Answer on Question 71466, Physics, Mechanics, Relativity

Question:

A car weighing 9800 N is moving with a speed of 50 km/h. On the application of the brakes it comes to rest after travelling a distance of 60 m. Calculate the average retarding force.

Solution:

We can find the average retarding force from the Newton's Second Law of Motion:

$$F_{avg} = ma,$$

here, F_{avg} is the average retarding force acting on the car, m is the mass of the car, a is the acceleration of the car.

We can find acceleration from the kinematic equation:

$$v^2 = v_0^2 + 2ad,$$

here, v_0 is the initial velocity of the car, $v = 0$ is the final velocity of the car (when it comes to rest), a is the acceleration of the car and d is the distance travelling after application of the brakes.

Then, we get:

$$a = -\frac{v_0^2}{2d}.$$

Let's first convert km/h to m/s:

$$v_0 = 50\ \frac{km}{h} \cdot \frac{1000\ m}{1\ km} \cdot \frac{1\ h}{3600\ s} = 13.9\ \frac{m}{s}.$$

Then, we can substitute v_0 into formula for acceleration and calculate it:

$$a = -\frac{v_0^2}{2d} = -\frac{\left(13.9\ \frac{m}{s}\right)^2}{2 \cdot 60\ m} = -1.61\ \frac{m}{s^2}.$$

The sign minus indicates that the car decelerates.

Also, we can find the mass of the car from the definition of the weight:

$$W = mg,$$

$$m = \frac{W}{g} = \frac{9800\ N}{9.8\ \frac{m}{s^2}} = 1000\ kg.$$

Finally, we can find the average retarding force:

$$F_{avg} = ma = 1000\ kg \cdot \left(-1.61\ \frac{m}{s^2}\right) = -1610\ N.$$

The sign minus indicates that the average retarding force directed in the opposite direction to the motion of the car.

Answer:

$F_{avg} = 1610\ N.$