Elastic and Inelastic Collisions

Summary

- In an isolated system, the total momentum of the system is conserved for all elastic, inelastic, perfectly elastic, and perfectly inelastic collisions:

$$m_1\vec{v}_{i_1} + m_2\vec{v}_{i_2} = m_1\vec{v}_{f_1} + m_2\vec{v}_{f_2}$$

- In a perfectly elastic collision, total kinetic energy is conserved:

$$\frac{1}{2}m_1v_{i_1}^2 + \frac{1}{2}m_2v_{i_2}^2 = \frac{1}{2}m_1v_{f_1}^2 + \frac{1}{2}m_2v_{f_2}^2$$

- In an inelastic collision, the total kinetic energy is not conserved, although total energy is always conserved.

COLLISIONS

TYPE	Kinetic Energy	Momentum
Elastic: Objects bounce off each other undamaged	Conserved	Conserved
Inelastic: Objects impact and separate, but there has been damage done to each	NOT conserved	Conserved
Perfectly Inelastic: Objects impact and STICK TOGETHER as one larger mass with the same, slower velocity	NOT conserved	Conserved

Elastic vs. Inelastic Collisions

Physicists divide collisions into several categories :

Completely Inelastic : bodies stick together
KE <u>not</u> conserved

Partially Inelastic : bodies separate
KE <u>not</u> conserved

Elastic : bodies separate
KE is conserved

Completely inelastic collisions are easy to solve : just use conservation of momentum.

Elastic collisions – which occur when hard, rigid objects like marbles or billiard balls collide – take more work. One must use both

<u>and</u> conservation of momentum
conservation of energy