

Collision

Collision is an interaction between two or more bodies in which sudden changes of momenta take place. e.g. : Striking a ball with a bat

Newton's third law of motion leads to the law of conservation of momentum (momentum can neither be created nor destroyed).

The momentum of a system $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ remains constant so long as no external forces act on it

Coefficient of restitution (e) : The coefficient of restitution between two bodies in a collision is defined as the ratio of the relative speed of separation after collision to the relative speed of their approach before their collision along the common normal (Line of Impact).

$$e = \frac{\text{relative speed of separation}}{\text{relative speed of approach}}$$

$$e = \frac{v_2 - v_1}{u_2 - u_1}$$

$$e = \frac{v_2 - v_1}{u_1 - u_2}$$

Eg : The value of e is 0.94 for two glass balls,
0.2 for two lead balls.

Types of collision : On the basis of conservation of kinetic energy.

Perfectly elastic collision If in a collision, kinetic energy after collision is equal to kinetic energy before collision, the collision is said to be perfectly elastic.

Coefficient of restitution $e = 1$

Inelastic collision If in a collision kinetic energy after collision is not equal to kinetic energy before collision, the collision is said to be inelastic

Coefficient of restitution $0 < e < 1$

Perfectly inelastic collision If in a collision two bodies stick together or move with same velocity after the collision, the collision is said to be perfectly inelastic.

Coefficient of restitution $e = 0$

Head on or one dimensional collision In a collision if the motion of colliding particles before and after the collision is along the same line, the collision is said to be head on or one dimensional.

Oblique collision If two particle collision is 'glancing' *i.e.* such that their directions of motion after collision are not along the initial line of motion, the collision is called oblique.

If in oblique collision the particles before and after collision are in same plane, the collision is called 2-dimensional otherwise 3-dimensional.