Names _____ Date _____

Collisions—Part 1

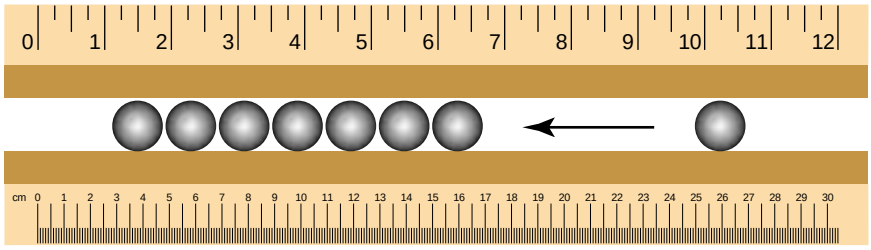
Materials
- Plastic ruler with center groove (30 centimeters long) or similar items for tracking the marbles, such as grooved wooden molding
- Eight identical marbles

Task

You will be observing colliding marbles, which demonstrate the law of conservation of momentum. The momentum of a moving object is the product of its mass and its velocity (M = mv). If all of the marbles are identical in mass and size, a moving marble will transfer its momentum to a stationary marble when they collide.

Parameter

Make sure your marbles are identical in size and mass.



Don't forget to return the marbles.

The rulers must be properly set up to get the correct results for the collision activities.

Procedure

1. Place all eight marbles in the ruler groove next to and touching each other.
2. Pull one of the marbles about 10 centimeters away from the rest and then push it back toward the other marbles, giving it some speed. Note what happens when the marbles collide.
3. Place the marbles back at their original position and pull two marbles about 10 centimeters away from the rest. Push the two marbles together toward the other six marbles so that they collide. Note what happens after the collision.
4. Repeat step 3 with three marbles, then four marbles, and finally, five marbles.

Conclusion

1. When one marble bumps against the other seven, why does just one marble move away?

_____

_____

2. Did the other six marbles move much after the first collision? Why? _____

_____

3. How many marbles moved away when you pulled three marbles back and made them collide with the remaining five marbles? _____

_____

4. If you were to use a twice as massive marble to collide with the seven other marbles of regular mass, would that cause just one marble to move away? Explain. _____

_____

_____

5. Would the end marble also move faster when one is hitting the row with a faster speed? _____

_____

Names _____ Date _____

Collisions—Part 2

Materials

- Two plastic rulers with center groove (30 centimeters long) or similar items for tracking the marbles, such as grooved wooden molding
- Two identical marbles
- Two identical books or boards to use as ramp supports

Task

You will cause two moving marbles to collide and observe the direction of the movement after collision.

Parameters

Make sure your marbles are identical in size and mass.

Procedure

1. Make a ramp using each of the rulers and a support, such as a board or a book.
2. Place the ends of the rulers that are resting on the table facing each other separated by a 10-centimeter distance, as shown in figure 1.
3. Place a marble at the top of each ruler and then release the marbles at the same time. Note and record the direction of movement after the marbles collide. _____

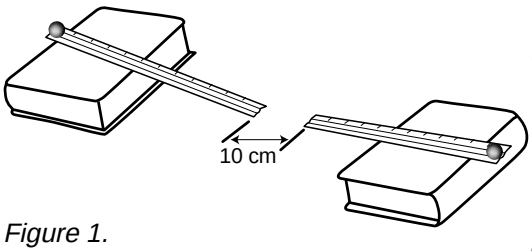


Figure 1.

4. Move the rulers farther apart so that there is 20 centimeters between them. Place a marble at the top of each ruler. Give one of the marbles a push, and let the other marble roll without a push (one fast-moving, one slow-moving). Note and record the differences between this collision and the collision in the previous step. _____

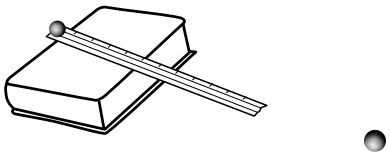


Figure 2.

5. Place one marble on the table 10 centimeters from the base end of one ruler to be a target. Place the other marble at the top of the ruler ramp, releasing it to hit the target marble. Note and record the direction of movement after the marbles collide (see fig. 2). _____

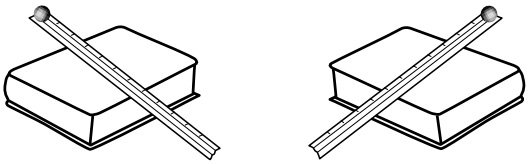


Figure 3.

6. Change the direction of the rulers so that they will collide and hit perpendicular to each other. Note and record the direction of movement after the marbles collide (see fig. 3).

7. Remove one of the rulers, placing the other ruler so that it faces the ramp stand directly head-on. Place a marble at the top of the ruler and release it. Note the direction that the marble moves after it collides with the ramp stand (see fig. 4). _____

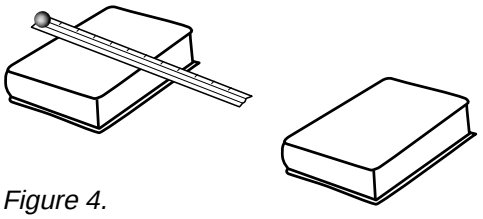


Figure 4.

8. Move the ruler so that it is at an angle with the ramp stand so that the marble will not hit head-on, such as in a side-impact collision (see fig. 5). Note the direction that the marble moves after it collides. _____

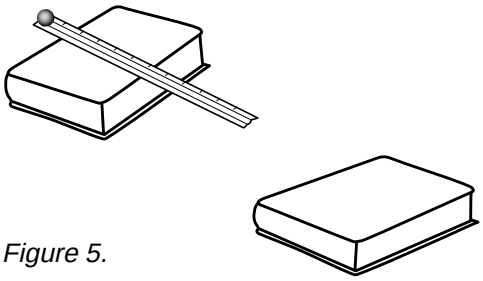


Figure 5.

9. Return the marbles to your teacher when you are finished with this activity.

Conclusion

1. Describe or illustrate how the marbles moved after they collided head-on in step 3 of the procedure. Is kinetic energy (KE) conserved? _____

2. The marble that was pushed has more KE, because it is moving faster. After the collision, which marble has more KE? _____

3. Although the bumper car riders are strapped in and do not fly out of the car, their heads are relatively free to move. Two bumper cars have riders that are the same size and mass, but rider A's car is moving faster than rider B's car when the cars collide head-on.
   a. What will be the resulting motion of each rider's head after collision (assuming they stay attached to the bodies)? _____
   b. What will be the resulting motion of the cars after the collision? _____

4. If the marble sitting still at the bottom of the ramp in step 5 of the procedure were twice as massive as the marble rolling down the ramp, how would the resulting movement of marbles be different than what you observed? _____

5. Illustrate or describe the movement of the marbles after the collision that was set up in step 6 of the procedure. Is the KE of the marbles conserved after the collision? _____

6. How is the direction of movement following the collision in step 7 different from that in step 8 of the procedure? _____