Momentum Notes

1/7/20

2 types of collisions:

① Elastic → kinetic energy does not change. Velocity stays the same.

2 objects collide and bounce off of each other.

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

② Inelastic → 2 objects collide and stick together.

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

Elastic collision example

A 1.2 kg cart traveling at 0.5 m/s collides elastically with a 1.6 kg traveling at −0.9 m/s. If the velocity of the larger cart is 0.18 m/s after the collision, find the velocity of the smaller cart.

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(1.2\text{ kg})(0.5\text{ m/s}) + (1.6\text{ kg})(-0.9\text{ m/s}) = (1.2\text{kg})(V_{1f}) + (1.6\text{ kg})(.18\text{ m/s})$$

$$.6 + -1.44 = 1.2(V_{1f}) + 0.288$$

$$-0.84 = 1.2(V_{1f}) + 0.288$$

$$-0.288 \quad\quad -0.288$$

$$\frac{-1.128}{1.2} = \frac{1.2(V_{1f})}{1.2}$$

$$V_{1f} = -0.94\text{ m/s}$$

Inelastic collision example

An 1850 kg sedan is stopped at a traffic light. A 975 kg car hits it from behind. The two cars become entangled. If the car was initially moving at 22 m/s, what is the velocity of the entangled mass after the collision?

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

$$(1850\,kg)(0\,m/s) + (975\,kg)(22\,m/s) = (1850\,kg + 975\,kg)\, v_f$$

$$0 + \frac{21450}{2825} = \frac{2825}{2825} v_f$$

$$\boxed{7.6\,m/s = v_f}$$

Recoil

$$\boxed{(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}}$$

objects start together, then once released are separated.

- Think of a bullet in a gun. Once fired, the bullet becomes it's own object.