

Answer on Question 62444, Physics, Mechanics | Relativity

Question:

An object 2.0 kg mass collides with another object 4.0 kg mass that moves at 11 ms^{-1} to the west, after the collision the first object moves at 4 ms^{-1} west and the second object moves at 12 ms^{-1} to the west. What was the velocity of the first object before the collision?

Solution:

Let's assume that the first object with mass of 2.0 kg moves to the east and collides with the second object with mass of 4.0 kg that moves at 11 ms^{-1} to the west. After the collision, the first object moves at 4 ms^{-1} to the west and the second object moves at 12 ms^{-1} to the west. Also, for convenience, we assume that the second object moves in the positive direction to the west. Then, we can apply the law of conservation of momentum:

$$-m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f},$$

here, m_1 , m_2 are the masses of the objects, v_{1i} , v_{2i} are its velocities before collision and v_{1f} , v_{2f} are its velocities after collision.

From this equation we can find the velocity of the first object before the collision:

$$v_{1i} = -\frac{m_1 v_{1f} + m_2 v_{2f} - m_2 v_{2i}}{m_1}.$$

Let's substitute the numbers:

$$v_{1i} = -\frac{2.0 \text{ kg} \cdot 4 \text{ ms}^{-1} + 4.0 \text{ kg} \cdot 12 \text{ ms}^{-1} - 4.0 \text{ kg} \cdot 11 \text{ ms}^{-1}}{2.0 \text{ kg}} = -6 \text{ ms}^{-1}.$$

The sign minus indicates that the velocity of the first object before the collision is directed to the east.

Answer:

$$v_{1i} = 6 \text{ ms}^{-1}.$$