Conservation of Momentum (§7-3)

Recall: Newton's Third Law

$$\vec{F}_A = -\vec{F}_B$$

$$\vec{F}_A \Delta t = -\vec{F}_B \Delta t$$

$$\Delta\vec{p}_A = -\Delta\vec{p}_B$$

$$\vec{p}_A' - \vec{p}_A = -(\vec{p}_B' - \vec{p}_B)$$

$$\vec{p}_A' - \vec{p}_A = -\vec{p}_B' + \vec{p}_B$$

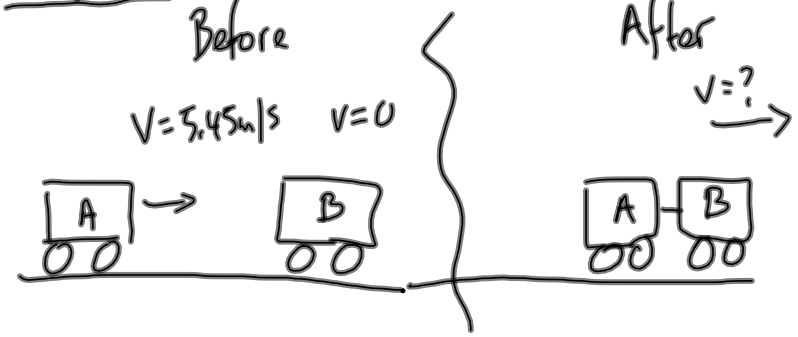
$$\vec{p}_A + \vec{p}_B = \vec{p}_A' + \vec{p}_B'$$

$$\vec{p}_{total} = \vec{p}_{total}'$$

Law of Conservation of Momentum

The total momentum before a collision is equal to the total momentum after a collision in an isolated system.

MP 313



$m_A = 1.75 \times 10^4 \text{ kg}$

$m_B = 2.00 \times 10^4 \text{ kg}$

$\vec{V}_A = 5.45 \text{ m/s [E]}$ (+)

$\vec{V}_B = 0 \text{ m/s}$

$\vec{V}_{AB} = ??$

* momentum is a vector

$$\vec{P}_{total} = \vec{P}'_{total}$$

$$m_A \vec{V}_A + m_B \vec{V}_B = m_{AB} \vec{V}_{AB}$$

($\vec{V}_B = 0$)

$$(1.75 \times 10^4 \text{ kg})(+5.45 \text{ m/s}) + 0 = (3.75 \times 10^4 \text{ kg})\vec{V}_{AB}$$

$$95375 \text{ kg·m/s} = (3.75 \times 10^4 \text{ kg})V_{AB}$$

$$V_{AB} = +2.54 \text{ m/s}$$

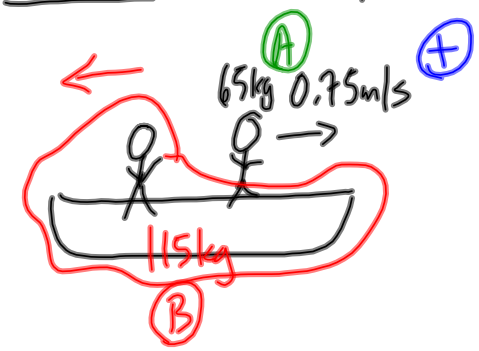
$$\vec{V}_{AB} = 2.54 \text{ m/s [E]}$$

OR Setup MVP chart

	BEFORE		AFTER
	A	B	AB
m	1.75×10^4 kg	2.00×10^4 kg	3.75×10^4 kg
v	+5.45 m/s	0	v
p	95375 kg·m/s	0	$(3.75 \times 10^4 \text{ kg})v$

$\vec{P}_{total} = \vec{P}'_{total}$

MP|316 (Recoil of a Canoe)



$$\vec{P}_{total} = \vec{P}'_{total}$$

$$\vec{P}_{AB} = \vec{P}_A + \vec{P}_B$$

$$0 = m_A v_A + m_B v_B$$

$$m_B v_B = -m_A v_A$$

$$(115\,kg)(v_B) = -(65\,kg)(+0.75\,m/s)$$

$$v_B = -\frac{(65\,kg)(+0.75\,m/s)}{115\,kg}$$

$$v_B = -0.42\,m/s$$

$\vec{v}_B = 0.42\,m/s$ [opposite the direction of your motion]

TO DO:

1. PP|315
2. PP|317
3. Review (see May 7, May 14)