Answer on Question #45692, Physics, Mechanics | Kinematics | Dynamics

To qualify for the finals in a racing event, a race car must achieve an average speed of 245 km/h on a track with a total length of 1,700 m. If a particular car covers the first half of the track at an average speed of 222 km/h, what minimum average speed must it have in the second half of the event in order to qualify?

Solution:

The average speed during the course of a motion is often computed using the following formula:

$$\text{Average Speed} = \frac{\text{Distance Traveled}}{\text{Time of Travel}}$$

$$v_{av} = \frac{d}{t_1 + t_2}$$

$v_1 = 222$ km/h,
$v_{av} = 245$ km/h,
$d = 1700$ m,
$v_2 = ?$

$$\text{time} = \frac{\text{distance traveled}}{\text{speed}}$$

$$t_1 = \frac{d_1}{v_1} = \frac{d}{2v_1}$$

$$t_2 = \frac{d_2}{v_2} = \frac{d}{2v_2}$$

Thus,

$$v_{av} = \frac{d}{t_1 + t_2} = \frac{d}{\dfrac{d}{2v_1} + \dfrac{d}{2v_2}} = \frac{1}{\dfrac{1}{2v_1} + \dfrac{1}{2v_2}}$$

$$\frac{1}{v_1} + \frac{1}{v_2} = \frac{2}{v_{av}}$$

$$\frac{1}{v_2} = \frac{2}{v_{av}} - \frac{1}{v_1}$$

So,

$$v_2 = \frac{v_1 v_{av}}{2v_1 - v_{av}} = \frac{222 \cdot 245}{2 \cdot 222 - 245} = 273.3 \text{ km/h}$$

Answer: $v_2 = 273.3$ km/h