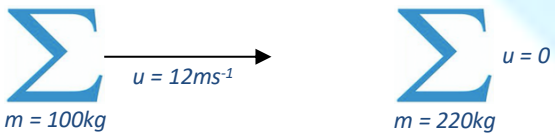
Name: ……..

PRELIMINARY PHYSICS SIGMA SCIENCE Q&A

Week 2: Collisions I

Question 1 (3 marks)

An object of mass 100kg travelling at $12ms^{-1}$ collides with a stationary object of 220kg. If these objects stick together, determine the initial velocity of the wreckage.



Worked solution:

Law of conservation of momentum states that $\Delta p = 0$.

$\therefore p_i = p_f$

Assigning object 1 to the 100kg mass and object 2 to the 220kg mass, we end up with:

$$\mathbf{m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2}$$

HOWEVER, seeing as the objects stick together, they both move with the same velocity after the collision, hence:

$$\mathbf{m_1u_1 + m_2u_2 = (m_1 + m_2)v}$$

$$(100 \times 12) + (220 \times 0) = (100 + 220)v$$

$$\therefore v = \frac{(100 \times 12) + (220 \times 0)}{(100 + 220)} = 3.75ms^{-1}$$

$$in\ the\ same\ direction\ as\ the\ initial\ velocity\ of\ the\ 100kg\ mass\ (Right)$$

Question 2 (3 marks)

An object of mass 150kg travelling at $12ms^{-1}$ collides with an object of mass 275kg travelling at the same speed in the opposite direction. If these objects stick together, determine the initial velocity of the wreckage.

Worked solution:

Law of conservation of momentum states that $\Delta p = 0$.

$\therefore p_i = p_f$

Assigning object 1 to the 150kg mass and object 2 to the 275kg mass, we end up with:

$$\mathbf{m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2}$$

HOWEVER, seeing as the objects stick together, they both move with the same velocity after the collision, hence:

$$\mathbf{m_1u_1 + m_2u_2 = (m_1 + m_2)v}$$

Seeing as they are moving in opposite directions, we must note that one of the objects must have a negative initial velocity. By convention, left is defined as negative and hence we will define the 275kg as having a negative initial velocity.

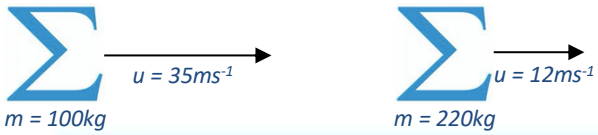
$$(150 \times 12) + (275 \times -12) = (150 + 275)v$$

$$\therefore v = \frac{(150 \times 12) + (275 \times -12)}{(150 + 275)} = -3.5ms^{-1}$$

$$\therefore v = 3.5ms^{-1} \textit{ in the same direction as the } 275kg \textit{ objects initial motion } (Left)$$

Question 3 (3 marks)

An object of mass 100kg travelling at $35ms^{-1}$ collides with an object of mass 220kg travelling at $12ms^{-1}$ in the same direction as the 100kg mass. After the collision, the 220kg object gains $2ms^{-1}$, determine the final velocity of the 100kg mass.



Worked solution:

Law of conservation of momentum states that $\Delta p = 0$.

$\therefore p_i = p_f$

Assigning object 1 to the 100kg mass and object 2 to the 220kg mass, we end up with:

$$\mathbf{m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2}$$

These objects **MAY NOT** stick together, so we cannot reduce it to the equation which we used in questions 2 & 3.

$$(100 \times 35) + (220 \times 12) = 100v_1 + (220 \times (12 + 2))$$

$$\therefore v_1 = \frac{(100 \times 35) + (220 \times 12) - (220 \times 14)}{100} = 30.6ms^{-1} = 31ms^{-1}(2sf^*)\ Right$$

$* Note$:
$-$ $ambiguity\ exists\ in\ number\ of\ sig\ figs\ in\ 100, but\ most\ teachers\ hate\ 1\ sf.$