LINEAR MOMENTUM

One of the most important physical quantities in physics is ***Linear Momentum***. Two reasons why:

1. N2L can be expressed in terms of **P**.
2. For an isolated system P is conserved. This conservation principle provides a very powerful method of solving many physics problems that are very difficult or impossible to solve using N2L.

The linear momentum of a particle of mass M and moving with velocity **V** is given by:

$$\boxed{\vec{P} = m\vec{V}}$$ Linear Momentum

- **P** is a vector quantity
- The SI unit of **P** is the kg m/s

Newton expressed his 2nd Law in terms of linear momentum:

$$\sum \vec{F}_{ext} = m\vec{a} = m\frac{d\vec{v}}{dt} = \frac{d}{dt}(m\vec{v}) = \frac{d\vec{p}}{dt}$$

(1) $\boxed{\sum \vec{F}_{ext} = \frac{d\vec{p}}{dt}}$ N2L

Equation (1) implies that:

1. A rapid change in momentum requires a large net force.
2. A gradual change in momentum requires a small net force.

This principle is used in the design or air bags in your car. When you're driving your car your body has a large momentum. If your car suddenly stops during a collision your body will experience a rapid change in momentum and thus a large force! The air bag causes you to lose momentum more gradually and thus reducing the force on your body and hopefully avoid a serious injury!

If the net external force on an object is constant then, (1) gives:

2. $\boxed{\vec{F}_{net} = \frac{\Delta\vec{p}}{\Delta t} = \frac{\vec{p}_f - \vec{p}_i}{t_f - t_i}}$ If $\vec{F}_{net}$ =constant

Physically or from a practical viewpoint what is Linear Momentum?? Let's consider the following example that will help us answer this question.