

Answer on Question #46137, Physics, Mechanics | Kinematics | Dynamics

A car is rolling back when it hits the gas. After 8.25 s, it is moving forward at 8.62 m/s, and is 12.9m to the right of the starting point. What was its starting velocity?

Solution:

The kinematic equation that describes an object's motion is:

$$x = x_0 - v_0 t + \frac{1}{2} a t^2$$

where

$x_0 = 0$ is initial position

$v_0 = ?$ is initial speed

a is acceleration

At time $t = 8.25$ s the position of car is $x = 12.9$ m.

Thus, from first equation

$$v_0 = \frac{at}{2} - \frac{x}{t}$$

The acceleration is

$$a = \frac{v - v_0}{t}$$

In our case, the initial velocity has minus sign.

Thus,

$$a = \frac{v - (-v_0)}{t} = \frac{v + v_0}{t}$$

Substituting

$$v_0 = \frac{t}{2} \left(\frac{v}{t} + \frac{v_0}{t} \right) - \frac{x}{t} = \frac{v}{2} + \frac{v_0}{2} - \frac{x}{t}$$

Thus,

$$\frac{v_0}{2} = \frac{v}{2} - \frac{x}{t}$$

So,

$$v_0 = v - \frac{x}{t} = 8.62 - \frac{12.9}{8.25} = 7.06 \text{ m/s}$$

Answer: $v_0 = 7.06 \text{ m/s}$