Answer on Question#39900 – Physics - Mechanics

A particle travels half of distance of a straight journey with speed 6m/s .the remaining part of the distance is covered with speed 2m/s for half of the time of remaining journey and with speed 4 m/s for other half of time .the average speed of the particle is?

Solution:

$V_1 = 6\frac{m}{s} - \text{speed on the first half of distance;}$

$V_2 = 2\frac{m}{s} - \text{speed on the first half of the time of remaining journey;}$

$V_3 = 4\frac{m}{s} - \text{speed on the second half of the time of remaining journey;}$

Let the total straight line distance be x. Time taken to cover $\frac{x}{2}$ distance :

$$t_1 = \frac{\frac{x}{2}}{V_1} = \frac{x}{2V_1}.$$

Distance left after travelling after $\frac{1}{2}x$

$$x - \frac{x}{2} = \frac{1}{2}x$$

Let time t_2 is taken to travel the rest $\frac{1}{2}x$ distance

Distance covered with $V_2 = 2\frac{m}{s}$:

$$d_2 = V_2 \times \frac{t_2}{2}$$

Distance covered $with$ $V_3 = 4\frac{m}{s}$:

$$d_3 = V_3 \times \frac{t_2}{2}$$

$$d_2 + d_3 = \frac{1}{2}x$$

$$V_2 \times \frac{t_2}{2} + V_3 \times \frac{t_2}{2} = \frac{1}{2}x$$

$$t_2(V_2 + V_3) = x$$

$$t_2 = \frac{x}{V_2 + V_3}$$

Total time taken to cover the distance:

$$t_1 + t_2 = \frac{x}{2V_1} + \frac{x}{V_2 + V_3} = \frac{x(V_2 + V_3 + 2V_1)}{2V_1(V_2 + V_3)}$$

Now average speed :

$$V_{average} = \frac{x}{t_1 + t_2} = \frac{x}{\frac{x(V_2 + V_3 + 2V_1)}{2V_1(V_2 + V_3)}} = \frac{2V_1(V_2 + V_3)}{V_2 + V_3 + 2V_1} = \frac{2 \cdot 6\frac{m}{s}\left(2\frac{m}{s} + 4\frac{m}{s}\right)}{2\frac{m}{s} + 4\frac{m}{s} + 2 \cdot 6\frac{m}{s}}$$

$$= 4\frac{m}{s}$$

Answer: average speed of particle is equal to $4\frac{m}{s}$.