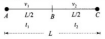
QUES 04

A vehicle travels half the distance L with speed v_1 and the other half with speed v_2, then its average speed is

(a) $\frac{v_1+v_2}{2}$ (b) $\frac{2v_1+v_2}{v_1+v_2}$ (c) $\frac{2v_1v_2}{v_1+v_2}$ (d) $\frac{L(v_1+v_2)}{v_1v_2}$

Sol. (c) Consider the diagram below in which motion is as shown below.



Let the vehicle travels from A to B. Distances, velocities and time taken are shown. To calculate average speed we will calculate total distance covered and will divide by time interval in which it covers that total distance.

Time taken to travel first half distance $t_1 = \frac{L/2}{v_1} = \frac{L}{2v_1}$

Time taken to travel second half distance $t_2 = \frac{L}{2v_2}$

Total time = $t_1 + t_2$

$$= \frac{L}{2v_1} + \frac{L}{2v_2} = \frac{L}{2}\left[\frac{1}{v_1} + \frac{1}{v_2}\right]$$

We know that

v_{av} = *Average speed*

= *total distance/total time*

$$v_{av} = \frac{L}{\frac{L}{2}\left[\frac{1}{v_1} + \frac{1}{v_2}\right]} = \frac{2v_1v_2}{v_1+v_2}$$

Important point: Students usually thought that $v_{av} = \frac{v_1+v_2}{2}$ but it is not the average speed when two equal distances are covered by speed v_1 and v_2.

Remember: If $t_1 = t_2 = t$, then $v_{av} = \frac{v_1+v_2}{2}$. *Average speed is equal to arithmetical mean of individual speeds. (if the particle moves in equal interval of times at different speeds v_1 and v_2.)*

And also we should not confuse with distance and displacement. Distance ≥ Displacement.