Answer on Question #40184 – Physics – Mechanics

1. A truck on a straight road starts from rest and accelerates at 1.0 m/s2 until it reaches a speed of 10 m/s. Then the truck travels for 30 s at the constant speed of 10 m/s until the brakes are applied, stopping the car in a uniform manner in an additional 5.0 s. How long is the truck in motion and what is its average velocity during the motion?

$a_1 = 1\frac{m}{s^2}$ $v = 10\frac{m}{s}$ $t_2 = 30\,s$ $t_3 = 5\,s$	
$t, \bar{v} - ?$	$l_1 = \frac{v^2}{2a_1}, \quad l_3 = \frac{v^2}{2a_3} = \left\lvert a_3 = \frac{v}{t_3} \right\rvert = \frac{vt_3}{2}.$

Solution.

Let use the correlation between the path of the body which moves with a constant acceleration and its initial and final velocities: $l = \frac{v_2^{\,2} - v_1^{\,2}}{2a}$.

During the first acceleration and the last one, the paths of the truck are:

The total time of the movement: $t = t_1 + t_2 + t_3$, $\boxed{t = \frac{v}{a_1} + t_2 + t_3}$.

The average velocity during the motion of the truck: $\bar{v} = \frac{l_1 + l_2 + l_3}{t_1 + t_2 + t_3}$, $\boxed{\bar{v} = \frac{\frac{v^2}{2a_1} + vt_2 + \frac{vt_3}{2}}{\frac{v}{a_1} + t_2 + t_3}}$.

Let check the dimensions.

$$[t] = \frac{m/s}{m/s^2} + s = s, \quad [\bar{v}] = \frac{\frac{(m/s)^2}{m/s^2} + \frac{m}{s} \cdot s}{\frac{m/s}{m/s^2} + s} = \frac{m}{s}$$

Let evaluate the quantities.

$$t = \frac{10}{1} + 30 + 5 = 45(s), \quad \bar{v} = \frac{\frac{10^2}{2 \cdot 1} + 10 \cdot 30 + \frac{10 \cdot 5}{2}}{\frac{10}{1} + 30 + 5} \approx 8.3\left(\frac{m}{s}\right).$$

Answer: $45\,s, \quad 8.3\frac{m}{s}$.