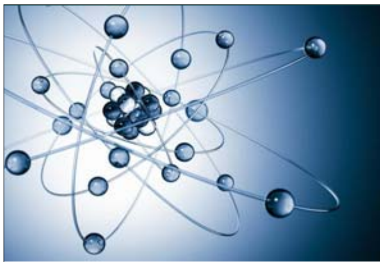
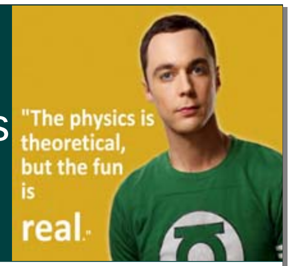


Unit 1: Kinematics

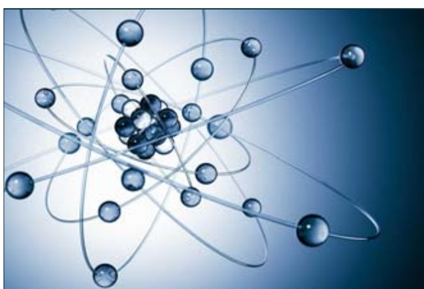


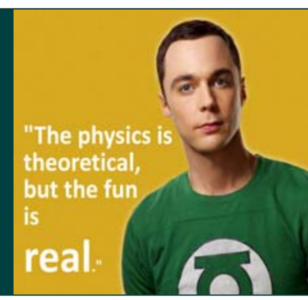
1.1 Scalars, Vectors and Uniform Motion

Kinematics - the study of how things move

Kinematics

$\vec{v}_{ave} = \frac{\Delta \vec{d}}{\Delta t}$	$\vec{d} = \vec{v}_f t - \frac{1}{2}\vec{a}t^2$
$\vec{a}_{ave} = \frac{\Delta \vec{v}}{\Delta t}$	$\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right)t$
$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$	$v_f^2 = v_i^2 + 2ad$
$\lvert\vec{v}_c\rvert = \frac{2\pi r}{T}$	$\lvert\vec{a}_c\rvert = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$





Recall from Science 10:

Scalars - tell us magnitude, but not direction ("how far", "how fast")

eg. My speed on the highway was 110 km/h.

I went for a 5 km run.

Vectors - tell us both magnitude and direction

eg. I was driving 110 km/h North.

I went for a 5 km run towards Bentley.

Scalars

distance: d

speed: v

time: t

Vectors

displacement: $\vec{d}$

velocity: $\vec{v}$

acceleration: $\vec{a}$

$\rightharpoonup$ This is called a "vector arrow" and it must be placed on top of all vectors. If you don't put it on top of a vector, you imply the quantity is a scalar and will lose marks.

The Uniform Velocity/Average Velocity Formula

$$\vec{v}_{\text{ave}} = \frac{\Delta \vec{d}}{\Delta t}$$

Δ - delta is a Greek letter that means "change in"

Often times, we are not given change in displacement or time and we will need to calculate it. To calculate change in displacement or time, subtract the quantities:

$$\Delta \vec{d} = \vec{d}_2 - \vec{d}_1$$

$$\Delta t = t_2 - t_1$$

Ex.) Sarah started running at 6:00 am and finished running at 8:00 am. What was her Δt?

$$\Delta t = 8{:}00\text{am} - 6{:}00\text{am} = \boxed{2{:}00\text{h}}$$

Ex.) I started 10 km from Red Deer and drove in a straight line until I was 55 km from Red Deer. What was my Δd?

$$\Delta d = 55\text{km} - 10\text{km} = \boxed{45\text{km}}$$

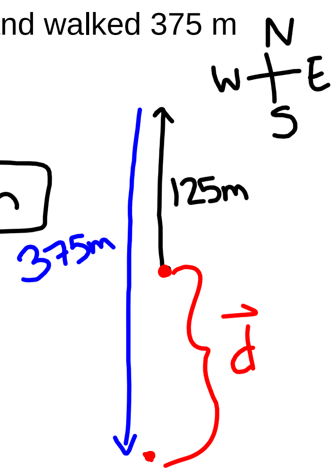
Ex.) Bob walked 125 m north and then turned around and walked 375 m south.

a) What was the distance he travelled?

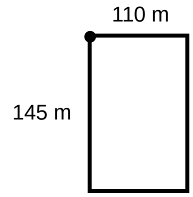
$$d = 125\text{m} + 375\text{m} = \boxed{500\text{m}}$$

b) What was his displacement?

$$\vec{d} = 375\text{m} - 125\text{m}$$
$$= \boxed{250\text{m [S]}}$$



Ex.) Ms. Austin takes her dog, Bo, out for a walk around the block.

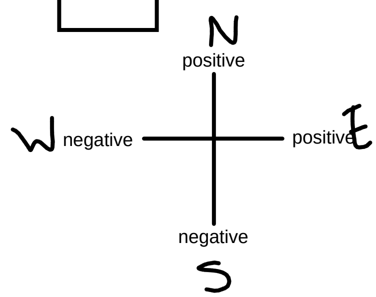


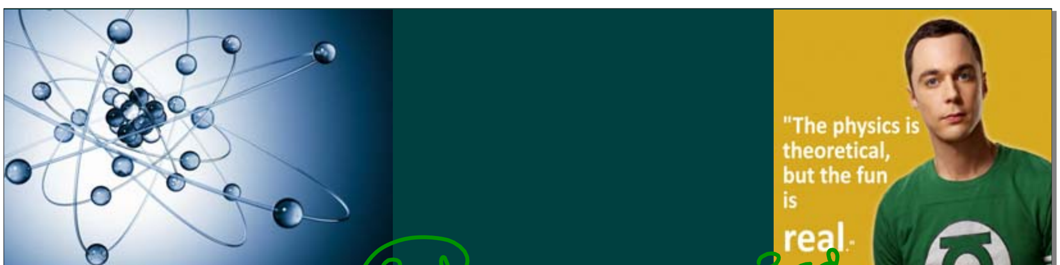
a) What is their distance travelled?

$d = 110m + 145m + 110m + 145m$
$= \boxed{510m}$

b) What is their displacement?

$\vec{d} = \boxed{0m}$





Ex.) A truck travels west for 3.0 h (2 sd). Its displacement ($\vec{d}$) is then 2.60 (3 sd) x 10² km west from its starting point.

a) What is the average velocity of the truck?

$t = 3.0h$
$\vec{d} = 2.60 \times 10^2 \text{ km [W]}$
$\vec{v} = ?$

$\vec{v} = \frac{\Delta\vec{d}}{\Delta t} = \frac{2.60 \times 10^2 \text{ km [W]}}{3.0h} = \boxed{87 \text{ km/h [W]}}$

b) What is the velocity in m/s?

$86.\bar{6} \text{ km/h [W]} \div 3.6 = 24.0740....$
$= \boxed{24 \text{ m/s [W]}}$

Shortcut!:

Converting between km/h and m/s can be done with the magic number of 3.6.

km/h → m/s: ÷ 3.6

m/s → km/h: x 3.6

Why? Dimensional analysis.

3 sd 2 sd

Ex.) It takes 1.00 min for a sound wave to travel 2.0 x 10[1] km [W]. What is the velocity of sound, in m/s?

$t = 1.00\,\text{min} = 60.0\,\text{s}$

$\vec{d} = 2.0 \times 10^{1}\,\text{km [W]} = 2.0 \times 10^{4}\,\text{m [W]}$

$\vec{v} = ?$

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{2.0 \times 10^{4}\,\text{m [W]}}{60.0\,\text{s}}$$

$$= 333.\overline{3}\,\text{m/s [W]}$$

$$= \boxed{3.3 \times 10^{2}\,\text{m/s [W]}}$$

9 sd

Ex.) How long does it take a photon of light to travel 149598000 km (the distance between the Sun and Earth) if the speed of light is 3.00 x 10^8 m/s?

3sd

$t = ?$

$d = 149598000000$ m

$v = 3.00 \times 10^8$ m/s

$v = \frac{d}{t}$

$t = \frac{d}{v} = \frac{149598000000 \text{ m}}{3.00 \times 10^8 \text{ m/s}}$

$= 498.\overline{6}$ s

$= 499$ s

$\frac{m}{m/s}$ $\quad m \div \frac{m}{s}$ $\quad m \times \frac{s}{m}$

Ex.) What distance could light travel in one year?

$v = 3.00 \times 10^8$ m/s

$t = 1$ year

$d = ?$

$t \cdot v = \frac{d}{t} \cdot t$

$d = t \cdot v$

$= (31536000 \text{ s})(3.00 \times 10^8 \text{ m/s})$

$= 9.46 \times 10^{15}$ m

$1 \text{ year} \times \frac{365 \text{ days}}{1 \text{ year}} \times \frac{24 \text{ h}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}}$

31536000 s

Read: Pg. # 6-10.

Pg. 9 # 1-3.

Pg. 10 # 1-7.