

Conservation of Momentum and Collisions

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Law of Conservation of Momentum:

In a closed system (no outside forces), momentum is conserved.
constant for the system as a whole.

Identify Conservation Problems vs. Impulse Problems

- More than one object.	- Force acting on an object
- Energy ^(Forces) is not added to the system	- Only one object.

Momentum for the system.



10kg 3m/s
A →

$$P_A = mv$$
$$= 10 \times 3$$
$$= 30 \text{ kgm/s East}$$

2m/s 12kg
← B

$$P_B = mv$$
$$= 12 \times 2$$
$$= 24 \text{ kgm/s West}$$

The p of the system is the vector addition of the p of each part.

$$p_{\text{sys}} = \sum p = P_A + P_B$$

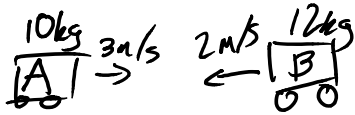
$$P_{\text{sys}} = 30 \text{ kgm/s} - 24 \text{ kgm/s}$$

$$P_{\text{sys}} = 6 \text{ kgm/s East}$$

What conservation means is the momentum does not change, even after an event/collision

$P_i = P_f$ & with two objects.

From the previous example
Before collision



$$m_A = 10\text{kg}$$

$$m_B = 12\text{kg}$$

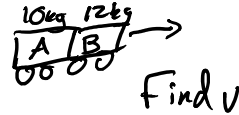
$$v_{Ai} = 3\text{m/s}$$

$$v_{Bi} = -2\text{m/s}$$

$$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$$

Initial Momentum = Final Momentum

After collision (stuck together)



$$P_i = 6\text{kgm/s} \rightarrow P_f = 6\text{kgm/s} = m_A v_{Af} + m_B v_{Bf}$$

Since they are stuck together
they have the same velocity

$$6 = 10v + 12v$$

$$\frac{6}{22} = \frac{22v}{22}$$

$$v = 0.27\text{m/s}$$

Elastic Collisions

Bouncy
(Billiard balls)

The final velocities
between the masses
will be different

vs. Inelastic Collisions

Sticky

(Cars stick together,
bullet in a block of wood,
Baseball moving a box)

The final velocities
will be the same for
the two masses