

4.34 A 1.0 kg standard cart A collides with a 0.10 kg cart B. The x component of the velocity of cart A is 0.60 m/s before the collision and 0.50 m/s after the collision. Cart B is initially traveling toward cart A at 0.40 m/s, and after the collision the x component of its velocity is 0.60 m/s. What are (a) the x component of the change in the momentum of A, (b) the x component of the change in the momentum of B, and (c) the sum of these two x components of the changes in momentum?



$$\vec{p} = m\vec{v}, \quad \vec{p} = p_x \hat{i} + p_y \hat{j}$$

$$\vec{v} = v_x \hat{i} + v_y \hat{j}$$

$$\Rightarrow p_x = mv_x, \quad p_y = mv_y$$

$$\begin{aligned} (a) \Delta p_{A,x} &= p_{A,f,x} - p_{A,i,x} \\ &= m_A (v_{A,f,x} - v_{A,i,x}) \\ &= (1 \text{ kg}) (0.5 \text{ m/s} - 0.6 \text{ m/s}) \\ &= -0.1 \text{ kg} \frac{\text{m}}{\text{s}} \end{aligned}$$

$$\begin{aligned} (b) \Delta p_{B,x} &= m_B (v_{B,f,x} - v_{B,i,x}) \\ &= (0.1 \text{ kg}) (0.6 \text{ m/s} - (-0.4 \text{ m/s})) \\ &= 0.1 \text{ kg} \frac{\text{m}}{\text{s}} \end{aligned}$$

$$\begin{aligned} (c) \Delta p_x &= \Delta p_{A,x} + \Delta p_{B,x} \\ &= -0.1 \text{ kg} \frac{\text{m}}{\text{s}} + 0.1 \text{ kg} \frac{\text{m}}{\text{s}} \\ &= 0 \end{aligned}$$