Answer on Question 76904, Physics, Other

Question:

A trolley of mass $10\ kg$ and a trolley of mass $5\ kg$ are traveling in opposite directions, both at a speed of $2\ m/s$. The $5\ kg$ trolley rebounds at $1\ m/s$. What is the speed and direction of the $10\ kg$ trolley?

Solution:

Let's suppose that the trolley of mass $m_1 = 10\ kg$ is traveling to the right and the trolley of mass $m_2 = 5\ kg$ is traveling in the opposite direction to the left. Let's also take the direction to the right as a positive. Then, we can find the speed and direction of the $10\ kg$ trolley from the law of conservation of energy:

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

here, m_1, m_2 are the masses of the trolleys, respectively; v_{1i}, v_{2i} are the speeds of the trolleys before the collision, respectively; v_{1f}, v_{2f} are the speeds of the trolleys after the collision.

Then, from this formula we can find the speed and direction of the $10\ kg$ trolley:

$$v_{1f} = \frac{m_1 v_{1i} - m_2 v_{2i} - m_2 v_{2f}}{m_1} = \frac{10\ kg \cdot 2\ \frac{m}{s} - 5\ kg \cdot 2\ \frac{m}{s} - 5\ kg \cdot 1\ \frac{m}{s}}{10\ kg} =$$
$$= 0.5\ \frac{m}{s}.$$

The positive sign indicates that the $10\ kg$ trolley is traveling to the right.

Answer:

$v_{1f} = 0.5\ \frac{m}{s}$, to the right.