

Average Speed and Velocity

1. Average speed is calculated by taking the total distance traveled and dividing by the total time taken to travel this distance.

$$\text{Average speed} = \text{distance/time}$$

2. Average velocity is the displacement divided by the time.

$$\begin{aligned} \text{Average velocity} &= \frac{\text{Displacement}}{\text{Elapsed time}} \\ \bar{v} &= \frac{x - x_0}{t - t_0} = \frac{\Delta x}{\Delta t} \end{aligned}$$

3. Average speed and average velocity have the same magnitude value when the object is moving in one direction. Only when the direction of the object changes do you get a different magnitude value for average speed and velocity.

Example:

A runner changes position from $X_1 = 50.0\text{m}$ to $X_2 = 30.5\text{m}$ in 3.00s. Calculate the runner's average speed and velocity.

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$\text{Average speed} = \frac{50.0\text{m} - 30.5\text{m}}{3.00\text{s}}$$

$$\text{Average speed} = 6.50 \text{ m/s}$$

$$\text{Average Velocity} = \frac{\text{displacement}}{\text{change in time}}$$

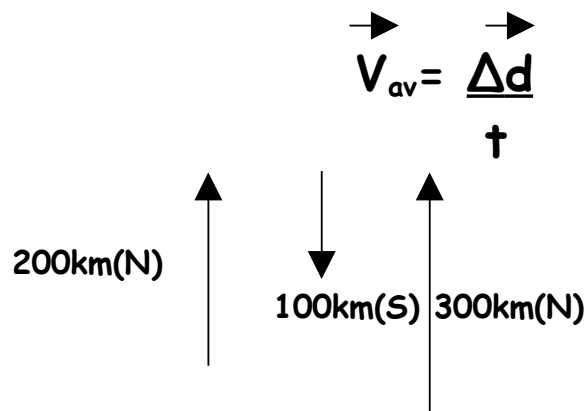
$$\text{Average Velocity} = \frac{\vec{X}_2 - \vec{X}_1}{\Delta t}$$

$$\text{Average Velocity} = \frac{30.5\text{m} - 50.0\text{m}}{3.00\text{s}}$$

$$\text{Average Velocity} = -6.50\text{m/s}$$

The negative indicates the direction and in this case it is in the negative direction.

Example: An airplane travels 200km North in 15 minute , 100km South in 5 minutes, and finally 300 km North in 20 minutes. What is the average velocity of the airplane?



Resulting position is 400km North

$$V_{av} = \frac{400\text{km North} - 0}{40 \text{ minutes}}$$

10 km/min

10 km/min × 60min/1hour

600km/h

See Example 2-2 page 23 for an additional example.