MOMENTUM

Definition: $\vec{p} = m\vec{v}$ → units are $kg \cdot m/s$

(no shortcut)

it's a vector!!

Momentum is important for a couple reasons: it's conserved and the more general form of Newton's second law

i) N2L: $F = ma$ is actually a special case. Should be written as

$$F = \frac{\Delta p}{\Delta t} \rightarrow = ma$$

$\Delta v = v_f - v_i$

To see this, remember that "Δ" means "change" so that

$$\Delta p = p_f - p_i$$

$$\Delta p = mv_f - mv_i$$ As long as mass doesn't change!

So $$\Delta p = m(v_f - v_i)$$

Hey! $a = \frac{v_f - v_i}{t}$

Let's continue from before....

So $$\frac{\Delta p}{\Delta t} = \frac{m(v_f - v_i)}{\Delta t} = ma!$$

So $$F = \frac{\Delta p}{\Delta t} = ma$$

2) Impulse: Let's just call "F" the net force for a moment:

$$\therefore \quad F = \frac{\Delta p}{\Delta t} \quad \Rightarrow \quad \underbrace{F\Delta t}_{\text{called "Impulse"}} = \Delta p$$

This means the impulse on an object equals its change in momentum.

The symbol for impulse is

$$J = Ft$$

and the units are "N·s"

N3L)

$$F_{AB} = -F_{BA}$$

$$F_{AB}\,\Delta t = -F_{BA}\,\Delta t$$

$$\Delta p_B = -\Delta p_A$$

That means every bit of momentum that B gains came from A.

MOMENTUM IS CONSERVED!

The only way something can gain momentum is to take it from something else. Conversely, the only way an object can lose momentum is to give it to another object.

we will look at a few different interactions to see [illegible] and we will usually say:

how this plays out, and we will usually say:

the ~~total~~ initial momentum = the ~~total~~ final momentum

This can be written as an equation:

$$\underbrace{\sum}_{\text{"total"}} \underbrace{p_i}_{\text{initial momentum}} = \underbrace{\sum}_{\text{"total"}} \underbrace{p_f}_{\text{final momentum}}$$