Momentum and Impulse Review:

Momentum --- think Pomentum

Momentum is the product of the object's mass & velocity.

Formula:

$$p = mv$$

momentum = mass x velocity

p stands for momentum measured in kgm/s
m stands for mass measured in kg
v stands for velocity measured in m/s

Impulse --- think Jimpulse

Impulse is a change in momentum

Formula:

$$J = Ft$$

Impulse = Force x time

J stands for impulse measured in Ns
F stands for Force measured in N
t stands for time measured in s

The unit for impulse is the same as the unit for momentum.

Impulse- Momentum Theorem

Formulas you will need to be able to use:

$Ft = m(v_f - v_i)$

$Ft = mv_f - mv_i$

Impulse equals change in momentum

Example 1:
A 0.75kg baseball is moving to the left at 30m/s. A bat is being swung with 900 N of force for 0.5 s. What is the final velocity of the baseball?

$$Ft = m(v_f - v_i)$$
$$(900N)(.5s) = (0.75kg)(v_f - -30m/s)$$
$$450 = 0.75(v_f + 30)$$
$$-30 \quad\quad -30$$
$$420 = 0.75\,v_f$$
$$\frac{420}{0.75} = v_f \qquad v_f = 560\,m/s$$

The law of conservation of momentum

In a system, momentum is neither created nor destroyed. In other words, total momentum is constant.

Two Types of Collisions

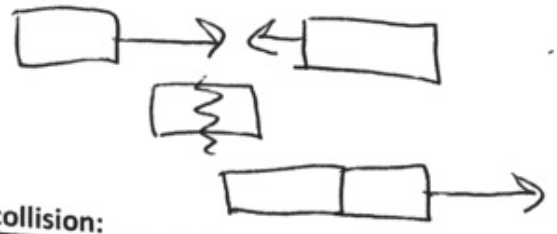
elastic : Kinetic energy is not lost to friction, acoustical (sound) energy, heat, etc.

Object's "bounce" off each other
For example: collisions on ice, in space, air hockey table

Draw a picture of this type of collision:

Inelastic : Kinetic is lost to friction, heat, acoustical energy, etc.
For example: car crash, train cars connecting

Draw a picture of this type of collision:



Formulas:

Elastic collision:

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

m_1 = the mass of object A
v_1 = velocity of object A BEFORE collision
v_{1f} = velocity of object A AFTER collision

m_2 = mass of object B
v_2 = velocity of object B BEFORE the collision
v_{2f} = velocity of object B AFTER the collision

Inelastic collision:

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

m_1 = the mass of object A
v_1 = velocity of object A BEFORE collision
m_2 = mass of object B
v_2 = velocity of object B BEFORE the collision
v_f = velocity of objects A and B AFTER collision

A car of mass 500kg travelling at 30 m/s rear ends another car with a mass of 600kg travelling at 20 m/s in the same direction. The collision is great enough that the two cars stick together after they collide. What type of collision is this and how fast will the cars be moving after the collision?

Car A	car B
500 kg 30 m/s	600 kg 20 m/s
v_f = ?	

inelastic

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

$500(30) + (600)(20) = (500 + 600)v_f$

$15000 + 12000 = 1100\ v_f$

$\frac{27000}{1100} = \frac{1100}{1100} v_f$

$v_f = 24.5$ m/s

A 3000kg truck moving at 10 m/s hits a 1000kg parked car. The impact causes the 1000kg car to be set into motion at 15 m/s and the 3000kg truck then bounces off in the opposite direction. Determine the velocity of the truck after the collision.

Truck	car
3000 kg 10 m/s	1000 kg 0 m/s
v_{1f} = ?	15 m/s

elastic

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

$(3000)(10) + (1000)(0) = (3000)(v_{1f}) + (1000)(15)$

$30000 = 3000\ v_{1f} + 15000$

$-15000 \quad -15000$

$\frac{15000}{3000} = \frac{3000}{3000} v_{1f}$

5 m/s