COLLISIONS.

Collisions refers to the interaction between two bodies due to which the direction and magnitude of the velocity of the colliding bodies change.

Types of collisions.

1. Perfectly elastic collisions.

The collision between two particles or bodies is said to be perfectly elastic if both the linear momentum and the K.E of the system before and after collision are equal.

Eg. Collision between atomic particles and subatomic particles.

2. Inelastic collision.

A collision is said to be inelastic if the linear momentum of the system remains conserved but its K.E is not conserved.

Eg. A stone / ball dropped does not rebound to the same height.

a. perfectly inelastic collision

It is a type of inelastic collision. Here the two bodies after collision stick together and move as one body. Here also linear momentum is conserved but K.E not. Total energy is conserved in ball types of collisions.

Eg. An arrow gets stuck in a target and the two move together.

Elastic collision in one dimension.

Consider two objects of masses m_1 and m_2 moving with velocities u_1 and u_2. $(u_1 > u_2)$. They will collide and let v_1 and v_2 be their velocities after collision.

According to the law of conservation of momentum,

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 .$$

$$m_1u_1 - m_1v_1 = m_2v_2 - m_2u_2 .$$

$$m_1(u_1 - v_1) = m_2(v_2 - u_2) . \quad \text{——— (1)}$$

Also from the law of conservation of energy,

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 .$$

$$m_1u_1^2 - m_1v_1^2 = m_2v_2^2 - m_2u_2^2 .$$

$$m_1(u_1^2 - v_1^2) = m_2(v_2^2 - u_2^2) .$$

$$m_1(u_1 + v_1)(u_1 - v_1) = m_2(v_2 + u_2)(v_2 - u_2) \quad \text{——— (2)}$$

$$(2)/(1) \Rightarrow (u_1 + v_1) = (v_2 + u_2) .$$

$$\text{or} \quad u_1 - u_2 = v_2 - v_1$$

ie, relative velocity of first body with respect to second before collision = relative vel. of 2nd body with respect to first after collision.

ie, relative vel. of approach = relative vel. of separation.