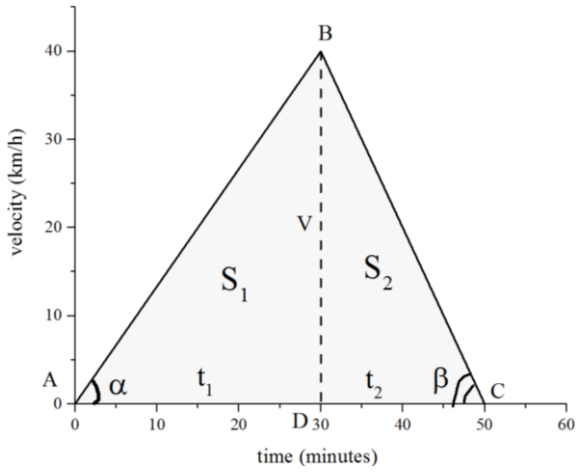
Answer on Question #85034 – Physics – Mechanics | Relativity

This problem is best done graphically. A ''toy train'' on its way to Darjeeling is speeding up slowly from v=0 to v=40.0 km/hr in 30.0 min and then slows down to a stop over the remaining 20.0 min. Plot v vs t for the train. Using your plot, calculate the distance traveled by the train in 50.0 min. Report the answer accurate to three significant figures.

-----km
B) What is the acceleration of the train in the first 30 min. Express your answer accurate to one significant figure
C.)What is the acceleration in the next 20 min. Express your answer accurate to one significant figure.
---- ×10−3 m/s2

Solution



First t_1=30 min train speeding up slowly with positive uniform acceleration which correspond to the AB line on figure 1. After that he slows down to a stop with negative uniform acceleration (BC line) over the remaining t_2=20.0 min.

A. To calculate the distance traveled by the train in 50.0 min we need to find a area of triangle ABC. Its more convenient to do by separating it into the two different triangles ABD and BCD. So full area will be the sum of their areas.

Let us denote S_1 as area of the triangle ABD and S_2 as area of the triangle BDC, so area of the ABC is $S = S_1 + S_2$

Using formula`s for right triangle $S = \frac{1}{2}ab$ where *a* and *b* are the legs of the triangle

We obtain $S = \frac{1}{2}Vt_1 + \frac{1}{2}Vt_2 = \frac{1}{2}V\left(t_1 + t_2\right)$, where V=40 km/h is the maximum train`s speed.

So

$$S = \frac{1}{2}V\left(t_1 + t_2\right) = \frac{1}{2}40\left[km/h\right]\left(\frac{1}{2}\left[h\right] + \frac{1}{3}\left[h\right]\right) = \frac{50}{3}[km] \approx 16.7[km]$$

B. Acceleration of the train in the first 30 min correspond to the tangent of angle α

$$a = \tan(\alpha) = \frac{V}{t_1} = \frac{40 \cdot 1000/3600[m/s]}{30 \cdot 60[s]} = \frac{1}{162}[m/s^2] \approx 0.006[m/s^2]$$

where we use $[km/h] = \frac{1000}{3600}[m/s]$

C. Analogously, acceleration in the next 20 min correspond to the tangent of angle $\pi - \beta$

$$a = \tan(\pi - \beta) = -\tan(\beta) = -\frac{V}{t_2} = \frac{40 \cdot 1000/3600[m/s]}{20 \cdot 60[s]} = -\frac{1}{108}[m/s^2] \approx -0.009[m/s^2],$$

Answer: (A)=16.7, (B) 6, (C) -9

https://en.wikipedia.org/wiki/Right_triangle