Question.

A droid was initially stationary and has a mass of 75.0kg and the application of the force amounts to a constant force of 3.00 x 10^2 N, how fast is the droid moving when it slams into a wall a distance of 5.00m from its initial location?

Given:

$v_0 = 0$

$m = 75 \ kg$

$F = 3 \cdot 10^2 \ N$

$L = 5 \ m$

Find:

$v = ?$

Solution.

As we know from the basic of kinematics:

$$v = v_0 + at,$$

where a is the acceleration.

In our case, a droid was initially stationary $\rightarrow \ v_0 = 0$. So,

$$v = at$$

Let remember the second Newton's law:

$$F = ma \rightarrow a = \frac{F}{m}$$

And the distance travelled can be defined the following:

$$L = v_0 t + \frac{at^2}{2}; v_0 = 0 \rightarrow L = \frac{at^2}{2} \rightarrow t = \sqrt{\frac{2L}{a}}$$

Thus,

$$v = at = a\sqrt{\frac{2L}{a}} = \sqrt{2aL} = \sqrt{\frac{2FL}{m}}$$

Calculate:

$$v = \sqrt{\frac{2 \cdot 300 \cdot 5}{75}} = \sqrt{40} = 6.325 \, \frac{m}{s}$$

Answer.

$$v = \sqrt{\frac{2FL}{m}} = 6.325 \, \frac{m}{s}$$

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