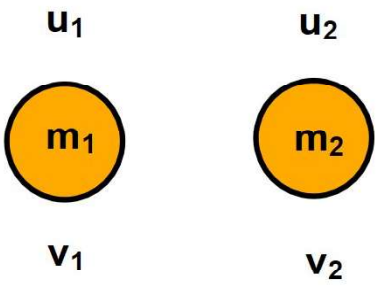
Principle of Conservation of Momentum

When two bodies collide, each one exerts an equal and opposite force on the other. Which law of Newton's is this?

They are in contact for the same time, so they each exert an impulse on the other of equal magnitude **BUT OPPOSITE DIRECTIO**

The momentum before the collision = the momentum after the collision



These are vectors! You will have to take direction into account!

Example 1

A **particle** P of mass 2kg is moving with **speed** 3ms^{-1} on a **smooth** horizontal **plane**. Particle Q of mass 3kg is at **rest** on the plane.
Particle P collides with particle Q and after the collision Q moves off with speed 7/3 ms^{-1}. Find:
a) the speed and **direction** of motion of P after the collision
b) the **magnitude** of the impulse received by P in the collision

Example 2

Two particles A and B of masses 2kg and 4kg **respectively** are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface.
The particles collide.
Before the collision the speeds of A and B are $3ms^{-1}$ and $2ms^{-1}$ respectively.
After the collision the direction of motion of A is **reversed** and its speed is $2ms^{-1}$.
Find:
a) the speed and direction of B after the collision
b) the magnitude of the impulse given by A to B in the collision

Example 3

Two particles P and Q, of masses 8kg and 2kg respectively, are connected by a **light inextensible** string.
The particles are at rest on a smooth horizontal plane with the string **slack**.
Particle P is **projected** directly away from Q with speed $4ms^{-1}$.
a) Find the **common speed** of the particles after the string goes **taut**.
b) Find the magnitude of the impulse transmitted through the string when it goes taut.

Example 4

Two particles A and B of masses 2kg and 4kg respectively are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface.
The particles collide. Before the collision the speeds of A and B are $3ms^{-1}$ and $2ms^{-1}$ respectively.
Given that the magnitude of the impulse due to the collision is 7Ns, find:
a) the **velocity** of A after the collision
b) the **velocity** of B after the collision

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Example 5

Unknown values:

Two particles, A and B, of masses m and 4m respectively, are moving in the same direction with speeds of 5u and u respectively, so that A is catching up with B. After they collide, the speed of B is 2u.
Find the velocity of A after the collision.
Find the magnitude of the impulse that A exerts on B.

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Coalescing particles

A particle P of mass 150 g is at rest on a smooth horizontal plane. A second particle Q of mass 100 g is projected along the plane with speed u m s^{-1} and collides directly with P. On impact the particles join together and move on with speed 4 m s^{-1}. Find the value of u.

An explosive charge of mass 150 g is designed to split into two parts, one with mass 100 g and the other with mass 50 g. When the charge is moving at 4 m s^{-1} it splits and the larger part continues to move in the same direction whilst the smaller part moves in the opposite direction. Given that the speed of the larger part is twice the speed of the smaller part, find the speeds of the two parts.