

## Speed vs Velocity:

**Speed** - is the distance covered by an object in a certain amount of time

Ex. 100 kilometers per hour 100km/h

**Velocity** - is the displacement of an object in a certain amount of time

- Because we include displacement, direction becomes involved

Ex. 100 km/h [E]

The **formulas** for calculating speed and velocity are very similar:

$$\text{Average Speed} = \frac{\text{Total distance traveled}}{\text{Time Interval}}$$

$$\text{Average Velocity} = \frac{\text{Displacement}}{\text{Time Interval}}$$

$$V = \frac{\delta}{t}$$

$$\vec{V} = \frac{\vec{\delta}}{t}$$

**Example:** A man walks 10.0 m [E] in 10.00 s and then runs 25.0 m [W] in 5.00 s.

What is the man's average speed?

$$\begin{aligned} V &: ? \\ \delta &: 35.0\text{m} \\ t &: 15.00\text{s} \end{aligned}$$

$$V = \frac{\delta}{t}$$

$$V = \frac{35.0\text{m}}{15.00\text{s}} = 2.3333\text{m/s} \\ = \boxed{2.33\text{m/s}}$$

What is the man's average velocity?

$$\begin{aligned} \vec{V} &: ? \\ \vec{\delta} &: 15.0\text{m} [\text{W}] \\ t &: 15.00\text{s} \end{aligned}$$

$$\vec{V} = \frac{\vec{\delta}}{t}$$

$$\vec{V} = \frac{15.0\text{m} [\text{W}]}{15.00\text{s}} = \boxed{1.00\text{m/s} [\text{W}]}$$

**Example:** Bob drives his car 20.0 km south in 15 min. Then realizes he forgot his wife at home and drives back 20.0 km north in 10 min.

For the whole trip, what is Bob's average speed?

$$\begin{aligned} V &: ? \\ \delta &: 40.0\text{km} \\ t &: 25\text{min} \end{aligned}$$

$$V = \frac{\delta}{t}$$

$$V = \frac{40.0\text{km}}{25\text{min}} = \boxed{1.6\text{km/min}}$$

What is Bob's average velocity.

$$\vec{V} = \frac{\vec{\delta}}{t} = \frac{0}{25\text{min}} = 0\text{km/min}$$

Khan Academy video - Introduction to Motion

[http://www.youtube.com/watch?v=8wZugqi\\_uCg&feature=player\\_embedded#at=79](http://www.youtube.com/watch?v=8wZugqi_uCg&feature=player_embedded#at=79)



### Working with the speed and velocity formulas:

- The speed and velocity formulas can be rearranged to find the distance travelled, displacement or time that an object was in motion.

**Example:** A car has an average velocity of 112 km/h [E] for a trip from Athabasca to Boyle that is 35 km long.

a) How long will the trip take in hours?

$$\begin{aligned}
 t &= ? \\
 \vec{v} &= 112 \text{ km/h [E]} \\
 \vec{d} &= 35 \text{ km [E]} \\
 \vec{v} &= \frac{\vec{d}}{t} \quad \Rightarrow \quad t = \frac{\vec{d}}{\vec{v}} = \frac{35 \text{ km [E]}}{112 \text{ km/h [E]}} = 0.3125 \text{ h} = \boxed{0.31 \text{ h}}
 \end{aligned}$$

b) How long will the trip take in minutes?

$$0.3125 \text{ h} \times \frac{60 \text{ min}}{1 \text{ h}} = 18.75 \text{ min} = \boxed{19 \text{ min}}$$

**Example:** A plane flies at an average speed of 500 km/h for 10.5 hours as it goes from Edmonton to Calgary and then to Mexico and back to Edmonton.

a) What is the distance travelled by the plane?

$$\begin{aligned}
 v &= 500 \text{ km/h} \\
 d &= ? \\
 t &= 10.5 \text{ h} \\
 v &= \frac{d}{t} \quad \Rightarrow \quad d = v \times t = 500 \frac{\text{km}}{\text{h}} \times 10.5 \text{ h} = 5250 \text{ km} = \boxed{5.25 \times 10^3 \text{ km}}
 \end{aligned}$$

b) What is the displacement of the plane?

$$0 \text{ km}$$

### Average vs Instantaneous Velocity/Speed