

Answer on Question #44567, Physics, Mechanics | Kinematics | Dynamics

Question:

A bus of mass 7.5 tonnes has a velocity of 72 km/h when the brakes are applied. The force of the braking system can be considered to be a constant 25 kN and is applied for 40 m. Determine the final velocity of the lorry in m/s.

Answer:

The law of conservation of energy:

$$\Delta E = W$$

where ΔE – change of body's energy, W – work of all forces acting on the body

Work can be expressed by the following equation:

$$W = Fd \cos \theta$$

where F is the force, d is the displacement, and the angle θ is defined as the angle between the force and the displacement vector.

Work of brakes equals:

$$W = F \cdot d \cos 180^\circ = -Fd$$

Change of body's kinetic energy equals:

$$\Delta E = \frac{mv^2}{2} - \frac{mv_0^2}{2}$$

where v is final velocity, v_0 is initial.

Therefore:

$$\frac{mv^2}{2} - \frac{mv_0^2}{2} = -Fd$$

$$v = \sqrt{v_0^2 - \frac{2Fd}{m}} = \sqrt{\left(\frac{72 \text{ m}}{3.6 \text{ s}}\right)^2 - \frac{2 \cdot 25 \text{ kN} \cdot 40 \text{ m}}{7500 \text{ kg}}} \cong 12 \frac{\text{m}}{\text{s}}$$

Answer: $12 \frac{\text{m}}{\text{s}}$