Question.

On a vehicle crash simulation, a car of mass 1200 kg is travelling at a velocity of 40 mph in the easterly direction when it is hit by a truck of mass 3300 kg travelling at a velocity of 25 mph from the westerly direction. Assuming that the two vehicles become entangled calculate in m/s their combined velocity after the crash.

Take 1.61 km/hr = 1 mph

$$1 \, mph = 1.61 \, \frac{km}{hr} = 0.447 \, \frac{m}{s}$$

Given:

$$m_1 = 1200 \, kg$$

$$v_1 = 40 \, mph$$

$$m_2 = 3300 \, kg$$

$$v_2 = 25 \, mph$$

Find:

$$v = ?$$

Solution.

Let use the law of conservation of momentum for this inelastic collision. Therefore,

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2)v$$

So,

$$v = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

Calculate:

$$v = \frac{1200 \cdot 40 + 3300 \cdot 25}{1200 + 3300} = \frac{48000 + 82500}{4500} = 29 \, mph = 13 \, \frac{m}{s}$$

If we will use the law of conservation of energy, we will receive the same answer:

$$\frac{m_1 v_1^2}{2} + \frac{m_2 v_2^2}{2} = \frac{(m_1 + m_2)v^2}{2}$$

$$v = \sqrt{\frac{m_1 v_1^2 + m_2 v_2^2}{m_1 + m_2}}$$

Calculate:

$$v = \sqrt{\frac{1200 \cdot 40^2 + 3300 \cdot 25^2}{1200 + 3300}} = 29 \; mph = \; 13 \; \frac{m}{s}$$

Answer.

$$v = 13 \; \frac{m}{s}$$