Lab: Conservation of Momentum

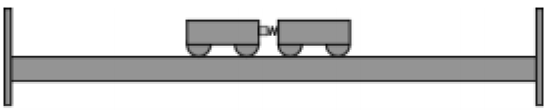
OBJECTIVE: Investigate if momentum is conserved in both elastic and inelastic collisions.

MATERIALS: Dynamics carts (pair with spring mechanism), 2 stopwatches, set of masses, meter stick, triple-beam balance

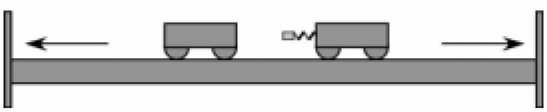
PROCEDURE: Study the cart with the spring mechanism so that you will know how to compress and release the mechanism. *Be very careful so that you do not break the mechanism and render the cart useless!*

1. Take the mass of each empty cart and record it in your data table (Trial #1). The mass of cart A will vary according to the masses you add during the lab. Don't forget to add the mass of the empty cart when recording the masses in your data table.

2. Set up the carts as shown in the diagram below. Make sure there are no obstructions in the paths of the carts. Be sure to mark the "starting" point for both carts each trial.



Carts A and B connected by spring mechanism



Carts A and B spring mechanism releasing carts

3. "Release" the mechanism and start the stopwatches (1 timing each cart).

4. Stop the timer when the cart comes to a stop, or hits a wall. Measure and record the distance each cart traveled.

5. Repeat steps 2-4 for the next 3 trials, but use the following weights (you will need to convert to kg):
   Trial 2: 3 N   Trial 3: 5 N   Trial 4: 10 N

DATA:

	Mass (kg)		**Time (s)**		**Distance (m)**	
Trial #	Cart A (m_1)	Cart B (m_2)	Cart A	Cart B	Cart A	Cart B
1						
2						
3						
4						

CALCULATIONS:

1. Calculate the average velocities for each cart. Be sure to note in your table whether the velocity is positive (going left to right) or negative (going right to left).
2. Calculate the momentum for each cart before and after releasing the spring. Again, note whether the momentum is positive or negative.
3. Considering the two carts to constitute your SYSTEM, calculate the total momentum of the SYSTEM before and after the collision. Remember that momentum is a vector, so the direction (positive or negative) is important.

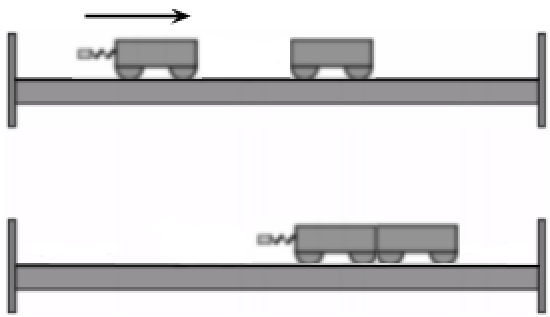
	Initial Velocity (m/s)		**Final Velocity (m/s)**	
Trial #	Cart A (v_1)	Cart B (v_2)	Cart A (v_1')	Cart B (v_2')
1				
2				
3				
4				

	Initial Momentum (kg*m/s)			**Final Momentum (kg*m/s)**		
Trial #	Cart A (p_1)	Cart B (p_2)	Total p	Cart A (p_1')	Cart B (p_2')	Total p'
1						
2						
3						
4						

Conservation of Momentum Lab (Part 2) :)

PROCEDURE:

1. Set up the empty carts as shown in the diagram below. Cart B (with the spring mechanism) should have the spring compressed and touching a wall. There should be space between the two carts, velcro sides facing each other.



2. Mark your "starting" point at the velcro side of **cart A**'s position. Measure the distance between both velcro ends of the carts. Record this distance for **cart B**.

3. Release the spring mechanism and start the stopwatch. Press "Lap" on the stopwatch when the carts collide with each other. Stop the time when the carts come to a stop. Record the lap times in your data table.

4. Measure and record the distance from your starting point to the MIDDLE of the 2 carts.

5. Repeat steps 2-4 for the next 3 trials, but ADD the following weights each time (convert to kg):
   Trial 2: 3 N   Trial 3: 5 N   Trial 4: 10 N

DATA:

	Mass (kg)		**Time (s)**		**Distance (m)**	
Trial #	Cart A (m_1)	Cart B (m_2)	Cart B	Cart A + B	Cart B	Cart A + B
1						
2						
3						
4						

CALCULATIONS: Complete the following tables with calculated values.

	Initial Velocity (m/s)		**Final Velocity (m/s)**	
Trial #	Cart A (v_1)	Cart B (v_2)	Cart A (v_1')	Cart B (v_2')
1				
2				
3				
4				

	Initial Momentum (kg*m/s)			Final Momentum (kg*m/s)		
Trial #	Cart A (p_1)	Cart B (p_2)	Total p	Cart A (p_1')	Cart B (p_2')	Total p'
1						
2						
3						
4						

ANALYSIS:

1. What type of collision occurred in part 1 of this lab? What type occurred in part 2?
2. In the elastic collisions you performed, how SHOULD the velocity of cart A have changed as mass increased?
3. Theoretically (probably not in your data), how should the magnitude of each cart's final momentum compare to the other, if they both started at rest? EXPLAIN why this may not be true in your data (sources of error?).
4. Theoretically, in the inelastic collisions you performed, how should the final momentum of the large cart compare to the initial momentum of the moving cart? Explain why.
5. In the inelastic collisions, what can you conclude about the importance of the mass difference? That is, how much better (or worse) were your results when the masses were significantly different than when they were roughly equal? What implications might this have as far as safety in normal life?
6. Theoretically, in the inelastic collisions you performed, how should the final velocity of the large cart compare to the initial velocity of the moving cart? Explain why.