Name: ____ Period: _____ Date: ______________

Momentum and Impulse Guided Notes: https://www.stickmanphysics.com/stickman-physics-home/momentum-impulse-and-conservation-of-momentum/collisions-and-conservation-of-momentum/

Variables

Name	Variable	MKS Unit	Unit Abbreviation
Momentum			
Mass			
Velocity			

Conservation of Momentum

$$p = mv$$

Q: What two things would cause more momentum in the equation above?

Interacting objects have their momentum conserved. The conservation of momentum equation can appear many ways depending on what happens to objects. Objects maintaining their shape, coming apart, sticking together determines the equation form.

Throwing a Projectile

Q: Describe what happens to a players and a baseballs momentum before and after a pitch starting from rest.

Conservation of Momentum Equation

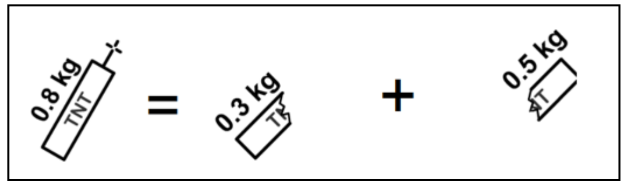
The momentum (p) of all the objects in a system before is equal to the momentum of those objects after.

Example Forms of the Conservation of Momentum Equation

Example Conservation of Momentum Scenario's	Sum of All Momentum Before = Sum of All Momentum After
<u>Both objects have separate velocities before and after</u> Two objects colliding and being separate afterwards	$(m_1v_{1i}) + (m_2v_{2i}) = (m_1v_{1f}) + (m_2v_{2f})$
<u>Both objects are together with the same velocity before but separate after</u> A person throwing an object, a firecracker blowing up	$(v_i)(m_1+m_2) = (m_1v_{1f}) + (m_2v_{2f})$
<u>Both objects are separate before and together traveling one velocity after</u> A dart hitting a movable target and sticking in it traveling together after	$(m_1v_{1i}) + (m_2v_{2i}) = (v_f)(m_1+m_2)$
<u>All objects are apart before then the first remains separate from the other two that stick together traveling the same velocity</u> One car hitting a second that sticks to a third after the collision	$(m_1v_{1i}) + (m_2v_{2i}) + (m_3v_{3i}) = (m_1v_{1f}) + (v_{f2+3})(m_2+m_3)$

Combined Final Momentum of Two Masses
Notice when objects are together the combined momentum is a single velocity times their masses added together.
$(v_i)(m_1+m_2)$ or $(v_f)(m_1+m_2)$

Example Problems
1. A 0.80 kg firecracker is traveling through the air at 12 m/s to the right when it explodes. After the explosion, a 0.30 kg piece of it is flying to the left at 6.0 m/s. What is the mass of the other piece and how fast is it flying?



2. A 95 kg pitcher at rest throws a 0.15 kg baseball 40 m/s to the right. How fast would the pitcher be going after the throw on a frictionless surface?

3. How fast is an 85 kg receiver traveling 6 m/s to the right going after catching a 0.43 kg football traveling at 30 m/s right?

<u>**Elastic Collisions**</u>
In elastic collisions, objects colliding's shape remain unchanged and do not stick together afterwards. Momentum is conserved and kinetic energy is conserved and no heat given off. Two pool balls colliding on a pool table is an example.

Common Elastic Collision Formula with Two Objects

$$(m_1v_{1i}) + (m_2v_{2i}) = (m_1v_{1f}) + (m_2v_{2f})$$

Example Problem
4. A 0.1 kg pool ball traveling 2.5 m/s hits another 0.1 kg at rest. If the first ball stops after the elastic collision, how fast is the second now moving?

<u>**Inelastic Collisions**</u>
During inelastic collisions, objects collide changing form, squishing, and can travel together afterwards. Inelastic collisions involve **conservation of momentum but not kinetic energy**. Some of the kinetic energy converts to heat as objects change form on impact. You can determine how much kinetic energy has changed by adding up the sum of the kinetic energies before and after ($KE = \frac{1}{2} mv^2$).

Common Inelastic Collision Formula with Two Objects Sticking Together

$$(m_1v_{1i}) + (m_2v_{2i}) = (v_f)(m_1+m_2)$$

Example Problem
5. A 0.05 kg dart traveling 16 m/s hits a 0.15 kg movable target and sticks to it. How fast is the dart in the target moving together after the collision?