BIG IDEA

MOMENTUM IS CONSERVED!

Any time objects push off each other or collide with each other, the total amount of momentum before the interaction is the same as the total amount of momentum after the interaction. The fast way of writing that is

$$\Sigma p_i = \Sigma p_f$$

We will see how this applies in a variety of situations.

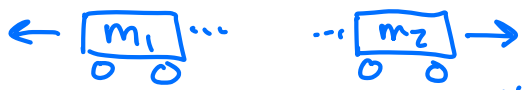
EXPLOSION/ RECOIL

The first situation is when objects push apart from each other - as in an explosion. (We also call these recoil problems).

In these situations two or more objects are all initially @ rest. Then they push or explode apart - going in opposite directions.

Because nothing is moving, the total initial momentum is 0. That means, after the objects push or explode apart the total momentum is still 0! Remember that momentum is a vector - so objects going in opposite directions have opposite momentum.

Initial $v_{1i} = 0$  $v_{2i} = 0$

Final 

v_{1f} v_{2f}

"Σp_i" means the total initial momentum:

Σp_i = the initial momentum of cart 1 + the initial momentum of cart 2

So $\Sigma p_i = p_{1i} + p_{2i}$

$= m_1(0) + m_2(0)$

$\Sigma p_i = 0$ [Makes sense b/c nothing moving.]

"Σp_f" means the total final momentum:

Σp_f = the final momentum of cart 1 + the final momentum of cart 2

$\Sigma p_f = p_{1f} + p_{2f}$

$\Sigma p_f = m_1 v_{1f} + m_2 v_{2f}$

Conservation of momentum means these <u>have</u> to be the same!

$$\Sigma p_i = \Sigma p_f$$

$$0 = m_1 v_{1f} + m_2 v_{2f}$$

Notice that the <u>only</u> way these two momenta add up to 0 is if one is positive & the other negative. That means they go in opposite directions.

We will do collisions between 2 objects later on. In those situations the total initial momentum will NOT be 0 - but we will save those examples for later.