

PART I: Bouncy Collisions with Equal Masses

Directions - In this part, face the magnetic end of each cart toward each other. The Velcro ends should be facing away from each other.

Case 1: Place one cart at rest in the middle of the track. Give the other cart an initial velocity toward the cart at rest.

Before

After



Case 2: Place both carts at opposite ends of the track. Give the carts approximately equal speeds toward each other.

Before

After



Case 3: Start both carts at one end of the track. Give the first cart a slow velocity and the second one a faster velocity so that the second cart catches up to the first.

Before

After



1. What is transferred from one cart to the other in the collisions? Explain how you observed this. (2 pts)

2. Thinking about Part I and the three equal mass Bouncy cases, write a general rule for how the velocities of the carts changed, relative to one another, from before to after the collision. (2 pts)

PART II: Bouncy Collisions with Unequal Masses

Directions - In this part, place two mass bars on one of the carts so that it now has a much higher mass (**M**) that the other cart (**m**). As before, face the magnetic end of each cart toward each other. The Velcro ends should be facing away from each other.

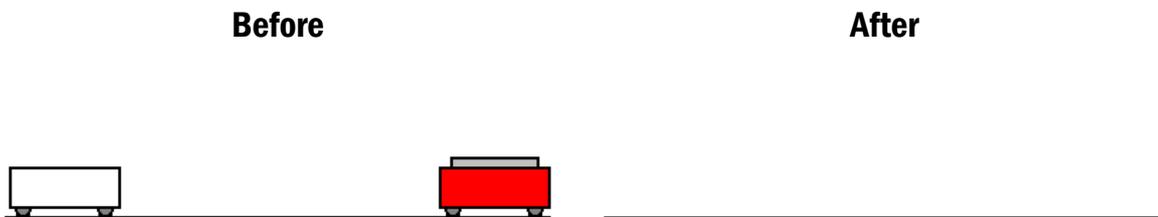
Case 1: Place the **M** cart at rest in the middle of the track. Give the cart **m** an initial velocity toward the cart at rest.



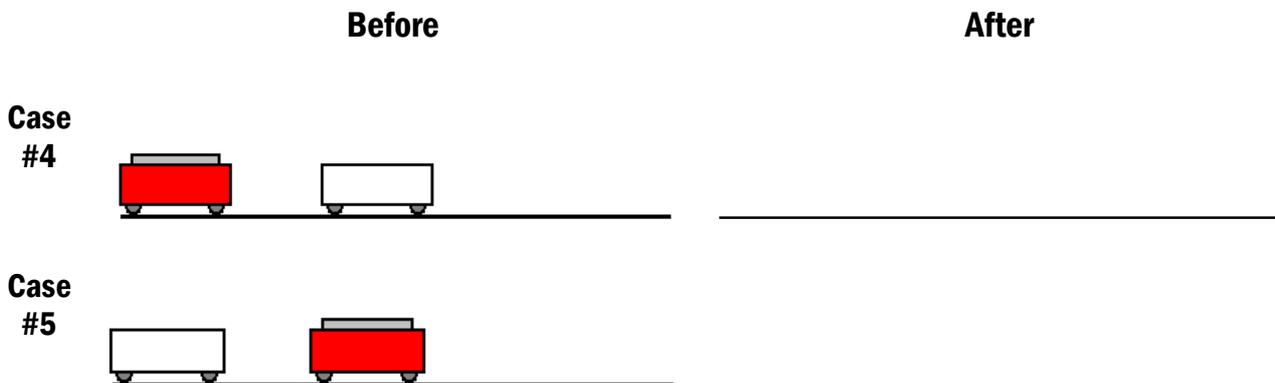
Case 2: Place the **m** cart at rest in the middle of the track. Give the **M** cart an initial velocity toward the cart at rest.



Case 3: Place both carts at opposite ends of the track. Give the carts approximately equal speeds toward each other.



Cases 4 & 5: Start with both carts at the same end of the track. Give the first cart a slow velocity and the second cart a faster velocity so that the second cart catches up to the first. Do this for both cases: once with the **m** cart first and then once with the **M** cart first.



3. When the two carts of unequal mass collided, which one had more force acting on it – the lighter cart or the heavier cart? Explain using Newton’s Laws. (2 pts)

4. Thinking about Part II and the five unequal mass Bouncy cases, write a general description of:
a. the magnitude of the lighter cart’s acceleration. (2 pts)

- b. the magnitude of the heavier cart’s acceleration.

5. What factors will affect the momentum of the cart? Explain how they affect it. (2 pts)

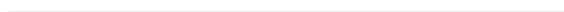
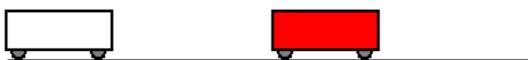
PART III: Sticky Collisions with Equal Masses

Directions - In this part, remove the mass bars and turn the carts so that their Velcro ends are facing each other. Be sure the two carts stick together when they collide.

Case 1: Place one cart at rest in the middle of the track. Give the other an initial velocity toward the cart at rest.

Before

After



Case 2: Start with one cart at each end of the track. Give the carts approximately equal speeds toward each other.

Before

After



Case 3: Start with both carts at the same end of the track. Give the first cart a slow velocity and the second cart a faster velocity so that the second cart catches up to the first.

Before

After



6. In which type of collision, sticky or bouncy, did the carts change their momenta more? Describe how you observed this.

(2 pts)

7. Thinking about Part III and the three Sticky cases, write a general statement comparing the velocity of the mega-cart (two carts stuck together) *after* to the individual cart velocities *before*. Why would this change occur?

(2 pts)

PART IV: Explosions

Directions - In this part, place the end of one cart that has the plunger against the magnetic end of the other cart. Put both carts at rest in the center of the track. Push in the plunger on one cart until it catches. Place the other cart right next to it. Tap the trigger quickly with your finger or the end of pen so that the plunger pops out and both carts “explode.”

Case 1: Do the explosion procedure listed on the previous page with no mass bars on the carts so that the carts have approximately equal masses.

Before

After



Case 2: Do the explosion procedure listed on the previous page with two mass bars on one of the carts so that the masses of the carts are unequal.

Before

After



8. When the two carts of unequal mass exploded, which one was pushed harder – the lighter cart or the heavier cart? Explain using Newton’s Laws. How did this affect their accelerations? (5 pts)

9. Thinking about Part IV, case 1, compare the velocities of each cart, relative to one another, after an explosion with equal mass. (2 pts)

10. Thinking about Part IV, case 2, compare the velocities of each cart, relative to one another, after an explosion with unequal mass. (2 pts)
