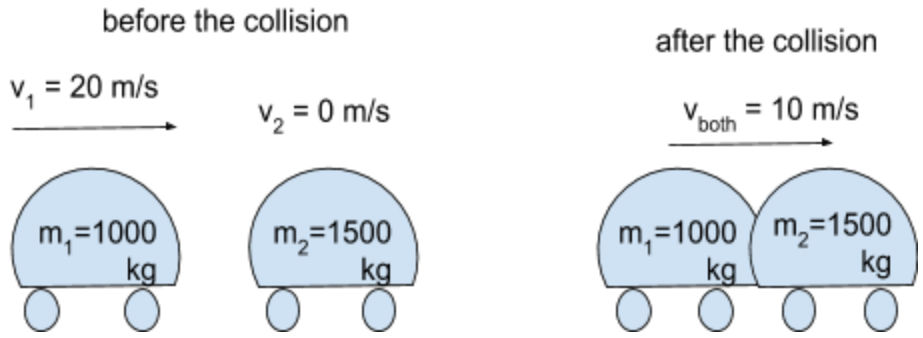
Day 4-5: Conservation of Momentum Notes

Do Now: Identify the error in the drawing of two cars before and after a collision below. Change the numbers so they work and explain the law you used to make your correction:



**Before taking notes on Conservation, we will go over questions from Day 2's Momentum Practice Problems.

Conservation of Momentum Notes

Objectives: You will be able to demonstrate an understanding of momentum by...

- Categorizing collisions as completely elastic, completely inelastic, and partially inelastic.
- Solving for velocity, mass and momentum for objects that collide with each other in a closed system

Step 1: *Looking at the activity from yesterday, find the TOTAL kinetic energy of the system (both balls) before and after the collisions for one pair of rows for both elastic and inelastic collisions)*

	Before Collision	After Collision
Inelastic Collision 1. Ball 1's KE = ½ mv^2 2. Ball 2's KE = ½ mv^2 3. Total KE		
Elastic Collision 1. Ball 1's KE = ½ mv^2 2. Ball 2's KE = ½ mv^2 3. Total KE		

Step 2:What patterns do you notice from the calculations above and from yesterday's activity?

Step 3: Notes

The total momentum in a closed system is conserved. We can model this law with the equation:

It is important to remember that this equation models TOTAL momentum, which means we must _____ and pay attention to _____.

A closed system is one with no outside forces like friction. However, in a system in which momentum is conserved, energy can still be lost due to heat, sound, and deformation of the objects during collision.

Types of Collisions

	Type of Collision			
	Perfectly Elastic Collision	**Completely Inelastic Collision**	**Partially Inelastic Collision**	**Explosion**
What is happening				
What is happening with the Kinetic Energy				
What is happening with the Momentum				

Step 4: Practice Problems

1. A big truck (2,400 kg) is driving at 25 m/s and it hits a car (1,600 kg) going 20 m/s.
    a. What is the initial momentum of the system (both cars together)?

    b. What is the final momentum of the system?

    c. If the cars stick together what is their combined mass?

    d. What is the final velocity of the combined car and truck?

    e. Which type of collision is this? How do you know?

2. A JetBlue airliner (7500 kg, not including the 1200 kg of luggage) takes off from Logan, and settles into a speed of 210 m/s. During the flight, the pilot presses the "shoot all the luggage out the back of the plane" button, causing all the luggage (1200 kg) to shoot straight out the back of the plane. The plane speeds up to 212 m/s because of this action.
    a. What is the initial momentum of the plane and luggage together?

    b. What is the final momentum of *just the plane* after the luggage ejection?

    c. What is the final momentum of the luggage after it is ejected?

d. What is the final velocity of the luggage after the ejection?

e. What type of collision is this? How do you know?

3. Two barges full of salted toad guts have a collision. The red barge has a mass of 150,000 kg and is traveling Northwest at 0.25 m/s. The blue barge has a mass of 100,000 kg and is traveling Southeast at 0.1 m/s. After the collision the blue barge has a velocity of 0.32 m/s to the Northwest.
   a. What is the final velocity of the red barge?

   b. Is this collision elastic?

4. A firework is shot up in the air and comes to rest at the top of its arc before it begins falling back down. It explodes at this point and separates, with Piece 1 (1.5 kg) flying upwards and Piece 2 (4 kg) flying downwards. Piece 2 moves at -18 m/s after the collision.
   a. What is the initial momentum of the system?

   b. What is the final momentum of the system?

c. What is the final momentum of Piece 2?

d. What is the final momentum of Piece 1?

e. What is the final velocity of Piece 1?

5. Two freight cars are on the same set of train tracks. Car 1 has a mass of 10000 kg and a velocity of 4 m/s down the tracks (towards Car 2), while Car 2 has a mass of 50000 kg and is stationary. The two cars collide and stick together, moving as a single unit after the collision.
   a. What is the initial momentum of Car 1?

   b. What is the total initial momentum of the two-car system?

   c. What is final momentum of the two-car system?

   d. What is the total mass of the two-car system?

   e. What is the final velocity of the two-car system?

6. A teen who is texting while driving a red car (800 kg) at 16 m/s crosses over the median strip and hits a driver in a blue car (400 kg) who was going -10 m/s (this means he was driving in the opposite direction). The two cars stick together and move off as a single unit.
    a. What is the initial momentum of the red car?

    b. What is the initial momentum of the blue car?

    c. What is the total initial momentum of the system?

    d. What is the total final momentum of the system?

    e. What is the total mass of the system?

    f. What is the final velocity of the system?