Answer on Question #64247, Physics / Solid State Physics

A car starts from rest and accelerates uniformly over a time of 5.21 seconds for a distance of 110 m. Determine the acceleration of the car.

SOLUTION

Uniform acceleration is a type of motion in which the velocity of an object changes by an equal amount in every equal time period. There is simple formula relating the displacement to the time elapsed:

$$s(t) = s_0 + v_0 t + \frac{1}{2}at^2, \text{ (1)}$$

where t is the elapsed time,

s_0 is the initial displacement from the origin,

$s(t)$ is the displacement from the origin at time t,

v_0 is the initial velocity, and

a is the uniform rate of acceleration.

In our case $t=5.21$ seconds, and $s(t) - s_0 = 110\ m$. At the beginning a car was in rest, that's why $v_0 = 0$. All these conditions simplify equation (1) into:

$$s(t) = s_0 + \frac{1}{2}at^2 \Rightarrow s(t) - s_0 = \frac{1}{2}at^2 \Rightarrow a = \frac{2(s(t)-s_0)}{t^2} = \frac{2 \cdot 110\ m}{(5.21\ s)^2} \approx 8.1\ {}^{m}/_{s^2}. \text{ (2)}$$

ANSWER: the acceleration of the car was 8.1 m/s^2.