Answer on Question #82082, Physics / Mechanics (fix 1)

A train at station P accelerates uniformly from rest until it attains a speed of 100 km/h. It then continues at the speed for some time and decelerates uniformly until it come to a stop at a station Q 60 km from P. The total time taken for the journey is on hour. If the rate of deceleration is twice that of the acceleration. Calculate the:

(i) Time taken during the constant speed is maintained

(ii) Acceleration of the train

Solution

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

$a_1 = \frac{100-0}{t_1}$ $a_3 = \frac{0-100}{t_3}$

$$a_2 = 2a_1$$

$$\frac{200}{t_1} = \frac{-100}{t_3}$$

$$t_1 = 2t_3$$

From the condition: $\begin{Bmatrix} t_1 + t_2 + t_3 = 1 \\ t_1 v_{average1} + t_2 v_{average2} + t_3 v_{average3} = 60 \end{Bmatrix}$

$$\begin{Bmatrix} 2t_3 + t_2 + t_3 = 1 \\ 50t_1 + 100t_2 + 50t_3 = 60 \end{Bmatrix}$$

Solving the system of equations we obtain:

$$t_1 = \frac{8}{15}\ hour$$

$$t_2 = \frac{3}{15}\ hour$$

$$t_3 = \frac{4}{15}\ hour$$

$$a_1 = \frac{v - v_0}{t_1} = \frac{100\ kilometer\ per\ hour}{\frac{8}{15}\ hour} = \frac{\frac{100000\ meter}{3600\ sec}}{1920\ sec} = 0.014\frac{meter}{sec^2}$$

Answer: $t_2 = \frac{3}{15}\ hour;\ a_1 = 0.014\frac{meter}{sec^2}$