Question #23588

car travels between 2 stations .60 km apart. Left first station, accelerates for 10.4 s at 1 m/s^2 and travels @ a constant speed until nearing the second station, when it brakes at 2.0 m/s^2 in order to stop at the station. How long did this trip take

Solution:

Let:

$S = 0.60\ km = 600\ m$

$t_1 = 10.4\ s$

$a_1 = 1\ m/s^2$

$a_2 = 2\ m/s^2$

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$t$ =?

$$\boldsymbol{t = t_1 + t_c + t_2},$$

$were\ t_c\ is\ the\ time\ of\ traveling\ with\ a\ constant\ speed, t_2\ is\ the\ time\ of\ braking$

$$\boldsymbol{t_c = \frac{S_c}{v}}$$

$were\ S_c\ is\ the\ distance\ of\ traveling\ with\ a\ constant\ speed, v\ is\ the\ velocity$

$$\boldsymbol{v = a_1 t_1}$$

$$\boldsymbol{t_2 = \frac{v}{a_2} = \frac{a_1 t_1}{a_2}}$$

$$\boldsymbol{S_c = S - (S_1 + S_2)}$$

$were\ S_1\ is\ the\ distance\ of\ traveling\ with\ accelration, S_2\ is\ the\ distance\ of\ braking$

$$\boldsymbol{S_1 = \frac{1}{2} a_1 {t_1}^2}$$

$$\boldsymbol{S_2 = \frac{1}{2} a_2 {t_2}^2 = \frac{1}{2} a_2 (\frac{a_1 t_1}{a_2})^2 = \frac{{a_1}^2 {t_1}^2}{2 a_2}}$$

$$\boldsymbol{t_c = \frac{S - (\frac{1}{2} a_1 {t_1}^2 + \frac{{a_1}^2 {t_1}^2}{2 a_2})}{a_1 t_1}}$$

$$\boldsymbol{t = t_1 + \frac{S - (\frac{1}{2} a_1 {t_1}^2 + \frac{{a_1}^2 {t_1}^2}{2 a_2})}{a_1 t_1} + \frac{a_1 t_1}{a_2} = 10.4 + \frac{600 - (\frac{1}{2} 1 * 10.4^2 + \frac{1^2 10.4^2}{2 * 2})}{1 * 10.4} + \frac{1 * 10.4}{2} = 65.5\ s}$$

**Answer: 65.5 s (or 1 m 5.5 s).**