

Linear Momentum Exam Review

Definitions

Units: kg*m/s

$$\vec{p} = m \bullet \vec{v}$$

$$\sum F = \frac{\Delta p}{\Delta t} = \frac{mv_2 - mv_1}{\Delta t} = ma$$

Conservation

$$m_1v_1 + m_2v_2 = m_1v'_1 + m_2v'_2$$

$$m_1v_1 + m_2v_2 + \dots + m_nv_n = m_1v'_1 + m_2v'_2 + \dots + m_nv'_n$$

$$\text{IF } \sum F_{ext} = 0$$

$$p_{total} = 0 = p_{fuel} + p_{rocket}$$

Collisions and Impulse

$$F\Delta t = \text{Impulse} = \Delta p$$

Kinetic Energy in Collisions

Elastic – kinetic energy is conserved

$$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = \frac{1}{2}m_1v_1'^2 + \frac{1}{2}m_2v_2'^2$$

$$v_1 + v_1' = v_2' + v_2$$

$$v_1 - v_2 = v_2' - v_1' = -(v_1' - v_2')$$

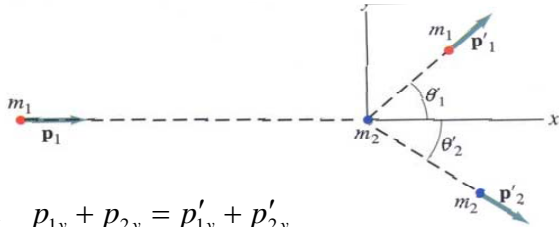
Solve a system of two equations.

Inelastic – kinetic energy is not conserved

Completely (perfectly) Inelastic – maximum amount of kinetic energy is lost to other forms (stuck together)

$$p_i = m_1 v_1 + m_2 v_2 = (m_1 + m_2) v_3 = p_f$$

Collisions in Two or Three Dimensions



$$p_{1y} + p_{2y} = p'_{1y} + p'_{2y}$$

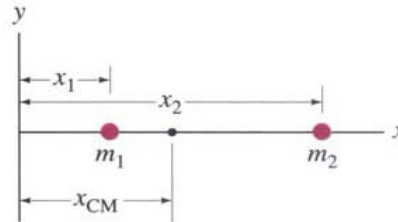
$$0 = m_1 v'_1 \sin \theta'_1 + m_2 v'_2 \sin \theta'_2$$

$$p_{1x} + p_{2x} = m_1 v'_1 \cos \theta'_1 + m_2 v'_2 \cos \theta'_2$$

Center of Mass/Center of Gravity

center of mass – the one point that moves in the same path that a particle would if subjected to the same net force

$$x_{cm} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2} = \frac{m_1 x_1 + m_2 x_2}{M}$$



center of gravity – the point on a body at which the force of gravity can be considered to act

