Conservation of Momentum in Explosions

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Lab Partners________________________

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Purpose:

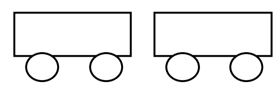
Demonstrate conservation of momentum by examining two carts exploding away from each other.

Introduction:

When two objects separate and no net external force acts on the system, linear momentum is conserved. Applying this principle, if the two objects start at rest, the final momentum of the objects must be equal and opposite.

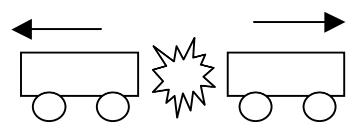
initial

$$m_1 v_1 = 0;\ m_2 v_2 = 0 \Rightarrow P_i = 0$$



final

$$m_1 v_1 - m_2 v_2 = 0 \Rightarrow P_f = 0$$



From this final state we can infer a relationship between the ratio of the masses and the ratio of the velocities.

$$m_1 v_1 = m_2 v_2 \Rightarrow \frac{m_2}{m_1} = \frac{v_1}{v_2}$$

To further simplify the calculations, the carts will be placed so that they will reach the end of the track simultaneously (Δt will be the same for both carts).

$$\frac{v_1}{v_2} = \frac{\frac{\Delta x_1}{\Delta t}}{\frac{\Delta x_2}{\Delta t}} = \frac{\Delta x_1}{\Delta x_2}$$

Finally, it can be inferred that the ratio of the masses is equal to the ratio of the distances:

$$\frac{\Delta x_1}{\Delta x_2} = \frac{m_2}{m_1}$$

Procedure:

1. Level the track so that a cart will not roll when placed at rest on the track.

2. Then, take the dynamics cart and push the plunger completely in until it latches in its maximum position. Place the two carts against each other on the track so that the plunger is between them.
3. Next, release the plunger (hitting it squarely with a pencil or something along those lines) so that the two carts travel to the ends of the track. Experiment with starting positions until they reach the ends at the same time.
4. When you find the correct starting position, weigh the two carts on the beam balances, record the masses and the starting position in table 1.
5. Finally, calculate the distances traveled by each cart (x_1 & x_2). Then fill in the two final columns x_1/x_2 and m_1/m_2 .

Do this for four cases:
- both carts without any additional mass bars
- one mass bar in one cart, none in the other
- two mass bars in one cart, none in the other
- two mass bars in one cart, one in the other

mass 1 (kg)	mass 2 (kg)	Starting position (cm)	x_1(cm)	x_2(cm)	x_2/x_1	m_1/m_2

Table 1: Data for Verifying Conservation of Momentum in an Elastic Collision

Questions:

1. Does the ratio of the distances equal the ratio of the masses in each of the cases; hence, is momentum conserved?

2. Why is this considered an elastic collision? What distinguishes an elastic collision from an inelastic collision?