Lab 11 - Conservation of Momentum
in Explosions

Name ____

Partner's Name ____

I. Introduction/Theory

This experiment demonstrates the conservation of momentum during an explosion, this is accomplished by calculating the momentum of two carts pushing away from each other.

When two carts push away from each other and no net force exists, the total momentum of both cars is conserved. Because the system is initially at rest, the final momentum of the two carts must be equal in magnitude and opposite in direction so the resulting total momentum of the system is still *ZERO*.

$$\vec{P} = m_1\vec{v}_1 + m_2\vec{v}_2 = 0$$

And as a scalar equation assuming v_2 is negative,

$$P = m_1v_1 - m_2v_2 = 0$$

Therefore, the ratio of the final speeds of the carts is equal to the ratio of the masses of the carts.

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

To simplify this experiment, the starting point for the carts at rest is chosen so that the two cars will reach the end of the track simultaneously. The speed, which is the distance divided by the time, can be determined by measuring the distance traveled since the time traveled by each cart is the same.

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

Thus the ration of the distances is equal to the ratio of the masses:

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

II. Equipment

Dynamic Cart with Bar Masses
Collision Cart
Dynamics Cart Track
Meter Stick
Ruler
Scale (500 g capacity)

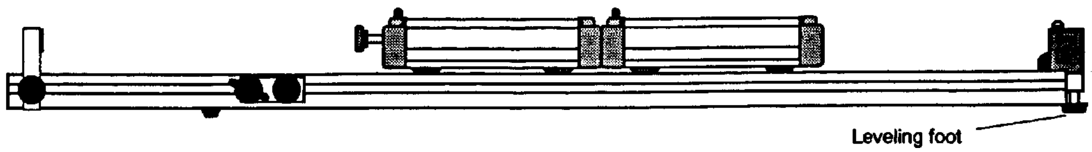

Figure 1

III. Procedure/Data

1. Level the track by setting a cart on the track to see which way it rolls, Adjust the leveling feet to raise or lower the ends until a cart placed at rest on the track will not move.
2. For each of the following cases, place the two carts against each other with the plunger of the Dynamics Cart pushed completely in and latched in its maximum position (see Figure 1).
3. Push the plunger release button with a short stick (ruler) and watch the two cart move to the ends of the track. Experiment with different starting positions until the two carts reach their respective ends of the track at the same time. Then weigh the two carts and record the masses and starting position in Table 1.
   CASE 1: Carts of Equal Mass (Use two carts without any additional mass bars)
   CASE 2: Carts of Unequal Mass (Put one mass bar in one cart, none in the other)
   CASE 3: Carts of Unequal Mass (Put two mass bars in one cart, none in the other)
   CASE 4: Carts of Unequal Mass (Put two mass bars in one cart, one mass bar in the other)

Mass 1	Mass 2	Position	Δx_1	Δx_2	$\Delta x_1/\Delta x_2$	m_2/m_1

Table 1

III. Analysis

1. For each of the cases, calculate the distances traveled from the starting position to the end of the track. Record the results in Table 1.

2. Calculate the ratio of the distances traveled and record in Table 1.

3. Calculate the ratio of the masses and record in Table 1.

4. Does the ratio of the distances equal the ratio of the masses in each of the cases? If your answer is yes, momentum is conserved. Explain why this is ($\Delta x_1/\Delta x_2 = m_2/m_1$ or $\Delta x_1/\Delta x_2 \neq m_2/m_1$).

5. When carts of unequal masses push away from each other, which cart has more momentum?

6. When carts of unequal masses push away from each other, which cart has more kinetic energy? Explain why this is.

7. Is the starting position dependent on which cart has its plunger cocked? Explain why this is.

IV. Conclusions (include physical concepts and principles investigated in this lab, independent of your experiments success, and summarize without going into the details of the procedure.)