AP Physics 1

Summer Vocabulary Ramp Up

Purpose

- The purpose of this document and to get you up to speed on some of the vocabulary that we will use throughout the year.

- We will begin working with these terms early in the year in lab based scenarios, so an understanding of the terms will go a long way in eliminating some frustrations.

Scalar vs. Vectors

- Scalars
  - Any quantity that has a magnitude but no direction.
  - Magnitude is a fancy way of saying amount.
  - If a question ask for magnitude, we want to know "how much."

Examples of Scalars:

- Mass (10 kg)
- Time (45 s)
- Speed (25 m/s)
- Distance (18 m)
- Energy (500 J)

A scalar example

- A person walks west for 4 meters and then directly north for 3 meters.
  - The distance traveled by this person is 7 m.
  - Since distance is a scalar direction does not matter; it's just a continual measure for how far the person has moved.

Vectors

Vectors are quantities that have both magnitude and direction.

- Directions are usually referred to as positive and negative.
- Angles may also be used to describe directions.
- Special rules are used to add vectors together.

Examples of Vectors:

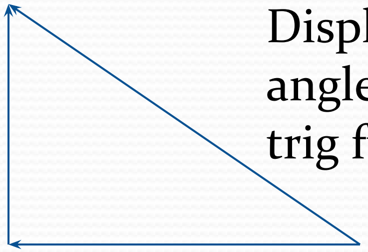
- Velocity (10 m/s, N)
- Acceleration (4 m/s^2 down)
- Force (35 N @ 45^o)
- Momentum (70 kg*m/s in the positive direction)
- Displacement (10 m, left)

Adding vectors

- Since vectors are direction dependent they must be added using vector addition rules. You will get more detail on this later, but here's a quick example using displacement.
- A person walks west for 4 m and then directly north for 3 m. The person's displacement is …… 5 m
- Vector addition compiles all horizontal quantities together independent of the vertical quantities. All vertical quantities are compiled independent of the horizontal.

Adding vectors

- So how do we combine the independent horizontal and vertical quantities?
  - Using the Pythagorean theorem. Since we isolate all of our quantities to a particular axis we will always form a resultant triangle that is a right triangle.



3 m north

Displacement 5 m at some angle we will identify with trig functions

4 m west

How does displacement differ from distance?

- Displacement compares the final and initially positions of an object; path taken does not matter.
  - Refer back to the triangle example on the previous slide. The person started at the right corner of the triangle (initial position) and ended at the top corner (final position). What happened in between does not matter is displacement is a straight line comparing these positions.

Displacement

Displacement (x or y) *"Change in position"*

It is not necessarily the total distance traveled. In fact, displacement and distance are entirely different concepts. Displacement is relative to an axis.

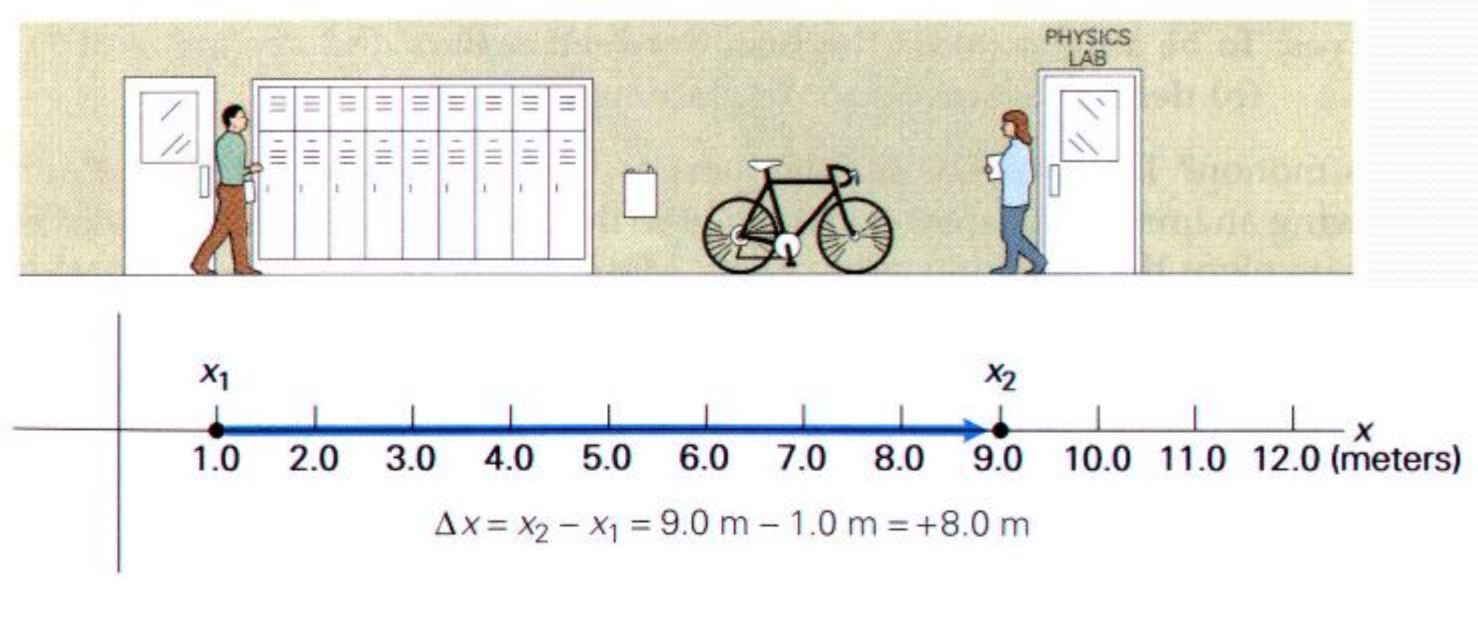
- "x" displacement means you are moving horizontally either right or left.
- "y" displacement means you are moving vertically either up or down.
- The word ***change*** is expressed using the Greek letter **DELTA (Δ)**.
- To find the ***change*** you ALWAYS subtract your **FINAL - INITIAL** position
- It is therefore expressed as either $\Delta x = x_f - x_i$ or $\Delta y = y_f - y_i$

Distance - How far you travel regardless of direction.

Distance is always greater than or equal to the displacement.

Example

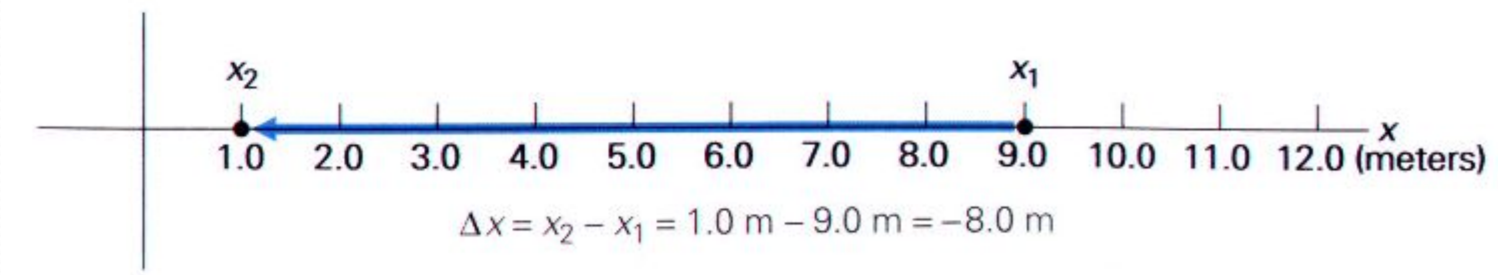
Suppose a person moves in a straight line from the lockers(at a position x = 1.0 m) toward the physics lab(at a position x = 9.0 m) , as shown below



The answer is positive so the person must have been traveling horizontally <u>to the right.</u>

Example Continued

- **Suppose the person turns around!**



The answer is negative so the person must have been traveling horizontally <u>to the left</u>

What is the *DISPLACEMENT* for the entire trip?

$$\Delta x = x_{final} - x_{initial} = 1.0 - 1.0 = 0m$$

What is the total *DISTANCE* for the entire trip?

$$8 + 8 = 16m$$

Velocity

- The rate at which an object's displacement changes.
  - Anytime we have a rate it is time dependent

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_{final} - x_{inital}}{t_{final} - t_{initial}}$$

- Vector that describes how fast (speed) an object moves in addition to its direction.
  - (-) velocity does not mean slow; it indicates a specific direction for the motion.
  - The direction of velocity will always match the direction of displacement.

Velocity

- A note about the equation on the previous slide:
  - It is only a useful equation if the object moves with a constant velocity, or we are dealing with an average velocity. More to come on this later in class ....

What about speed?

- Speed is how fast or slow something is moving but it's a scalar so direction is meaningless.

- Speed is the distance traveled over the time interval.

$$\bar{s} = \frac{\Delta d}{\Delta t}$$

Acceleration

- Acceleration is the rate at which an object's velocity changes.
  - Acceleration does not indicate how fast or slow something is moving.
  - It only describes how quickly or how slowly an object's motion is changing.
  - Acceleration includes any change in motion including: an increase in velocity (speeding up), a decrease in velocity (slowing down), or a change in direction.

Acceleration

- The average acceleration can be found using

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_{final} - v_{initial}}{t_{final} - t_{initial}}$$

- This equation holds true for constant accelerations and will be used to derive other equations in class.

Constant Velocity vs Constant Acceleration

- These are often confused as the same thing, but think back to the individual definitions of velocity and acceleration.

- A constant velocity simply means the velocity is not changing.
- If the velocity is not changing then the acceleration is zero. The object is moving but there is no change to its motion.

Constant velocity vs constant acceleration

- Constant acceleration implies that the object's motion is changing at the same rate.
  - Velocity is increasing, decreasing, or changing directions at a constant rate.
  - The object speeds up, slows down, or changes direction in equal increments over time.

Using directions to determine speeding up vs slowing down

Quantity	Positive	Negative
Displacement	You are traveling north, east, right, or in the +x or +y direction.	You are traveling south, west, left, or in the –x or –y direction.
Velocity	The rate you are traveling north, east, right, or in the +x or +y direction.	The rate you are traveling south, west, left, or in the –x or –y direction.
Acceleration	Your velocity(speed) is increasing in a positive direction or your speed is decreasing in a negative direction.	Your velocity(speed) is decreasing in a positive direction or your speed is increasing in a negative direction.

More on the (+) and (-)

- Velocity will always agree with displacement.

- If velocity and acceleration agree, then the object speeds up.
  - A negative acceleration doesn't necessarily mean the object is slowing down. An object moving to the left (-) direction with a (-) acceleration is speeding up.
- If the velocity and acceleration disagree, then the object slows down.

Force

- Any interaction that can change or maintain an object's motion.
- Forces are the cause of all accelerations.