Answer on Question 59554, Physics, Mechanics | Relativity

Question:

A car travelling with a speed of 60 km/hr brakes and comes to rest within a distance of 20 m. If the speed of the car were 120 km/hr, the stopping distance will be?

Solution:

Let's first find the deceleration of the car from the kinematic equation:

$$v_f^2 = v_i^2 + 2ad,$$

here, $v_f = 0\ ms^{-1}$ is the final speed of the car, v_i is the initial speed of the car, a is the deceleration of the car and d is the stopping distance.

Then, from this formula we can find the deceleration of the car:

$$-v_i^2 = 2ad,$$

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

Let's convert the initial speed of the car from km/h to m/s:

$$v_i = \left(60\ \frac{km}{hr}\right) \cdot \left(\frac{1000\ m}{1\ km}\right) \cdot \left(\frac{1\ hr}{3600\ s}\right) = 16.66\ \frac{m}{s}.$$

Then, we can calculate the deceleration of the car:

$$a = \frac{-v_i^2}{2d} = \frac{-\left(16.66\ \frac{m}{s}\right)^2}{2 \cdot 20\ m} = -6.94\ \frac{m}{s^2}.$$

As we know the deceleration of the car, we can find the new stopping distance of the car from the same kinematic equation:

$$d_{new} = \frac{-v_{inew}^2}{2a}.$$

Let's again convert the new initial speed of the car from km/h to m/s:

$$v_{inew} = \left(120\ \frac{km}{hr}\right) \cdot \left(\frac{1000\ m}{1\ km}\right) \cdot \left(\frac{1\ hr}{3600\ s}\right) = 33.33\ \frac{m}{s}.$$

Then, we can calculate the new stopping distance of the car (if the speed of the car were $120\ \ km/hr$):

$$d_{new} = \frac{-v_{inew}^2}{2a} = \frac{-\left(33.33\ \frac{m}{s}\right)^2}{2 \cdot \left(-6.94\ \frac{m}{s^2}\right)} = 80\ m.$$

Answer:

$d_{new} = 80\ m.$