

Motion 5 - Momentum

In physics there is a super special set of observations that rule over all of physics. They are **Laws of Conservation**. In chemistry you met two of them, 'Conservation of Mass' and 'Conservation of Energy'. Today you meet a new Law of Conservation, and in your next and final unit, you will meet yet another.

Laws of Conservation are so important because they form the basis of nearly everything we know about science.

Definitions

Momentum - Momentum is Mass times velocity, $p = mv$.

System - A group of stuff that is interacting.

Conservation of Momentum - Total momentum of a system is conserved IF no forces act on the system.

Conservation of Momentum

Conservation of momentum means that the momentum of a **system** is constant IF there are no forces acting on the **system**. Remember, when you apply a force the system changes because your objects accelerate.

The most common example of conservation of momentum is the game pool. Once the cue (the name for a pool stick) hits the pool ball, the momentum of all the pool balls is conserved because they now form a system. IF someone sticks their hand on the table and grabs or stops a ball they are applying a force to the system and the momentum of the system will change.

Example

If you have a ball that weighs 1 kg, and is rolling at 1 m/s, then the balls momentum is:

Momentum = Mass \times Velocity

$$p = mv = (1 \text{ kg}) (1 \text{ m/s}) = 1 \text{ kgm/s}$$

Activity

You are going to check to see if the conservation of momentum is true. To test this you will analyze 3 different collisions using the 'Tracker' program.

Setup - Procedure

- Get a length of foam track, two steel balls, and a wooden ball, two short pieces of tape, and a meter stick.
- Tape the track to the floor, and place the meter stick next to the track.
- Record a video of the two steel balls colliding.
 - Make sure you hold the camera still
 - Make sure that you can see the meter stick in your video
- Record a video of a steel ball and the wood ball colliding.
 - Make sure you hold the camera still
 - Make sure that you can see the meter stick in your video
- Measure the mass of the steel ball and the wooden ball on the balance.
- Return all of the items.
- Get two balls.
- Record a video where you drop both balls at the same time, one on top of the other.
 - Hold the camera still
 - Make sure you can see the meter stick in the shot.
- Process all three videos using the tracker program. Note, you need to specify the mass of the point mass to have the momentum be correct.

Questions for Labbook

For **EACH** of your three collisions sketch the following graph into your lab notebook.

- On the **SAME** graph plot:
 - The total momentum (p , not p_x , or p_y) of the first object.
 - The total momentum (p , not p_x , or p_y) of the second object.
 - The sum of the two momentums.

Notes

- The 'Tracker Usage Notes' have been updated to explain how to plot two different momentums on the same graph.
- You will have to do the sum by hand, I have yet to figure out how to plot a sum.