Answer on Question #62460-Physics-Other

There are two factors that contribute to the total stopping distance for a traveling vehicle. These two factors are the perception-reaction distance and the braking distance.

When an event occurs that requires an emergency stop, the vehicle continues to travel at its initial velocity while the driver reacts to the event. The distance traveled for this time is the perception-reaction distance. Secondly, the vehicle undergoes constant acceleration while the brakes are applied. The distance traveled for this time interval is the braking distance.

Historically, engineers have used a perception-reaction time of 0.75 seconds, but they now assume a perception-reaction time of 1.0 seconds for the average driver. A vehicle has an initial velocity of v0. The driver has a perception-reaction time of t.

a. When the driver begins braking, the vehicle has an acceleration of magnitude a. Write an expression for the total stopping distance of the vehicle.

Solution

The total stopping distance of the vehicle is

$$D_{stop} = D_{perception-reaction} + D_{braking}$$

The perception-reaction distance is

$$D_{perception-reaction} = v_0 t.$$

The braking distance is

$$v_0^2 - 0 = 2aD_{braking}$$

$$D_{braking} = \frac{v_0^2}{2a}$$

Therefore:

$$D_{stop} = v_0 t + \frac{v_0^2}{2a}$$