Science 20 Unit B - Physics

Intro to Physics: Scalars and Vectors

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POS Checklist

- ☐ distinguish between scalar and vector quantities, including distance and displacement, speed and velocity
- ☐ define velocity as $v = \Delta d / \Delta t$

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Kinematics

- the study of how things move.

What are some terms that we use to describe, in every day life, how things move?

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Scalar Quantities vs. Vector Quantities

There are two ways to describe motion: using scalars and using vectors.

A) Scalar Quantities: Have magnitude, but not direction.

Scalars tell us:
- "how fast"
- "how far"

magnitude = "how much"

but do not tell us what direction objects are moving in.

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ex) Mayerthorpe is 300 km away from Mallaig.

This is a statement of a scalar quantity. It tells us how far (300 km) but not the direction.

ex) _____, the cheetah, ran at 110 km/h.

This is also a scalar statement. It tells how fast, but not the direction the cheetah ran in.

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Some Typical Scalars...

Distance - how far an object has moved.
Symbol: d

Speed - the distance moved during a time of motion.
Symbol: v

Time - ...
Symbol: t

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B) Vector Quantities: have both magnitude and direction.

ex) Mayerthorpe is 300 km west of Mallaig.

ex) _____ the cheetah ran at 110 km/h towards a grizzly bear.

These are now vector statements.

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Some Typical Vectors:

Displacement: distance with direction included; the change in position of an object.
Symbol: $\vec{d}$

Velocity: speed with direction included; the rate of change of an object's position.
Symbol: $\vec{v}$

The little arrow on top of the symbols is called a vector arrow. You must place it on top of all vector quantities (until I say not to).

$\vec{v}$

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With these symbols, we can now introduce our first equation of Science 20!

The Uniform Velocity Formula

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

Where:

$\vec{v}$ = velocity*
$\triangle \vec{d}$ = change in displacement
$\triangle t$ = change in time

***Note: the $\triangle$ is the Greek symbol delta meaning "a change in".**

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Note: these formulas appear in your data booklet!

Kinematics and Dynamics Formulas

speed $\longrightarrow v = \frac{\Delta d}{\Delta t}$

velocity $\longrightarrow \vec{v} = \frac{\Delta \vec{d}}{\Delta t}$

v = average speed (m/s)
$\vec{v}$ = average velocity (m/s)
d = distance (m)
$\vec{d}$ = displacement (m)

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Rearranging the formulas:

- You need to be able to rearrange some simple formulas in Science 20.
- Do not use the triangle! It won't help you learn HOW to rearrange a formula, and you will need to know how to do that later on anyhow.

Practice: Solve for the given variable:

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

a) Solve for d.

b) Solve for t.

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Sometimes you are given the change in displacement or time. Sometimes, you will need to work it out.

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

$$\triangle t = t_2 - t_1$$

(This probably seems a lot more complicated than it really is...)

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ex) _____ starts running at 4:00 pm and finishes at 6:00 pm. What is his/her $\triangle t$ of running?

Ans: 2.00 h

ex) _____ the ant is walking down a ruler. He/she starts at the 10 cm mark and walks to the 25 cm mark. What is the ant's $\triangle \vec{d}$?

$\triangle \vec{d}$ = 15 cm

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Try this on your own:

ex) _____ walks 275 m east and then turns around and walks 425 m west.

a) What is the distance traveled?

$\triangle d$ = 700 m

b) What is the displacement?

$\triangle \vec{d}$ = 150 m west

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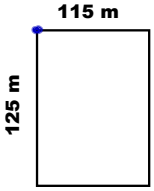
ex) _____ takes his/her pet _____ out for a walk around the block.



a) What is the distance traveled?

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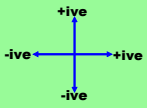
b) What is the displacement?

The displacement is zero because the pair end up at their starting point.



"Anytime you draw a diagram, let up and right be +ive and down and left be -ive."

$\triangle \vec{d}$ = +115 m -125 m - 115 m + 125 m
= 0 m

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Now, let us apply our velocity equation:

ex) A(n) _____ travels south for 3.0 h, after which it's displacement is 2.60×10^2 km south from its starting point.

a) What is the average velocity of the object?

b) What is the velocity of the object in m/s?

$\vec{v}$ = 24 m/s [S]

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Important Note:

To convert between km/h and m/s, the number 3.6 is key!

$$\frac{1\text{ km}}{1\text{ h}} = \frac{1000\text{ m}}{60\text{ min} \times 60\text{ s}} = \frac{1000\text{ m}}{3600\text{ s}} = \frac{1}{3.6}\text{ m/s}$$

To convert from km/h to m/s, divide by 3.6.

$$\frac{1\text{ m}}{1\text{ s}} = \frac{0.001\text{ km}}{\frac{1}{3600}\text{ h}} = 3.6\text{ km/h}$$

To convert from m/s to km/h, multiply by 3.6.

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ex) A sound wave travels 2.0 x 10^1 km [W] in 1.00 minute. What is the velocity of sound (in m/s)?

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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?

ex) What distance could light travel in one year?

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HW: pg 178 #4 and pg 185 # 1-5

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