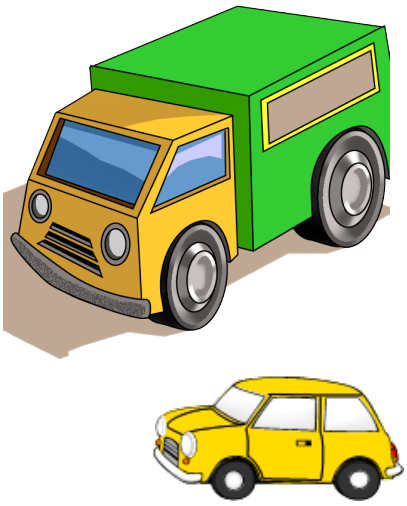
Momentum and Its Conservation



If a truck and a car were traveling at the same speed and had to come to a stop, which vehicle would require more force to stop?

Suppose two cars are traveling at different velocities. Which car would require more force to stop?

So both velocity and mass of an object help to determine what is needed to change its motion.

The product of mass and velocity is called momentum. Momentum is represented by "*p*" The equation for momentum is:

$$\vec{p} = m\vec{v}$$

The units for momentum can be derived from the equation

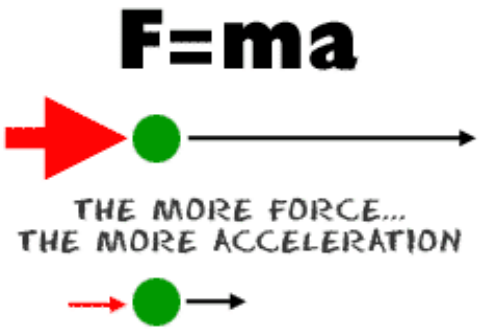
mass --> kg
velocity --> m/s

Newtons First Law

If the mass doesn't change and velocity is constant, then so is momentum!

So.. if a single body has no mass acting on it, its momentum is conserved.

Newtons Second Law describes how a body is changed by a force acting on it.



Can you remember the equation for acceleration?

$$\vec{F} = m\vec{a}$$

$$\vec{F} = \square$$

multiplying by Δt gives us

The left side of this equation is called the **impulse** (the product of the net force and the time interval).

Impulse is a *vector* quantity in the *direction of the force*.

If the mass is constant however, then a change in velocity is a change in momentum.

$$\Delta\vec{p} = m\Delta\vec{v}$$

... and we can rewrite our impulse equation as...

$$\Delta\vec{p} = \vec{F}\Delta t$$

This is the impulse momentum theorem!

Example 1:

A baseball of mass 0.14 kg is moving at 35 m/s [in the positive direction].

a) Find the momentum of the baseball
b) Find the velocity at which a bowling ball, mass 7.26kg, would have the same momentum as the baseball.

Example 2

A 0.144 kg baseball is pitched horizontally at 38 m/s [positive direction]. After it is hit by a bat it moves horizontally at 38 m/s [negative direction].

a) What impulse did the bat deliver to the ball?
b) If the bat and ball were in contact 0.80 ms, what was the average force the bat exerted on the ball? (1000 ms = 1 sec)
c) Find the average acceleration of the ball during its contact with the bat.

Try questions 1-3 on pages 178-179
and Pg. 180 # 1.1 - 1.3