Perfectly Inelastic Collision.

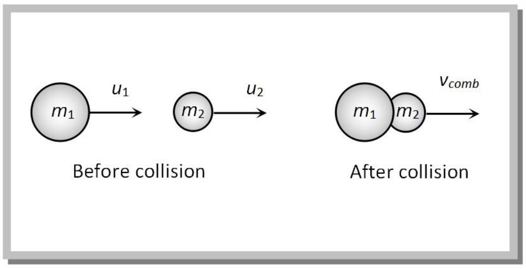
In such types of collisions the bodies move independently before collision but after collision as a one single body.

(1) **When the colliding bodies are moving in the same direction**

By the law of conservation of momentum

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v_{comb}$$

$$\Rightarrow \quad v_{comb} = \frac{m_1u_1 + m_2u_2}{m_1 + m_2}$$



Loss in kinetic energy $\Delta K = \left(\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2\right) - \frac{1}{2}(m_1 + m_2)v_{comb}^2$

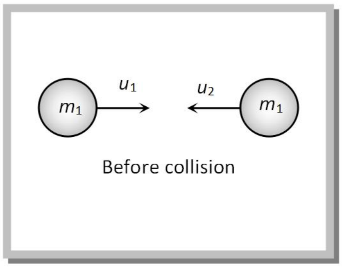
$$\Delta K = \frac{1}{2}\left(\frac{m_1m_2}{m_1 + m_2}\right)(u_1 - u_2)^2$$ [By substituting the value of v_{comb}]

(2) **When the colliding bodies are moving in the opposite direction**

By the law of conservation of momentum

$m_1u_1 + m_2(-u_2) = (m_1 + m_2)v_{comb}$ (Taking left to right as positive)

$$\therefore \quad v_{comb} = \frac{m_1u_1 - m_2u_2}{m_1 + m_2}$$



when $m_1u_1 > m_2u_2$ then $v_{comb} > 0$ (positive)

i.e. the combined body will move along the direction of motion of mass m_1.

when $m_1u_1 < m_2u_2$ then $v_{comb} < 0$ (negative)

i.e. the combined body will move in a direction opposite to the motion of mass m_1.

(3) **Loss in kinetic energy**

ΔK = Initial kinetic energy – Final kinetic energy

$$= \left(\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2\right) - \left(\frac{1}{2}(m_1 + m_2)v_{comb}^2\right)$$

$$= \frac{1}{2}\frac{m_1m_2}{m_1 + m_2}(u_1 + u_2)^2$$