

Extremely Important Note: I suggest you put it on your bedroom door for a week! September 4th / 2012

The study of motion is called **kinematics**. A lot of the words used to describe ideas in kinematics are similar, but these words have slightly different meanings in everyday language than they do scientifically. Other words that you'll come across will be completely new. Before going any further, a series of terms will be defined in order for you to have a clear and specific understanding of the language used in the rest of this unit. A formative (not for marks) multiple choice quiz will follow so that you can test your knowledge.

Scalar—any measure that does not have an associated direction. Some scalar quantities include: time, mass, distance, and speed. Examples: 35 seconds, 150 kg, 200 m, 50 km/h.

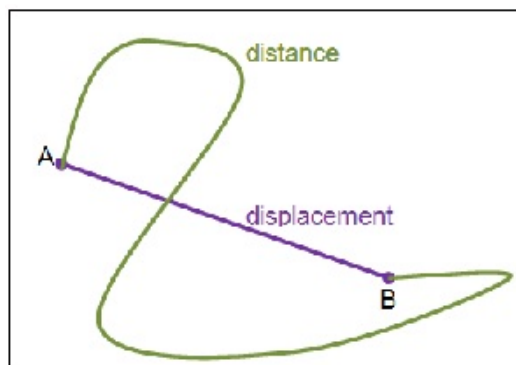
Vector—any measure that does have an associated direction. Some vector quantities include: displacement, velocity, acceleration, and force. Examples: 20 km [North], 10 m/s [up], 9.8 m/s² [down], 37 N [right].

Distance—the length of the path travelled—scalar quantity with the base unit metres (m) and the symbol d . Example: The hiking trail was 560 m long.

Displacement—the shortest distance \vec{d} between two points. Vector quantity with the base unit metres (m) and the symbol \vec{d} .

The half arrow on top of the symbol indicates a vector quantity. Example: The start of the hiking trail is 30 m [East] from the end of the trail.

Note that distance and displacement are often confused. This diagram visually shows the difference. Point A is the starting point and Point B is the end point. The purple line is the shortest distance between the two points and represents the displacement. The green line represents the path travelled to get from Point A to Point B and it is the distance. The distance will always be bigger than or equal to the displacement.



Position—a location given with respect to some reference point—a vector quantity with the base unit metres (m) and the symbol \vec{d} . Example: My house is located 620 m [North] of the school. In this case, the school is the reference point and the position of the house is being indicated.

Speed—distance travelled per unit time—a scalar quantity with the base unit metres per second (m/s), although it is often expressed in kilometres per hour (km/h). Symbol is v . Example: The car's speed is 50 km/h, or 14 m/s.

Quantity	Base unit	Other common units
Length	m	km, cm, inches, feet
Mass	kg	g, lb, tonnes
Speed/Velocity	m/s	km/h, km/s, miles/hour
Acceleration	m/s ²	km/h/s, km/s ²
Force	N = kg·m/s ²	g·m/s ² , kg·cm/s ² , kN

To convert units:

Identify the starting and ending units.

Example: Convert 1.0 km/h into m/s.

$$\frac{1.0 \text{ km}}{\text{h}} \cdot \frac{1000 \text{ m}}{1 \text{ km}} = 1000 \text{ m/h}$$

MISSING????

$$\frac{1000 \text{ m}}{1 \text{ h}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \frac{\text{m}}{\text{s}}$$

$$= 0.27 \frac{\text{m}}{\text{s}}$$

CON

- a. 32 km → mm
- b. 1 year → seconds
- c. 100 km/h → m/s
- d. 32 km/h/s → m/s²

VERT the FOLLOWING

a)

$$\begin{aligned} & 32 \text{ km} \cdot \frac{1000 \text{ m}}{1 \text{ km}} \cdot \frac{1000 \text{ mm}}{1 \text{ m}} \\ & = 32\,000\,000 \text{ mm} \\ & = 3.2 \times 10^7 \text{ mm} \end{aligned}$$

b)

$$\begin{aligned} & 1 \text{ year} \cdot \frac{365.25 \text{ days}}{1 \text{ year}} \cdot \frac{24 \text{ hours}}{1 \text{ day}} \cdot \frac{3600 \text{ s}}{1 \text{ hour}} \\ & = 31\,557\,600 \text{ s} \\ & = 3.2 \times 10^7 \text{ s} \end{aligned}$$

c) WHAT is the ERROR??????????

$$100 \text{ km/h} \cdot \frac{1000 \text{ m}}{1 \text{ km}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} = 27.7 \text{ s}$$

d)

$$\begin{aligned} & \frac{32 \frac{\text{km}}{\text{h}}}{\frac{1 \text{ s}}{32 \text{ km}}} \\ & = \frac{32 \text{ km}}{1 \text{ h}} \cdot \frac{1}{1 \text{ s}} \cdot \frac{1000 \text{ m}}{1 \text{ km}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} \\ & = 8.8 \text{ m/s}^2 \end{aligned}$$

e) $9.8 \text{ m/s}^2 = \text{km/h}^2$????

f) 30 m/s into km/h ???

Instantaneous speed - speed at a particular point in time - a scalar quantity with the base unit metres per second (m/s), although it is often expressed in kilometres per hour (km/h). Symbol is v_{inst} . Example: At 6:02 p.m., the policeman clocked me at 72 km/h, or 20 m/s. Older style car speedometers (without directions) give you your instantaneous speed.

Average speed - total distance travelled divided by the total time - a scalar quantity with the base unit metres per second (m/s) and the symbol v_{avg} . Example: It took 3.0 hours to travel 279 km to the cottage, so the average speed was 93 km/h, or about 26 m/s. Your average speed is generally lower than your usual travelling speed since it takes into account that you need to stop for lights, slow down to make turns, and other such delays.

Velocity - is displacement per unit time. Vector quantity with the base unit metres per second (m/s) and the symbol v .

The direction of the velocity will be the same as the direction of the displacement.

Example: The car's velocity is 50 km/h [West] or 14 m/s [West]. As with distance and displacement, velocity will always be lower than or equal to speed.

Instantaneous velocity - is velocity at a particular point in time. Vector quantity with the base unit metres per second (m/s) and the symbol v_{inst} .

Example: At 6:02 p.m., the policeman clocked me at 72 km/h [South] or 20 m/s [South]. The instantaneous velocity is the same as the instantaneous speed, only it has a direction attached..

Average velocity - total displacement divided by the total time. Vector quantity with the base unit metres per second (m/s) and the symbol v_{avg} .

Example: The cottage is 198 km [North] from home, so if it took 3.0 hours to drive there, the average velocity is 66 km/h [North], or about 18 m/s [North].

Uniform motion—constant velocity, no acceleration. This means that there is no change in speed or direction.

Non-uniform motion—is motion where speed and/or direction are changing.