Physics 20 Unit A - Kinematics

Intro to Kinematics: Scalars, Vectors and Uniform Motion

Velociraptor = Distraptor / Timeraptor

POS Checklist

- ☐ define, qualitatively and quantitatively, displacement, velocity and acceleration
- ☐ define, operationally, and compare and contrast scalar and vector quantities

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.

B) Vector Quantities: have both magnitude and direction.

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

Some Typical Vectors:

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

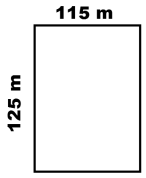
Velocity: speed with direction included; the rate of change of an object's position.
Symbol: $\vec{v}$

The little arrow on top of the symbols is called a vector arrow or a

harpoon! $\vec{v}$

You must place it on top of all vector quantities!

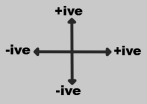
ex) _____ takes his/her pet _____ out for a walk around the block.



a) What is the distance traveled?

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."

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

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

The Uniform Velocity Formula

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

Where:

$\vec{v}$ = velocity*
$\Delta\vec{d}$ = change in displacement
Δt = change in time

*Note: the Δ is the Greek symbol delta meaning "a change in".

*This is sometimes referred to as "average velocity", $\vec{v}_{ave}$.

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

$$\Delta d = d_2 - d_1$$

$$\Delta t = t_2 - t_1$$

Now, let us apply our velocity equation:

ex) A train 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?

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.

Write this on your data sheet and memorize it!

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

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 3.00×10^{8} m/s?

ex) What distance could light travel in one year?

Onto Graphing!
(next lesson)