

## Solving Problems

In physics, you will often be presented with a situation and asked to come up with a solution, there are several steps that will make this process easier:

1. Read the entire situation.
2. Underline or highlight any numbers or clue words (rest, stop...)
3. Make a sketch or diagram of the situation
4. List the given variables.
5. List the unknowns - what are you trying to find?
6. If an equation is required, choose one with:
  - a) all of your given and unknown variables
  - b) does not contain other variables
7. Substitute your variables into the equation and solve.
8. Check your answer for reasonableness and make sure you use the correct units.

## Equations for 1-dimensional motion :

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

\*can only be positive



units  $\frac{\text{meters}}{\text{second}}$   
or  $(\text{m/s})$

$$\text{Average velocity} = \frac{\text{displacement}}{\text{time}}$$

\*can be negative or positive



units  $\frac{\text{meters}}{\text{second}}$   
or  $(\text{m/s})$

$$\text{Displacement} = \text{final position} - \text{starting position}$$

$$\Delta x = x_f - x_i$$

units (meters)  
or (m)

\*can be negative  
or positive

$$\text{Average acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$\bar{a} = \frac{\Delta v}{t}$$

\*can be  
negative or  
positive

units  $\frac{\text{meters}}{\text{second}^2}$   
or  $(\text{m/s}^2)$

## How to Graph Data

You will often be asked to generate graphs, especially of lab data.

### Steps to a Quality Graph:

1. Use graph paper - free-hand ~~graphs~~ graphs will not be accurate. Graph paper is required and will be available in the room.
  - any graph turned in not on graph paper will receive a zero.
2. Label Everything - You need to include a descriptive title, axis labels (with units), and label each line if you have more than one.
3. Make it the right size - Make sure your data is graphed as large as possible in the space you have. You will be drawing conclusions from the graph, ~~and it will be reading it~~
4. Don't play connect-the-dots - After you plot your points, you will draw a best fit line or curve near the points. Why? In Physics, you are measuring the real world. Your measurements of the real world aren't going to be perfect. Drawing a best fit line minimizes the error from each measurement so your overall result is as accurate as possible

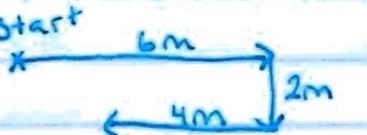
## Unit 2- 1D motion

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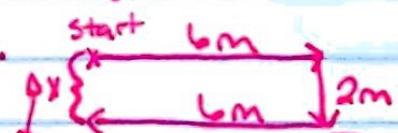
### Distance, Displacement, position

Position is an object's location relative to a starting point. \*Can be negative or positive\*  
ex. the box is 2m left of the door.

Distance is the change in position relative to a reference point - how far you have traveled. \*Distance is always positive\*

Ex.  distance:  $6\text{m} + 2\text{m} + 4\text{m}$   
 $= 12\text{m}$

Displacement is the distance between your starting and ending points. \*Can be positive or negative\*  
Direction is always included.

Ex.  displacement =  $6\text{m right} + 2\text{m down}$   
 $+ 6\text{m left}$   
displacement =  $2\text{m down}$  or  $-2\text{m}$

Direction is relative to the starting position

#### positive directions

up ↑

Right →

North

East

#### Negative directions

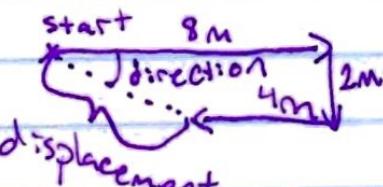
down ↓

left ←

South

West

If the final position is at an angle to the original position, the angle is the direction.

Ex.  displacement

## Unit 2- 1D motion

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### Instantaneous and Average Speed

Speed is how fast an object is moving.

Instantaneous Speed is how fast an object is moving at a specific instant

Ex. A Police officer uses a radar gun to measure instantaneous speed.

Average Speed is the total distance traveled over the total time it took. Average speed ~~never~~ does not show any changes in speed.

\* speed is always positive.  
Ex. A person walks 2 km, stops at a friend's house for 3 hours then walks 2 km back home.

If they left at 10am and got back at 4pm their average speed is  $4 \text{ km} \div 6 \text{ hr}$  or  $0.67 \text{ km/h}$

Velocity is displacement over time.

$$\bar{v} = \frac{\Delta x}{t}$$



$\bar{v}$  = average velocity (m/s)  
 $\Delta x$  = displacement (m)  
 $t$  = time (s)

\* velocity can be negative or positive

\* velocity must have a direction

Constant Acceleration

Acceleration is the \*rate of change of velocity

$$\bar{a} = \frac{\Delta v}{t}$$

$\bar{a}$  = average acceleration ( $m/s^2$ )  
 $\Delta v$  = change in velocity ( $m/s$ )  
 $t$  = time (s)

\* Acceleration can be  
negative or positive

3 causes for acceleration:

1. Speeding up
2. Slowing down
3. Changing direction

If an object is speeding up, acceleration and velocity have the same direction!

positive direction

$$a \rightarrow$$

$$v \rightarrow$$

negative direction

$$\leftarrow a$$

$$\leftarrow v$$

If an object is slowing down, acceleration and velocity have opposite directions!

$$a \rightarrow$$

$$\leftarrow a$$

$$\leftarrow v$$

$$v \rightarrow$$

\* The car will be moving in the direction of the velocity \*

Kinematic Equations are used to describe motion with constant acceleration.

$$1. a = \frac{(V_f - V_i)}{t}$$

$$2. \Delta x = V_i(t) + \frac{1}{2} a t^2$$

$$3. V_f^2 = V_i^2 + 2 a \Delta x$$

$$4. \Delta x = \frac{(V_i + V_f)}{2}(t)$$

## Falling Objects

Objects that fall near the surface of Earth  
 ➔ have an acceleration due to gravity of  $-9.81 \text{ m/s}^2$ . \*The negative is because they go in the negative direction (down).

Free-Fall is when an object is moving and the only force acting on it is gravity.

Objects that Drop Straight down:

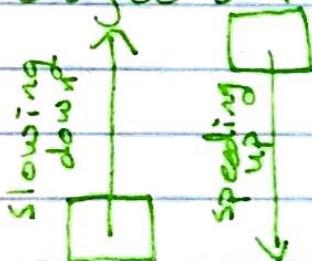


$$V_i = 0 \text{ m/s} \text{ (no initial velocity down)}$$

$$a = -9.81 \text{ m/s}^2 \text{ (due to gravity)}$$

$V_f$  = velocity just before it hits the ground

Objects that are thrown upward:



$$V_i \neq 0 \text{ m/s} \text{ (it has initial velocity upward)}$$

$$a = -9.81 \text{ m/s}^2 \text{ (due to gravity)}$$

Velocity at the top is  $0 \text{ m/s}$

$$V_i = V_f \text{ if caught at initial height}$$

\*Air resistance is ignored unless otherwise stated.

- This might still be a cause of error in an experiment

Time to top = Time back to bottom

if the object is caught at the initial launch height

what effect will air have on a falling body?