21-P-MOM-AG-041

A m_1-kg car is towing a m_2-kg trailer. The traction force at the car wheels is F kN. What speed is the car going at T seconds if it starts from rest? Also, what is the tension in the coupling between the car and the trailer at that time?

Neglect the mass of the wheels

ANSWER:

We use the principle of linear impulse and momentum to find the velocity of the car at T seconds.

$$m_i v_i + Ft = m_f v_f$$

$$0 + F \cdot T = (m_1 + m_2) v_f$$

$$v_f = \frac{T \cdot F}{(m_1 + m_2)}$$

Next, we use Newton's second law to find out the tension.

$$\sum F_x = m_1 a = F - tension$$

$$tension = F - m_1 a = F - \frac{m_1 \cdot F}{(m_1 + m_2)}$$