

Question #72914, Physics / Classical Mechanics

On straight road, an object starts moving with starting speed at 0 and acceleration of $a=5 \text{ m/s}^2$, then object starts moving with same speed for a time period t . Then object starts slowing down with $a=-5 \text{ m/s}^2$ until it stops moving. Total moving time is 25 s. Medium speed of whole motion is $V_{sr}=72 \text{ km/h}$. How long the object was moving with constant speed? Find that speed.

Solution

Since the object accelerates and slows down with the same absolute value of acceleration, the time intervals of acceleration and slowing down is the same. Hence, the time of

acceleration is $\frac{25-t}{2} = 12.5 - 0.5t$ s.

The maximum speed of the object is $5(12.5 - 0.5t)$ m/s.

The distances traveled during acceleration and slowdown intervals are

$$\frac{v^2 - v_0^2}{2a} = \frac{25(12.5 - 0.5t)^2}{2 \times 5} = 2.5(12.5 - 0.5t)^2$$

The distance traveled during uniform motion is

$$5t(12.5 - 0.5t)$$

The total distance is $2 \times 2.5(12.5 - 0.5t)^2 + 5t(12.5 - 0.5t) = 5(12.5 - 0.5t)^2 + 5t(12.5 - 0.5t)$

The average speed is

$$\frac{5(12.5 - 0.5t)^2 + 5t(12.5 - 0.5t)}{25} = 20 \text{ m/s (72 km/h)}$$

Solving for t , obtaining $t = 15$ s.

Answer: the object was moving at a constant speed during 15 s.

Answer provided by <https://www.AssignmentExpert.com>