Answer on Question#82112 - Physics - Other

A car can be brakes to stop from 60 mi/h in 43 m.

a) what is the magnitude of the acceleration in SI units and “g units”? Assume that acc is constant.
b) what is the stopping time? If your reaction time T for braking is 400 ms to how many “reaction times” does the stopping time correspond?

<u>Solution:</u>

Since $1\ \text{mile} = 1{,}60934\ \text{km}$, we obtain

$$v_i = 60\frac{\text{mi}}{\text{h}} = 60 \cdot 1{,}60934\ \frac{\text{km}}{\text{h}} = 96.56\frac{\text{km}}{\text{h}} = 26.82\frac{\text{m}}{\text{s}}$$

The initial v_i and final v_f speeds are related to the stopping length l and acceleration a in the following way

$$v_f^2 - v_i^2 = 2al$$

Thus

$$a = \frac{v_f^2 - v_i^2}{2l}$$

Since $l = 43\ \text{m}$ and $v_f = 0\frac{\text{m}}{\text{s}}$, we obtain

$$a = \frac{\left(0\frac{\text{m}}{\text{s}}\right)^2 - \left(26.82\frac{\text{m}}{\text{s}}\right)^2}{2 \cdot 43\ \text{m}} = -8.36\ \frac{\text{m}}{\text{s}^2}$$

Since $g = 9.80665\ \text{m/s}^2$, the acceleration in g units is given by

$$a = \frac{-8.36\ \frac{\text{m}}{\text{s}^2}}{9.80665\frac{\text{m}}{\text{s}^2}} = 0.85g$$

The stopping time is given by

$$t = \sqrt{\frac{2l}{|a|}} = \sqrt{\frac{2 \cdot 43\ \text{m}}{8.36\ \frac{\text{m}}{\text{s}^2}}} = 3.2\ \text{s}$$

Thus the ratio of the stopping time t to reaction time ($T = 400\ \text{ms} = 0.4\ \text{s}$) is

$$\frac{t}{T} = \frac{3.2\ \text{s}}{0.4\ \text{s}} = 8$$

<u>Answer:</u> $a = -8.36\ \frac{\text{m}}{\text{s}^2} = 0.85g,\ t = 3.2\ \text{s} = 8T.$