from photogate 2. You can scroll back and forth between the displayed velocities from photogates 1 and 2 by pressing either of these keys. Press **3** to reactivate the **Speed: collision (cm/s)** mode or to change modes.

PART A: Inelastic Collisions

4. Perform each of the following inelastic collisions:

   Equal Masses

   a) Place one cart at rest in the middle of the track. Give the other cart an initial velocity toward the cart at rest.

   Unequal Masses

   Put one or two mass bars in one of the carts so that the mass of one cart greater than the other cart. (Weigh the carts and record the masses in **Table 1**).

   b) Place the lighter cart at rest in the middle of the track. Give the heavier cart an initial velocity toward the cart at rest.

   c) Start the carts at opposite ends of the track at approximately the same speed toward each other.

PART B: Elastic Collisions

5. Set up the carts so the magnetic ends face each other, so the carts will repel each other when they collide. Repeat a) through c) in step 4 and record your data on **Table 2**.

Raw Data

Table 1. Inelastic Collisions

	M1	M2	V1 initial	V2 initial	V final
a)					
b)					
c)					

Table 2. Elastic Collisions

	M1	M2	V1 initial	V2 initial	V1 final	V2 final
a)						
b)						
c)						

Data Analysis

For each of the cases, calculate the momentum before and after the collision and record the results in **Tables 3** and **4**.

Table 3. Inelastic Collisions

	p1 initial	p2 initial	p total initial	p total final	% of difference
a)					
b)					
c)					

Table 4. Elastic Collisions

	p1 initial	p2 initial	p1 final	p2 final	p total initial	p total final	% of diff
a)							
b)							
c)							

Conclusions

Answer the following questions.

1. Was the momentum conserved in all your collisions? If not, in which cases it wasn't conserved and what was the % of difference?

2. What factors do you think may cause for there to be a difference between the momentum before and the momentum after collisions?

3. When two carts moving toward each other have the same mass and the same speed, they stop when they collide and stick together. What happens to each cart's momentum? Is momentum conserved? Explain

4. Kinetic energy is not conserved in inelastic collisions. For one of the collisions. Where does this energy go?