Momentum formulas

during collisions

There are three basic ways to crash:
Elastically, which means you bounce
Inelastically, sticking together
Explosions, which are like backwards crashes
While each has a separate formula, the basic underlying concept is always the same:

The total momentum in a collision is conserved!

Since two object colliding must push on each other with the same force, for the same time, the impulse on both objects must be the same. Since an impulse causes a change in momentum, both objects will have the same sized change. Forces have opposite directions, so momentum "lost" by one object equals momentum "gained" by the other.

Our generic formula: p = p'

the ' is called a prime mark - it stands for "after" This shows that momentum before the collision = the momentum after
The momentum can be shifted around between objects, but the total is constant.

explosions

since p = p', the momentum after an explosion must be: zero! therefore all the pieces, considering direction, cancel each other out!
When there are only two pieces,

$0 = p_1 + p_2$ so

$p_1 = - p_2$ or, since p = mv

$$m_1v_1 = -m_2v_2$$

elastic collisions

since they bounce, before and after the collision there are two objects.

p = p' so

$p_1 + p_2 = p_1' + p_2'$ since p = mv

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$$

Why does only the v portion have the '

$$v_1' = \frac{(m_1-m_2)v_1}{(m_1 + m_2)} + \frac{2m_2v_2}{(m_1 + m_2)}$$

$$v_2' = \frac{2m_1v_1}{(m_1 + m_2)} + \frac{(m_2-m_1)v_2}{(m_1 + m_2)}$$

Inelastic collisions

Two objects start the collision, but only one object comes out - why?

p = p' so

$p_1 + p_2 = p'$ since p = mv

$$m_1v_1 + m_2v_2 = (m_1 + m_2)v'$$

Remember that direction is very important in this unit. Hitting from behind - both are (+) Head-on collisions have one (+) and one (-) Any object bouncing backwards has the opposite sign it had originally. If it was originally going (-) it is now going (+) ... get it?

A 7.93 kg bowling ball named bob is rolling at 2.23 m/s toward a 1.44 kg basketball named bill. Bill rolls toward bob at 7.63 m/s, bracing for impact. After the titanic collision, bill is forced backward at 9.06 m/s. How fast is bob now rolling?

For homework! Pbs, B, of course!