Explosion Lab

PSI Physics

Name:_____

Objectives:

- To discover the law of conservation of momentum
- To be able to predict the motion of two objects resulting from an explosion

Materials:

- Two (2) dynamics carts with spring plungers
- Dynamics track (optional)
- Two (2) meter sticks
- Two (2) books (bumpers)
- Set of masses

Explosions are events in which on object (or a group of touching objects) is blown apart. In this experiment, you will research explosions that break apart a pair of stationary touching carts.

Experimental Procedure:

1. Weigh the carts to find their mass to the nearest 0.1 kg (100 g). The carts may have had small masses attached; do not remove these. Both carts should have about the same mass. *Record the mass of a cart in the table on the next page*.
2. Place the two meters sticks (cm side up) with their zero cm ends touching. If you have a dynamics track, set it up parallel to the meter sticks, and so that the middle point of the track is next to where the meter sticks touch.
3. Place the two carts together with the spring plungers touching and one of the plungers loaded. Make sure that the mid point of the two carts is aligned with where the two meter sticks meet.
4. Place one book to act as a wall or bumper 60 cm from the end of the cart on the left side. This book should not be moved.
5. With the carts as setup above, estimate how far the second book must be placed on the right side so that the carts will hit the books at the same time. Release the spring and watch carefully how the carts hit the books. If the carts don't hit at the same time, adjust the location of the book on the right until they do. *Enter this distance in the first row of the table*.
6. Repeat step 5 adding 1x, 2x and finally 3x the mass of a cart to the cart on the right. *Enter this distance in the appropriate row of the table (added mass = 1x, 2x or 3x cart)*.

Data Collection Analysis Table:

m_1 (kg)		M (kg)	$m_2=m_1+M$ (kg)	d_1 (m)	d_2 (m)	m_1d_1 (kg•m)	m_2d_2 (kg•m)	$m_1d_1+ m_2d_2$
mass of a cart mass of left cart	mass added to right cart	mass added to right cart	mass of right cart (= mass of a cart + added mass)	position of book from left cart note: this is negative	position of book from right cart			
	0 x cart	0		–0.60				
	1 x cart			–0.60				
	2 x cart			–0.60				
	3 x cart			–0.60				

Note: For the purposes of this experiment, any motion to left is going to be considered, and motion to the right will be considered positive. This means that when calculating m_1d_1 for the left cart, your answer should be negative.

Analysis:

1. Complete the table above by
   a) Calculating the values of m_1d_1 and m_2d_2
   b) Finding the sum of m_1d_1 and m_2d_2 for each row

2. Before the spring is released,
   a. What is the momentum, mv, of each cart?

      m_1v_1 = _____ m_2v_2 = _____

   b. What is the momentum of both carts, $m_1v_1+m_2v_2$?

      $m_1v_1+m_2v_2$ = _____

3. Because the carts are moving at constant velocities after they are released, the distance of each cart can be represented by $d = vt$. Since the time it took for both carts to reach their respective distances was the same, we can divide each m_1d_1 and m_2d_2 by t. So we can say that the momenta of the two carts after the explosion, $m_1v'_1$ and $m_2v'_2$ will have same relationship to each other as m_1d_1 and m_2d_2. Using this knowledge
    a. What can you conclude about the relationship between the momentum of the carts immediately after the explosion? *Write an equation between the momentum of the left cart to the momentum of the right cart just after the explosion.*

    b. What can you conclude about the total momentum of the carts immediately after the explosion?

4. Conservation of Momentum is one of the most fundamental principles of physics. Momentum of a system is conserved (doesn't change because of an event) if and only if no <u>outside</u> forces act upon the objects in the system. Was momentum conserved in this experiment?

<u>Application:</u>

5. While your practicing your tennis game, you look at the machine that is shooting tennis balls and you realize that this is an explosion. You know the mass of a tennis ball is 0.06 kg, and the mass of the launcher is 12 kg. After a tennis ball is launched, you observe the launcher moves backwards at a speed of 0.2 m/s. How fast are the tennis balls being launched? (*<u>Hint: use the equation you found in question 3. a) above</u>*)