Question #56936, Physics / Classical Mechanics

Two trolleys A and B are free to move on a level frictionless track, and are initially stationary. A man on trolley A throws a bag of mass 10 kg with a horizontal velocity of 4 m/s with respect to himself on to trolley B of mass 100 kg. The combined mass of trolley A (excluding bag) and the man is 140 kg. Find the ratio of velocities of trolleys A and B, just after the bag lands on trolley B.

Solution:

According to the equality of momentum at the moment when the man threw the bag:

$$m_A \times v_A = m_{bag} \times (v_{rel} - v_A);$$

Since the collision of bag and trolley B was inelastic, thus:

$$m_{bag} \times (v_{rel} - v_A) = (m_{bag} + m_B) \times v_B$$

Therefore,

$$m_A \times v_A = (m_{bag} + m_B) \times v_B;$$

$$\frac{v_A}{v_B} = \frac{m_{bag} + m_B}{m_{A+m}};$$

$$\frac{v_A}{v_B} = \frac{m_{bag} + m_B}{m_{A+m}} = \frac{10 + 100}{140} = 0.786$$

Answer: 0.786