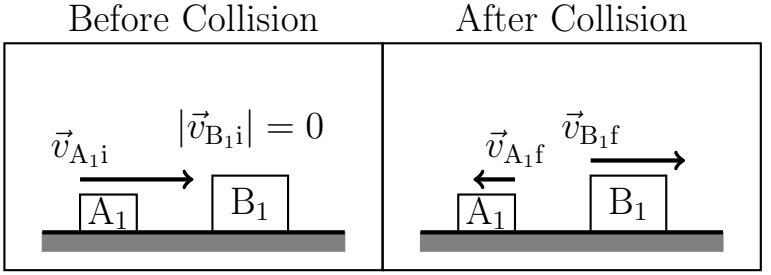
Lecture 21: Collisions

Prediction

- Experiment 1 is conducted with two carts, A_1 and B_1, on a level, frictionless track. The mass of cart B_1 is greater than that of cart A_1 (*i.e.* $m_{B_1} > m_{A_1}$).
- In experiment 1, cart A_1 moves toward cart B_1, which is initially at rest. Magnets are attached to the carts so that the carts repel each other without touching. After the collision, cart A_1 has reversed direction and cart B_1 moves to the right.
- *Predict* whether the magnitude of the final momentum of cart B_1 is *greater than*, *less than*, or *equal to* that of the system S_1 of both carts. Briefly explain.



Experiment 1

(A) Greater than

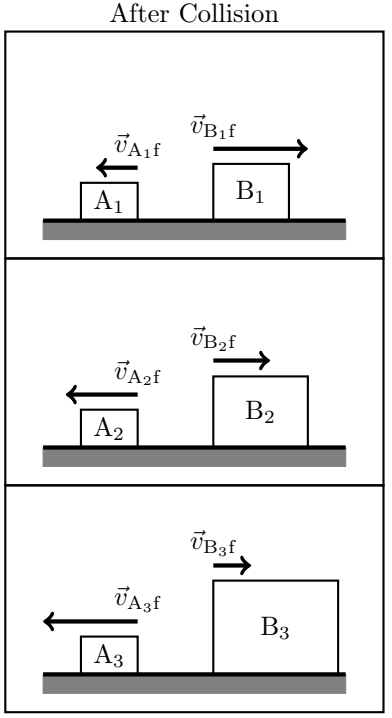
(B) Less than

(C) Equal to

(D) Not enough information

L21-1: Collision Experiments

- Two additional experiments are performed that are identical to experiment 1 with one exception: the mass of the target cart is larger in each subsequent experiment (*i.e.* $m_{B_3} > m_{B_2} > m_{B_1}$).
- In each experiment, cart A moves toward cart B, which is initially at rest.
- The incoming carts A_1–A_3 are identical and have the same initial velocity to the right.
  - Create momentum vector diagrams for experiments 1, 2, and 3 (your vectors only need to be qualitatively accurate).
  - Use your vector diagrams to rank the final momenta of the B carts according to magnitude.
  - Consider what would happen in the special case that the mass of cart B is made *very large*.



L21-2: Carnival Game

A carnival game requires you to knock over a wood post by throwing a ball at it. You're offered a very bouncy rubber ball and a very sticky clay ball of equal mass. Assume that you can throw them with equal speed and equal accuracy. You only get one throw.

- Which ball do you choose? Why?
- Create a momentum vector diagram for this situation to defend your answer.
- Ask someone on the instructional team to help you check your answers.

Main Ideas

- Momentum and impulse are useful quantities for solving dynamics problems.
- The impulse is always equal to the change in momentum for a system.
- When the impulse is zero (because the net force is zero), the momentum of the system is constant—it is *conserved*.