

**EXPERIMENTAL QUESTION**

Chapters N1, N3, and N7 discuss Newton's third law. In this experiment, you will make and test some predictions about Newton's third law in a specific case.

**EDUCATIONAL PURPOSE**

The primary educational goal of this lab is have you experience *with your own body* some of the implications of Newton's third law.

**PROCEDURAL COMMENTS**

When you begin the experiment, your helper will show you how to mount empty soda cans as a "bumper" on the front of each of two low-friction carts. You will then collide the carts in various ways to see which cart gets its can bumper crushed more *while riding the carts*.

Before you actually begin the lab, stop and discuss the following situations with your teammates. What will happen to the cans in the following situations? Write your predictions in the spaces provided below. If your arguments are cogent, you will not be penalized at all for making wrong predictions (indeed, the experiment will be even more vivid and surprising if you do!). Therefore, make the predictions that you *deeply believe in your heart of hearts* will happen, not the answers that you might *think* we want. Check the appropriate boxes directly on this sheet.

1. Imagine that both carts are equally massive, and both approach each other with roughly equal speeds. Which cart gets its cans crushed more extensively?  
 the cart moving left     the cart moving right     both sets will be crushed equally
2. Imagine that both carts are equally massive, but one cart is moving before the collision and the other cart is at rest. Which cart gets its cans crushed more extensively?  
 the moving cart     the stationary cart     both sets will be crushed equally
3. Imagine that both carts approach each other with roughly equal speeds, but one is much more massive than the other. Which cart gets its cans crushed more extensively?  
 the massive cart     the lighter cart     both sets will be crushed equally
4. Imagine that a moving massive cart hits a lightweight cart at rest. Which cart gets its cans crushed more extensively?  
 the massive cart     the lighter cart     both sets will be crushed equally
5. Imagine that put one cart so that its back end is firmly set against a wall, and collide the other cart with it. Which cart gets its cans crushed more extensively?  
 the moving cart     the stationary cart     both sets will be crushed equally

When you have come to consensus about each of these answers, and you have worked out a procedure for testing them, your helper for an interview. After your helper has checked your answers and your reasoning about the questions and cleared your procedure, perform the experiments to test your predictions.

Since this experiment involves colliding the carts while they are traveling at significant speeds, there is the potential for getting people hurt: please be very careful. Anyone riding the carts *must* wear a helmet at all times. Also, an incident several years ago has made us absolutely firm in our resolve that everyone must wear appropriate shoes (a cart running into an unprotected foot can cause very painful and unsightly damage).

At the end of this experiment, you will take a quiz about Newton's 3rd law. Be sure that you ask your helper about *anything* you don't understand about Newton's 3rd law. You will be graded individually on this quiz, which will be worth 8 points. (There will be a similar quiz for the non-inertial frames lab next week that will be worth 12 points: combined, these two quizzes will count as a normal lab.)