

Answer on Question #69101 – Physics / Mechanics | Relativity

Question. A train travelling with a velocity of 40 km/h

(i) what should be the acceleration on it so that it may reach a point 10 km ahead in 8 minutes?

(ii) what will be its velocity on reaching that point?

Solution.

In the International System of Units $40 \frac{\text{km}}{\text{h}} = 11,1 \frac{\text{m}}{\text{s}}$; $10 \text{ km} = 10000 \text{ m}$; $8 \text{ minutes} = 480 \text{ s}$.

Initial velocity $v_0 = 11,1 \frac{\text{m}}{\text{s}}$;

Distance $S = 10000 \text{ m}$;

Time $t = 480 \text{ s}$.

$$(i) \quad S = v_0 t + \frac{at^2}{2} \Rightarrow S - v_0 t = \frac{at^2}{2} \Rightarrow 2(S - v_0 t) = at^2 \Rightarrow a = \frac{2(S - v_0 t)}{t^2} = \frac{2 \cdot (10000 - 11,1 \cdot 480)}{480^2} \approx 0,04 \frac{\text{m}}{\text{s}^2}.$$

$$(ii) \quad v = v_0 + at = v_0 + \frac{2(S - v_0 t)}{t^2} t = v_0 + \frac{2(S - v_0 t)}{t} = \frac{v_0 t + 2S - 2v_0 t}{t} = \frac{2S - v_0 t}{t} = \frac{2 \cdot 10000 - 11,1 \cdot 480}{480} \approx 30,6 \frac{\text{m}}{\text{s}}.$$

Answer: acceleration $a = 0,04 \frac{\text{m}}{\text{s}^2}$; velocity $v = 30,6 \frac{\text{m}}{\text{s}}$.

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