

Who's Your Mom-entum? Final Lab and Report

Physics

This lab report is an individual assignment and should be turned in with all work shown, all calculations clear (including equations and derivations), and diagrams and drawings where necessary.

Part I: Prediction

Using your equations, experience, and measurements from the preliminary lab, answer the following questions. Please note that there is an implied frame of reference; if one cart has a positive velocity and the other has a negative velocity, it implies the two carts are moving toward each other.

1. What will the momentum be of an elastic cart (0.5 kg) with two mass bars (an additional 0.5 kg each) that has a velocity of approximately 0.5 m/s? From here on, we will refer to this cart as Cart 1.
2. What will the momentum be of an elastic cart (0.5 kg) with one mass bar (0.5 kg) that has a velocity of approximately -0.25 m/s? From here on, we will refer to this cart as Cart 2.
3. What is the total momentum of Cart 1 and Cart 2 combined?
4. If the velocity of Cart 2 is 0.65 m/s after the collision, what will the velocity of Cart 1 be after the collision?
5. During the preliminary lab, you observed several collisions. What was the typical amount of time that passed during those collisions?
6. Using your estimate of the amount of time from step 5, along with the change in momentum of Cart 2 that you calculated in steps 2 and 4, calculate the approximate average force produced by Cart 1 during the collision. (You will need to use the formula for impulse, like you did in the preliminary lab.)

Part II: Test

Set up two elastic carts as described above, one with a total mass of 1.5 kg (the cart plus two bars) and the other with a total mass of 1.0 kg (the cart plus one bar). Using the motion sensors and the track, roll the carts toward each other until you get a good trial where the graphs are clear and the velocities of the two carts approximately match the velocities described in Part I of this lab report (while moving towards each other, Cart 1 should have a speed of 0.5 m/s and Cart 2 should have a speed of 0.25 m/s). Using the data from the graphs, answer the following questions.

7. What is the velocity and momentum of Cart 2 just before the collision?
8. What is the velocity and momentum of Cart 2 just after the collision?
9. What is the amount of time that passes during the collision?
10. What is your estimate of the average force exerted by Cart 1 on Cart 2 during the collision?

Part III: Error Analysis

11. In a paragraph of 5-6 sentences, discuss your results. How well did your test match your prediction? Was the velocity of Cart 2 after the collision reasonably close to 0.65 m/s? (Where do you suppose that number came from?) What are some of the reasons why your test results may not have matched up with your predictions? (Hint: "Measurement error", "Human error", and "Equipment error" are not specific enough. What are some specific ways in which measurements could be incorrect, human error could have contributed to differences in theoretical and actual values, and the equipment could somehow lead you astray?)