

Homework

Momentum

$$F = ma$$

$$F = m \frac{\Delta v}{\Delta t}$$

$$(\Delta v = v_f - v_i)$$

$$= \frac{mv_f - mv_i}{\Delta t}$$

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

momentum

$$\Sigma F = \frac{\Delta p}{\Delta t}$$

Units: kg m/s

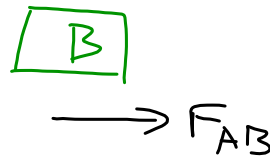
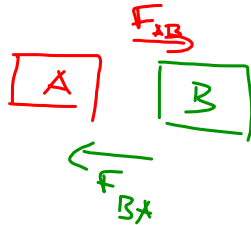
Momentum

- Is the product of mass and velocity.
- Has no physical meaning other than the total amount of momentum in a closed system never changes.
 - A closed system has no net force acting on the system.

Remember that a system is just a collection of objects we are studying. Here we want to study a collection of objects in a situation so there is no change in momentum.

Conservation of Momentum

Consider two objects that are interacting (exerting forces on each other), where there are no other forces in the system.



$$\begin{aligned} \sum F_A &= m_A a_A \\ F_{BA} &= \frac{\Delta P_A}{\Delta t} \\ \Delta P_A &= F_{BA} \Delta t \end{aligned}$$

$$\begin{aligned} \sum F_B &= m_B a_B \\ F_{AB} &= \frac{\Delta P_B}{\Delta t} \\ \Delta P_B &= F_{AB} \Delta t \end{aligned}$$

$$\Delta P_A + \Delta P_B = F_{BA} \Delta t + F_{AB} \Delta t$$

$$F_{BA} = -F_{AB}$$

$$\Delta P_A + \Delta P_B = -F_{AB} \Delta t + F_{AB} \Delta t$$

same!!!

$$\Delta P_A + \Delta P_B = \text{☺}$$

$$\sum \Delta P = 0$$

$$\sum (P_f - P_i) = 0$$

$$\sum P_f - \sum P_i = 0$$

$$\sum P_f = \sum P_i$$

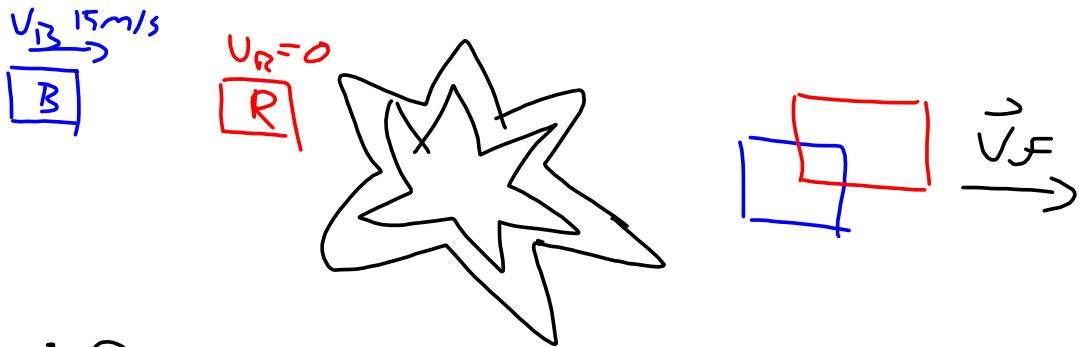
5 - 2 + 3

Benefits of Momentum

- With momentum, we only care about the change in momentum.
- To determine a change we need to look at two distinct points in time (initial and final).
 - You will need two diagrams (one for each time)
- An event occurred between the initial and final time
- This event changes the momentum of the objects in the system, but the overall change in momentum is 0
- This provides us with a mathematical equation that we can use to find the velocity of an object after the event

Example.

A 2000 kg blue car, moving 15 m/s [East], crashes into a stationary 2500 kg red car. After the collision the cars stick together. What is the velocity of the cars?



$$\sum P_i = \sum P_f$$

$$\cancel{m_R v_{Ri}} + m_B v_{Bi} = (m_R + m_B) v_f$$

$$(2000 \text{ kg})(15 \text{ m/s}) = (2500 \text{ kg} + 2000 \text{ kg}) v_f$$

$$\frac{30000 \text{ kg m/s}}{4500 \text{ kg}} = v_f$$

$$v_f = 6.67 \text{ m/s}$$

Homework

Momentum Worksheet Q. 1,4,7