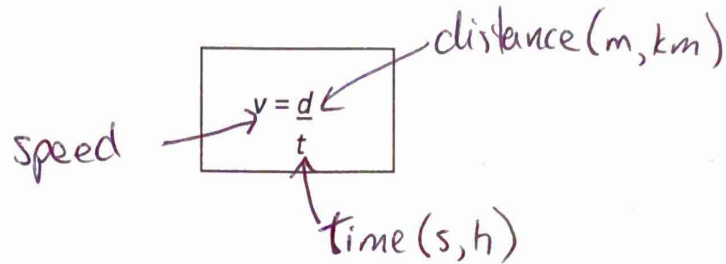# Speed

Speed is a scalar quantity. Speed describes how fast something is moving. The standard unit of measure is meters per second (m/s). We represent speed with the unit "v".

*km/h

In order to determine a speed, we must know what distance an object covers in a particular amount of time:

speed = <u>distance</u>
        time

speed → $v = \dfrac{d}{t}$ ← distance (m, km)

              time (s, h)

Example:

A car travels 220 km in 2.0 hours, what was the car's speed?
$$v = d/t = 220 \text{ km} / 2.0 \text{ h} = 110 \text{ km/h}$$

$d = 220 km$

$t = 2.0 h.$

$v = ?$

$$v = \frac{d}{t} = \frac{220 km}{2.0 h} = 110 \, km/h$$

Velocity

• Speed with a direction is called *velocity*. Velocity describes how fast an object's position is changing and in what direction. Velocity is measured in meters per second (m/s), kilometers per hour (km/hr) etc.

Velocity is the rate of change of position. E.g. rate of a car moving (km/h) or rate of water flowing (m/s).

velocity = displacement
                time

$v = \dfrac{\Delta d}{t}$ ← velocity

displacement (m, km)

* $\Delta d = d_f - d_i$

time (s, h)

$\dfrac{\Delta d}{v \mid t}$

Examples:

1. A train travels at a constant speed through the countryside and has a displacement of 150 km [E] in a time of 1.7 h. What is the velocity of the train?

$\Delta d = 150 \, km \, [E]$
or
$+150 \, km$

$t = 1.7 \, h$

$\vec{v} = ?$

$v = \dfrac{\Delta d}{t} = \dfrac{+150 \, km}{1.7 \, h} = +88.235 \, km/h$

OR

$88.235 \, km/h \, [E]$

2. A high school athlete runs 100 m race. If he has the average velocity of 9 m/s, how long will it take him to finish the race?

$t = ?$

$\Delta d = +100 \, m$

$\vec{v} = +9 \, m/s$

$t \left(\vec{v} \neq \dfrac{\Delta d}{t} \right) t$

$\dfrac{t \cdot v}{v} = \dfrac{\Delta d}{v}$

$t = \dfrac{\Delta d}{v}$

$t = \dfrac{\Delta d}{v}$

$t = \dfrac{+100 \, m}{+9 \, m/s}$

$t = 11.1 \, s$

*PRACTICE
Speed and Velocity -Answers

1. What is the difference between speed and velocity? Use examples to help answer this question. *Velocity has direction. Examples will vary*

2. A car travels 450 km in 4.4 hours, what was the car's speed? *100 km/h.*

3. A train travels at a constant speed through the countryside and has a displacement of 190 km [W] in a time of 6 h. What is the trains velocity? *31.7 km/h [W]*

4. Brody skates to school, a total distance of 4.5 km. He has to slow down twice to cross busy streets, but overall the journey takes him 0.62 h. What is Cody's average speed during the trip? *7.3 km/h*

5. Ms. B can run at an average speed of 12 km/h. If she is running for 19 km, how long is it going to take her? *1.6 hours*

6. Bobby runs at an average speed of 13 km/h. If he is running for 2 hours, how far does he travel? *26 km*

7. A car and a truck travel along the same highway with the car moving faster than the truck.
   a. Which travels a further distance in the same amount of time? *car*
   b. How do their times compare after traveling the same distance? *car has shorter time than truck*

8. If two hikers walk the Trans Canada Trail for 6.0 h, and covered 31 km, what is their speed for the day? *5.2 km/h*

9. Theresa rides her bike for 1.5 hours, and covers 25 km. What is her average speed? *16.7km/hr*

10. Mary walked for 2.1 hours at a speed of 3.6 km/h. What distance did she travel? *7.56km*

11. A hot air balloon called Orbiter 3 traveled 6600 km in 21h.
    a. How far did the balloon travel in minutes? *1260min*
    b. Calculate the average speed of the balloon. *314.3km/h*
    c. Using the average speed, what length of time did it take the Orbiter 3 to cross the Atlantic Ocean, a distance of 10000 km? *31.8h*
    d. For part of the trip, the balloon flew for 7h at an average speed of 210 km/h. How far did it travel? *1470km*

12. In a marathon race, one runner moving at 5.0 km/h passes a second runner moving at 4.5 km/h. What is the distance between the runners 30 **minutes** after the one runner passed the other? *R1 - 2.5km* *R1* *R2* *R2- 2.25km* *2.5 - 2.25 = 0.25km or 250m*

13. Alec boarded to school, a distance of 3 km in 0.5 h. What was his velocity? *+6 km/h*

14. Jamie rode his unicycle at 2.5 km/h for 2 hours. How far did he travel? **5 km**

15. Suzie hiked up Mt Everest, a distance of 14 km. She hiked at 3 km/h. How long did it take her to get to the top? **4.7 h.**

16. A car is driving west from Winnipeg to Regina. If it travels 247.6 km in 2 hours, what is its velocity (km/hr)? **123.8 km/h [W]**

17. What is the velocity of a swimmer who does the 100 m butterfly forwards in 11.28 seconds? **8.9 m/s [Forward]**

18. What is the velocity of a sprinter who runs the 200m dash backwards in 30 seconds? **6.7 m/s [backwards]**

19. Ms. B is trying to predict the time required to ride her bike south to FRC. She knows that the distance is 15km and averages about 35km/h. How long will her trip take? **0.43 h.**

20. Now Ms. B has to ride her bike home! She must ride 15km north but is tired so it takes her 45 minutes to get home! What was her velocity in km/h? **20 km/h**

21. Jacob travels 225 km [E] all the way to Kenora in 2.00 hours. He stops for gas for 0.25 hours and realizes that she was supposed to pick up Brian at Falcon Lake. Now he has to drive back 75km [W] for 0.75 hours. When he arrives at Falcon Lake determine the following:
    a. What would his average speed be for the entire trip? **100 km/h**
    b. What would his average velocity be for the entire trip? **50 km/h [E]**