Answer on Question 69049, Physics, Mechanics | Relativity

Question:

A train travels first $30\ km$ at uniform speed of $30\ km/h$. How fast must the train should travel next $90\ km$ so as to have the average speed of $60\ km/h$?

Solution:

By the definition, the average speed is the total distance traveled divided by the total time:

$$v_{avg} = \frac{d_{tot}}{t_{tot}}.$$

It is obvious that the total distance is equal to

$$d_{tot} = d_1 + d_2 = 30\ km + 90\ km = 120\ km.$$

Let's find the time that the train needs to travel first $30\ km$ at $30\ km/h$:

$$t_1 = \frac{d_1}{v_1} = \frac{30\ km}{30\ \frac{km}{h}} = 1.0\ h.$$

Then, we can find the total time for the train's trip:

$$t_{tot} = t_1 + t_2 = 1.0\ h + t_2.$$

Substituting d_{tot} and t_{tot} into the formula for the average speed, we get:

$$60\ \frac{km}{h} = \frac{120\ km}{1.0\ h + t_2}.$$

From this formula, we can find the time t_2 that the train needs to travel next $90\ km$ at speed v_2 in order to have the average speed of $60\ km/h$ for the entire journey:

$$60\ \frac{km}{h} \cdot (1.0\ h + t_2) = 120\ km,$$

$$1.0\ h + t_2 = 2.0\ h,$$

$$t_2 = 1.0\ h.$$

Finally, we can find how fast the train must travel next $90\ km$ in order to have the average speed of $60\ km/h$ for the entire journey:

$$v_2 = \frac{d_2}{t_2} = \frac{90\ km}{1.0\ h} = 90\ \frac{km}{h}.$$

Answer:

$v_2 = 90\ \frac{km}{h}$.