Impulse - Momentum

- Start with Newton's 2nd Law:

$$\bar{F} = m\bar{a} \qquad \bar{a} = \frac{\Delta \bar{v}}{\Delta t}$$

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

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

Impulse change in momentum

Impulse - momentum theorem

- Momentum

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

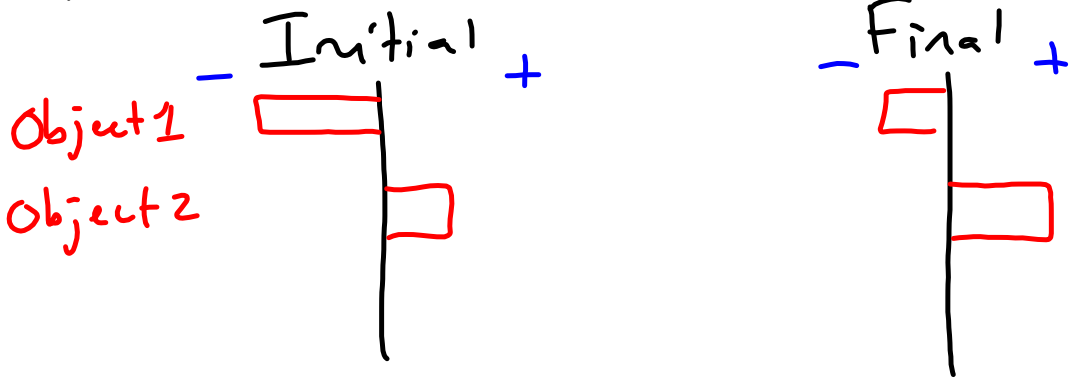
$\bar{p}$: momentum; m: mass; $\bar{v}$: velocity

Units: $kg \cdot m/s$

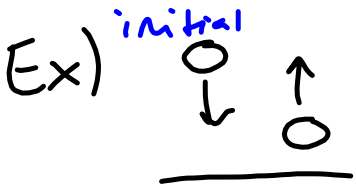
- change in momentum

$$\Delta\bar{p} = \bar{p}_f - \bar{p}_i = m\bar{v}_f - m\bar{v}_i$$

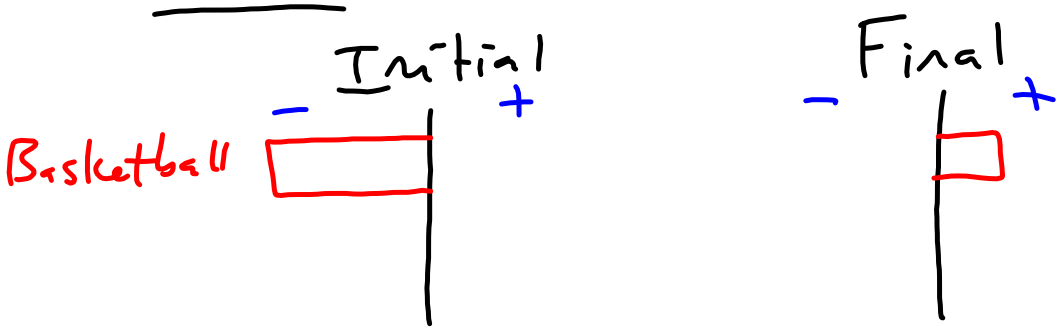
- Momentum chart



Momentum and Impulse PS

Ex) 

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



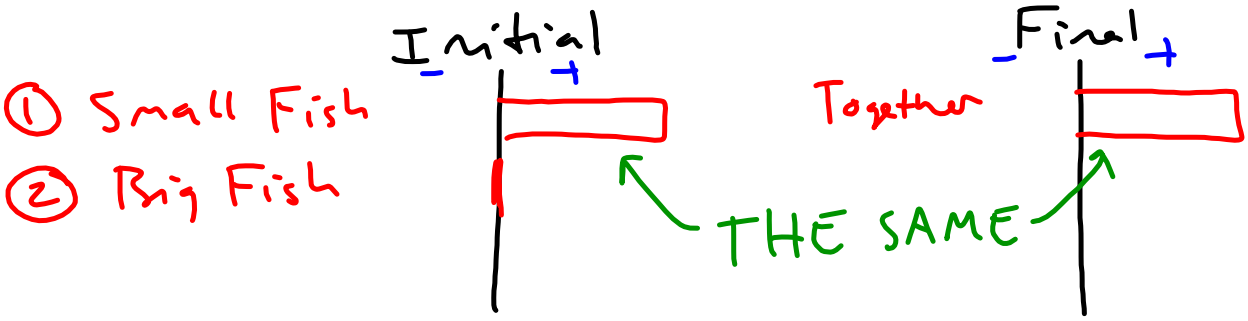
$$\text{Impulse} = \Delta\bar{p} = \bar{p}_f - \bar{p}_i$$
$$= m\bar{v}_f - m\bar{v}_i$$
$$= (2\,kg)(0.8\,m/s) - (2\,kg)(-3\,m/s)$$
$$= 7.6\,kg\cdot m/s$$

$$\bar{F}\Delta t = \Delta\bar{p}$$

$$\bar{F} = \frac{\Delta\bar{p}}{\Delta t}$$
$$= \frac{7.6\,kg\cdot m/s}{0.05\,s}$$
$$= 152\,N$$

Conservation of Momentum

8)



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

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

$$v_f = \frac{m_1 v_{1i}}{m_1 + m_2}$$

$$= \frac{(0.35\ kg)(3\ m/s)}{1.4\ kg + 0.35\ kg}$$

$$= 0.6\ m/s$$