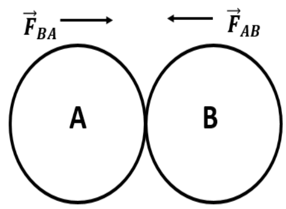
2. ***Newton's 3rd law from 2nd law:***

Consider the collision of two bodies in the absence of external force. (In the collision, one body applies to action and another gives a reaction)



Let, $\vec{F}_{AB}$ = Force on body 'A' due to body 'B'. (Action)

$\vec{F}_{BA}$ = Force on body 'B' due to body 'A'. (Reaction)

Then, the net force acting during the collision,

$$\vec{F}_{net} = \vec{F}_{AB} + \vec{F}_{BA}$$

$$or,\ 0 = \vec{F}_{AB} + \vec{F}_{BA} \quad \text{[Net external force is absent]}$$

$$or,\ \boldsymbol{\vec{F}_{AB} = -\vec{F}_{BA}} \quad ; -ve \text{ sign indicated the opposite direction.}$$

This is Newton's 3rd law of motion.

Principle of conservation of Linear Momentum:

Statement: "If no external force (net force) acts on a system, the total linear momentum of the system always remains constant".

Proof of principle of conservation of momentum using second law of motion. [For SQ]

According to Newton's second law of motion,

$$Force = Rate\ of\ change\ of\ momentum$$

$$F_{net} = \frac{dp}{dt}$$

If $F = 0$, then

$$\frac{dp}{dt} = 0$$

$$or, dp = 0$$

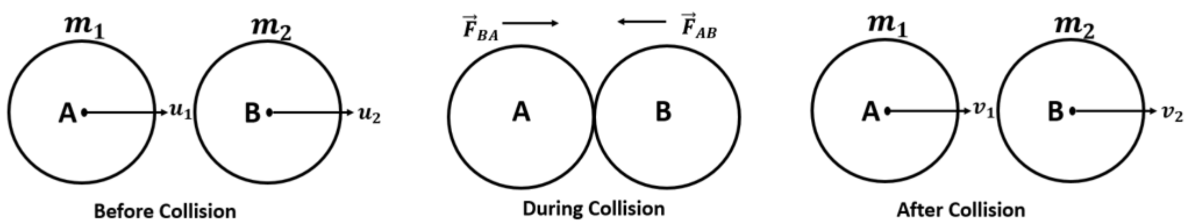
Integrating both the sides, $\int dp = constant$

$$\Rightarrow \boldsymbol{p = constant}$$

Thus, this equation verifies the principle of conservation of linear momentum.

Proof of principle of conservation of momentum using 2nd law and 3rd law of motion. [For LQ]

Consider two bodies: A and B of masses m_1 and m_2 are moving in a straight linear path with velocities u_1 and u_2 respectively with $u_1 > u_2$.



Since $u_1 > u_2$, as they will undergo collision for short time say $'t'$, and after collision they separate from each other with velocities $v_1\ and\ v_2$ respectively as shown in figure.