Answer on Question 52856, Physics, Mechanics | Kinematics | Dynamics

Question:

Object A with a mass of $2kg$, a velocity of $7\,m/s$ and object B with a mass of $9kg$ and a velocity of $-5\,m/s$ are moving towards each other along the x axis. They collide and stick together after collision. Determine the kinetic energy lost during the collision.

Solution:

Let us first find the final velocity of objects A and B when they collide and stick together after collision. We use the law of conservation of momentum (we assume that object A moves along the x axis in positive direction):

$$m_A v_A + m_B v_B = (m_A + m_B) \cdot v_{AB}$$

Then, we obtain:

$$v_{AB} = \frac{m_A v_A + m_B v_B}{(m_A + m_B)} = \frac{2kg \cdot 7\frac{m}{s} + 9kg \cdot \left(-5\frac{m}{s}\right)}{(2kg + 9kg)} = -2.82\frac{m}{s}.$$

The sign minus indicate that the final velocity of objects A and B directed opposite to the positive direction of the x axis.

Let's obtain the kinetic energy of objects A and B and the final kinetic energy after collision:

$$KE_A = \frac{1}{2} m_A v_A^2 = \frac{1}{2} \cdot 2kg \cdot \left(7\frac{m}{s}\right)^2 = 49J,$$

$$KE_B = \frac{1}{2} m_B v_B^2 = \frac{1}{2} \cdot 9kg \cdot \left(5\frac{m}{s}\right)^2 = 112.5J,$$

$$KE_{AB} = \frac{1}{2}(m_A + m_B) v_{AB}^2 = \frac{1}{2} \cdot 11kg \cdot \left(2.82\frac{m}{s}\right)^2 = 44J.$$

Then, we can obtain the kinetic energy lost during the collision:

$$KE_{lost} = KE_{AB} - (KE_A + KE_B) = 44J - (49J + 112.5J) = -117.5J$$

The sign minus means that kinetic energy is lost.

Answer:

The kinetic energy lost during the collision is $KE_{lost} = 117.5J$.