Conservation of Momentum Lab

Introduction:

The momentum of an object is defined to be the product of its mass and velocity. When two objects interact (collide), their individual momenta may change but the total momentum of the system, P, remains constant before, during, and after the interaction provided no external forces are acting on the system. This is called the *conservation of momentum principle.* Stated mathematically for a two object system:

$$P_I = P_f$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

Where m_1 is the mass of the first cart and m_2 is the mass of the second cart. v_{1l}, v_{2i} are the initial velocities of the carts respectively and $v_{1f,}$ v_{2f} are the final velocities of the carts respectively.

In this exercise, you will verify the conservation of momentum principle as two dynamic carts interact during a simulated explosion.

Equipment Reguired:

Two Motion Detectors
Two Ti-83 Calculators
Two low friction dynamic carts (one with a spring)
3 1-kg weights
Scales

Equipment Set-up Procedure:

Procedure: (do this for both CBLs)

1. Connect the CBL unit to the TI-83 Calculator with the unit–to-unit link cable using the ports located on the bottom edge of each unit. Press the cable ends in firmly.

2. Connect the motion detector to the sonic port on the left side of the CBL unit. Turn on the CBL.

The CBL system is now ready to receive commands from the calculator.

3. Under the program button on the TI83, choose physci. Hit enter three times.

4. Next choose 1 “Set up probes”

5. Enter “1” for the number of probes

6. Under Select Probe choose “7: more probes” and the “3:motion” for the probe.
Next under the main menu choose “2:collect data” and then “2:Time Graph”

7. Enter .1 seconds between samples and hit enter.

8. Enter 50 as the number of samples and hit enter twice. This will give you five seconds for data collection.

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9. Choose “use time setup” next and you are ready to collect data.

Instructions:

1. Measure the mass of each cart and the weights (you must do this separately because of the amount of mass). Record this information.
2. Place the two carts back to back with the spring mechanism between the two carts. Load the spring mechanism (compress it until you can lock it using one of the slots in the bar). Make sure the carts are in direct contact by the spring mechanism.
3. Place the two rangers on the floor about one meters from each end of the carts so that when released the carts will move toward the rangers.
4. When you are ready to start collecting data, press enter on each calculator. After one second release the spring device. If the carts do not follow a straight line you will need to repeat the experiment.
5. When you are satisfied with the results, select the Velocity-time plot to see a graph of the velocity verses time on each calculator. You may need to adjust the Ymax and Xmax in the window so as to create an appropriate viewing rectangle. If you are satisfied with the graphs use the trace function and record the maximum velocity for each cart in your data.
6. Repeat the experiment except this time place one of the masses on each cart.
7. Repeat a third time using two masses on each cart or two masses on one cart and one mass on the other cart. Record your data each time.

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Analysis of the Data: (show all work)

1.) What was the momentum of cart A before the spring was released?

2.) What was the momentum of cart B before the spring was released?

3.) What was the total momentum of the system (cart A and Cart B) before the spring was released?

4.) In the data table you are asked to calculate m x d instead of m x v for momentum, why can do this and still be testing for the conservation of momentum? Explain in detail.

5.) What was the error for each of the three trials? (subtract the product of (m x d) of cart B from the product of (m x d) cart A)

6.) What was your percentage of error for each of the three trials? (divide the error by (m x d) of cart A)

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7.) **What might have caused your errors?**

8.) **Determine whether momentum was conserved (if your error was 10% or less assume momentum was conserved)**

9.) **If you momentum was not conserved, why?**

10.) **In complete sentences, list three ways that you could improve your accuracy while maintaining the integrity of the experiment.**

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