

Ex.

Two balls are moving according to the following diagram. What is the initial and final linear momentum of this closed system?



The initial linear momentum of each object is:

$$\begin{aligned}\mathbf{p}_{1i} &= m_1 \mathbf{v}_1 = (100\text{kg})(5\text{m/s}) \\ &= + 500 \text{ kg m/s}\end{aligned}$$

$$\begin{aligned}\mathbf{p}_{2i} &= m_2 \mathbf{v}_2 = (75\text{kg})(-6\text{m/s}) \\ &= - 450 \text{ kg m/s}\end{aligned}$$

The total initial linear momentum is then:

$$\mathbf{p}_i = \mathbf{p}_{1i} + \mathbf{p}_{2i} = 500 \frac{\text{kg m}}{\text{s}} - 450 \frac{\text{kg m}}{\text{s}}$$

$$\mathbf{p}_i = + 50 \frac{\text{kg m}}{\text{s}}$$

This means that the total **initial** linear momentum of the system is 50 kg m/s to the right (*positive direction*).

From conservation of linear momentum ($\mathbf{p}_i = \mathbf{p}_f$), the total **final** linear momentum of the system *after* the collision **MUST BE** 50 kg m/s to the right (*positive direction*).

$$\mathbf{p}_f = 50 \frac{\text{kg m}}{\text{s}}$$