Answer on Question #66359, Physics / Optics

Question:

A car is traveling at 40 mi/h when the driver slams on the brakes coming to rest over a distance of 68 meters. What is the acceleration of the car in m/s^2?

Solution:

Let v_1 be the initial truck's speed, v_2 — its final speed, S — distance, a — acceleration of the truck, and t — time spent for decreasing the speed.

For uniformly accelerated motion

$$v_2 = v_1 + at \qquad (1)$$

$$S = v_1 t + \frac{at^2}{2} \qquad (2)$$

From 1st equation $t = \frac{v_2 - v_1}{a}$

and then $S = v_1 \frac{v_2 - v_1}{a} + \frac{a\left(\frac{v_2 - v_1}{a}\right)^2}{2} = v_1 \frac{v_2 - v_1}{a} + \frac{(v_2 - v_1)^2}{2a} = \frac{v_2^2 - v_1^2}{2a}$.

Finally $a = \frac{v_2^2 - v_1^2}{2S}$.

$$v_1 = 40 \frac{mi}{h} = 40 \cdot \frac{1609.34\ m}{3600\ s} = 17.88\ \frac{m}{s}, \quad v_2 = 0\ \frac{m}{s}, \quad S = 68\ m$$

$$a = \frac{0^2 - 17.88^2}{2 \cdot 68} = -2.35\ \frac{m}{s^2}$$

Answer:

$$-2.35\ \frac{m}{s^2}$$