Physics

Introduction Review

Units

- Numerical answers do not mean anything unless they are labeled in proper units
- All answers must be labeled in proper units
- We will use different units for 3 primary diff. Types of measurements
  - Length
  - Time
  - mass

Length, Time, & Mass

- Each of these diff types of measurements has many different units
  - Ex. For Length…
    - METRIC---- Meter (m), centimeter (cm), kilometer (km)
    - Standard---- Foot (ft), yard (yd), mile
  - Ex. For time
    - Sec. (s), min (min), hour (hr), year (yr)
  - Ex. For mass…
    - METRIC
      - **Kilogram** (kg), gram (g), milligram (mg)
    - Standard
      - Pound (lb), ton (tn)
- Will almost always use Metric units, …. Standard units will only pop up once and awhile
- Will not have to do much converting of units in this class, but still need to be familiar with different units

Converting Units

SI Base Units--- the standard unit a quantity is measured in

Quantity	Base Unit	Symbol
Length	Meter	m
Time	Second	s
Mass	Kilograms	Kg**

Metric Prefixes- smaller or bigger divisions of base units

Name	Symbol	How it relates to base unit	From prefix to base	From base to prefix
Kilo-	k	x 1000	3 to right	3 to left
Base Unit		x 1		
Centi-	cm	x 1/100	2 to left	2 to right
Milli-	m	x 1/1000	3 to left	3 to right
Micro-	µ	X 1/1,000,000	6 to left	6 to right
Nano-	n	X 1/1,000,000,000	9 to left	9 to right

Examples of Converting units

Name	Symbol	How it relates to base unit	From prefix to base	From base to prefix
Kilo-	k	x 1000	3 to right	3 to left
Base Unit		x 1		
Centi-	cm	x 1/100	2 to left	2 to right
Milli-	m	x 1/1000	3 to left	3 to right
Micro-	µ	X 1/1,000,000	6 to left	6 to right
Nano-	N	X 1/1,000,000,000	9 to left	9 to right

- 1.2 mm = .0012 m
- 25 km = 25,000 m
- 13 g = .013 kg
- 5.43 kg = 5,430,000 mg
- 13.4 mm = _____m
- 35 kg =_____ g
- 490 g = _____kg

- ** Note-- Units for Time do not use prefixes… sec, min, hrs, days, years ……. Are units for time……
  - You should be able to convert between these fairly easily
    - 60 s = 1 min 60 min = 1 hr 24 hr =1 day 365 day = 1 yr
  - Ex. 120 sec = 2 min
    - 210 min = 3.5 hours

Derived Units

- Any unit that is derived from base units
- All other units are formed from the base units on the previous page
  - Examples
    - m/s ….. (meters per second) ….. Unit for speed
    - m/s^2 …… (meters per second squared) …… unit for acceleration
    - Kg m/s (kilogram meters per second) ……. Unit for momentum

Scientific Notation

- used to express very large or very small numbers
- to express a number in **scientific notation**, rewrite the actual numbers of the problem as a number between 1 and 10 and multiply it by 10, to a certain power.
- takes the form: $M \times 10^n$
- The power to which 10 is raised is how many places the decimal is being moved.
  - If the power is negative, move to the left
  - if the power is positive, move to the right.
- $314{,}000 \text{ kg} = 3.14 \times 10^5 \text{ kg}$
- $227{,}800{,}000{,}000 \text{ m} = 2.278 \times 10^{11} \text{ m}$ (the distance from Mars to the sun)

- Calculator tip: to easily use scientific notation in your calculator, use the E button, which represents what the number is being multiplied by. If you write "6E4," your calculator will read this as being 6 x 104.

Scientific Notation

- Ex 1.2×10^{8} m = 120,000,000 m
  - We moved the decimal place over 8 places to the RIGHT since the exponent was POSITIVE 8
- Similarly…. Ex. 2 3.75×10^{-5} s = .0000375 s
  - We moved the decimal place over 5 places to the LEFT since the exponent was NEGATIVE 5

Significant figures

- It is important to not use more digits than you actually know, when you make a measurement. **Significant figures –are digits that are "significant," or actually valid. Every number should transmit information. To do this only record significant digits…… Sig Figs are *digits that were actually measured*.**
- http://video.google.com/videoplay?docid=-8711497301438248744

What digits are significant?

- **THE RULES:**
  - **1. All nonzero digits are significant.**
  - **2. All final zeroes after the decimal point are significant.**
  - **3. Zeroes between two other significant digits are significant.**
  - **4. Zeroes used solely as placeholders are not significant.**

Examples

- *Consider the following examples.*
  - 245 m 10.0 g 308 km 0.00623 g
  - Each has 3 sig figs…. No more no less

How many do each of the following have?

.003 kg

2.00 m

3400 km

505.0010 g

Math with Sig. Figs…

- **Sig Fig Rule for Adding/Subtracting**
  - When you add/subtract numbers together, your answer should have only as many decimal places as the **least amount of decimal places in the problem. In other words… take the decimal of the least precise measurement involved.**

  - ex. 15.691mm + 2.2 mm = **17.9 mm *even though the calculator answer would be 17.891 mm***

Math with Sig. Figs…

- **Sig Fig Rule for Multiplying/Dividing**
  - When you multiply/divide numbers together, your answer should have only as many significant figures as the **least amount of significant figures in the problem. Only take the significant digits of the least precise measurement.**

  - ex. 3.561 cm x 2.0 cm = 7.1cm

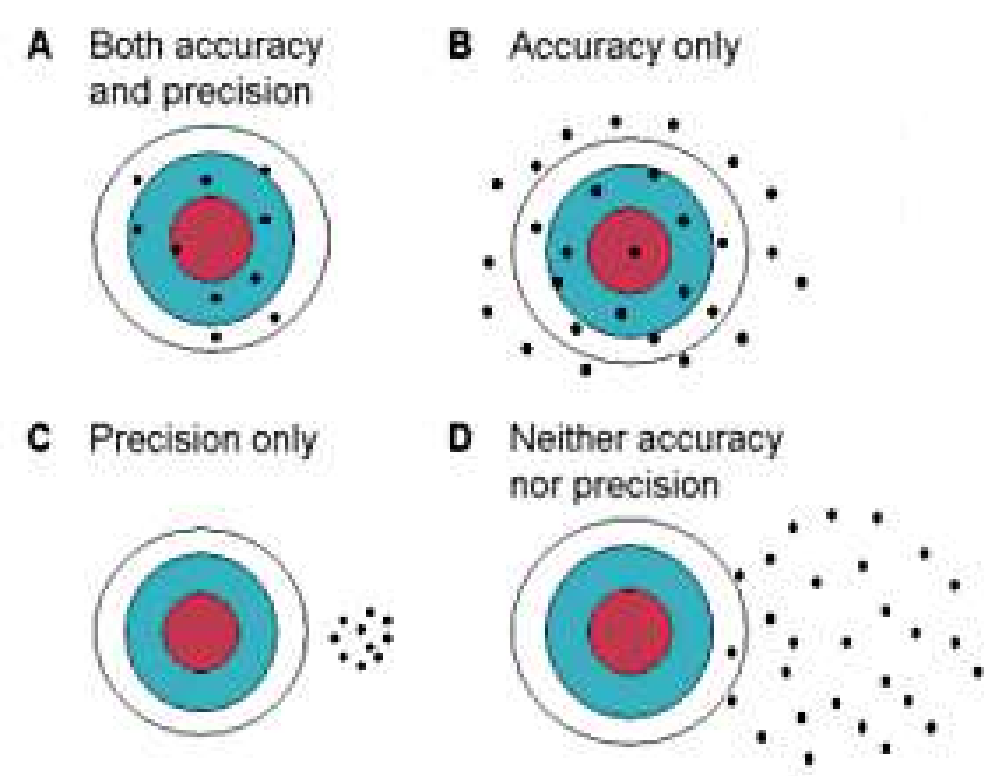
even though the calculator answer is 7.122 cm

Problems

- 22.37 cm x 3.10 cm x 85.75 cm =
  - 5.95×10^3 cm^3
- 3.76 g + 14.83 g + 2.1 g =
  - 20.7 g.
- How many sig figs. in these numbers?
- 22.070 = _
- 3.10 = _
- 0.0750 = _
  - Answers
    - 5, 3 , 3

Accuracy and Precision

- - **Accuracy** describes how well the results agreed with the standard or accepted values or outcomes.
- - **Precision** describes how well the results agreed with each other.

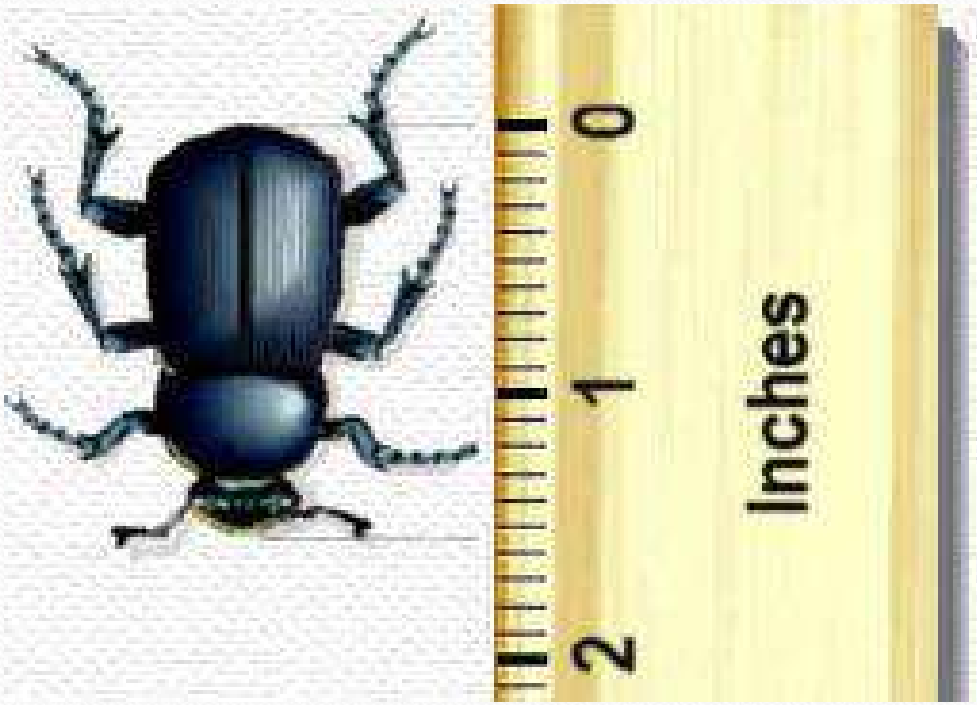


Identify these lab results as accurate, precise, both, or neither. The accepted value is 10 kg.

- Group A: 2.1, 8, 17.8, 27.12, 29.9, _____
- Group B: 9.8, 10, 12.1, 11.2, _____
- Group C: 10, 10, 10, 10.5 _____
- Group D: 8.2, 8.4, 8.5, 8.7 _____
- **Answers**
- Group A: neither
- Group B: accurate
- Group C: both
- Group D: precise

Making Measurements

- ****When taking measurements, all data should be recorded to 1/10$_{th}$ the smallest division on the measuring scale.****



This measurement should be recorded as 1. 54 inches…. With the last decimal place being estimated . Could also be estimated to be 1.55 in , 1.53 in….etc.

Graphing

- **Independent Variable**
  - Manipulated variable … what experimenter is in control of
  - Always on x axis
  - Time (t) will almost always be on the x-axis

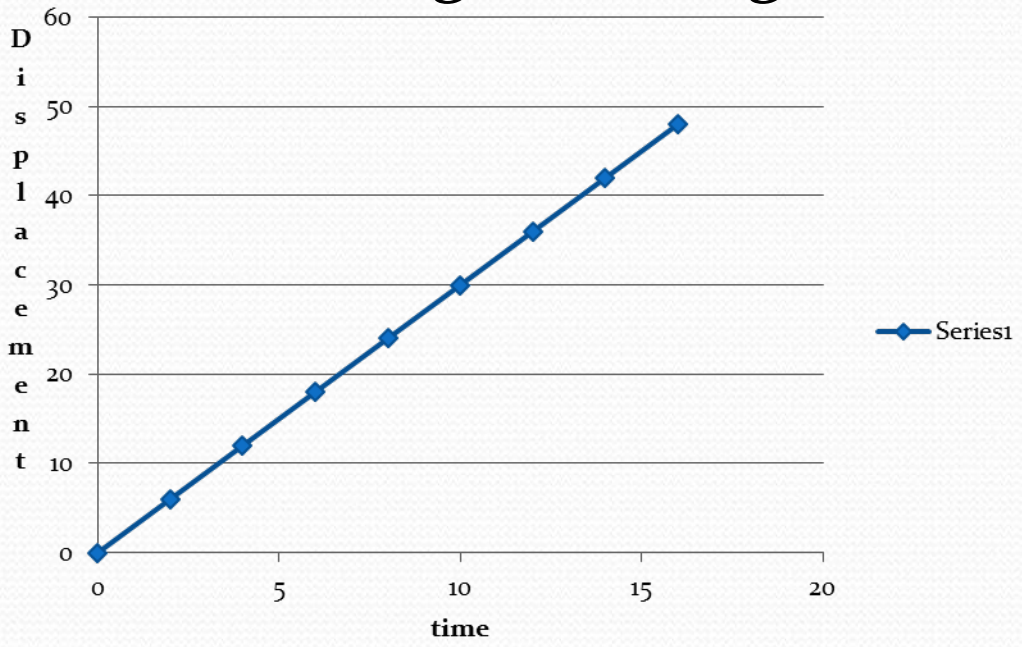
- **Dependent Variable**
  - Responding Variable … what responds to the change in the independent variable
  - Always on y axis

Mathematical Relationships-

- *Certain relationships always exist between certain variables. A large part of physics is understanding and examining these relationships between different physical quantities.*
  - *** Remember--- If y and x are our two variables then the 'y' is always the response to whatever 'x' does
  - In other words, 'y' is a function of 'x'.
- However, in real physics problems these will not always be x's and y's , you will need to determine what is your 'x' and what is your 'y'

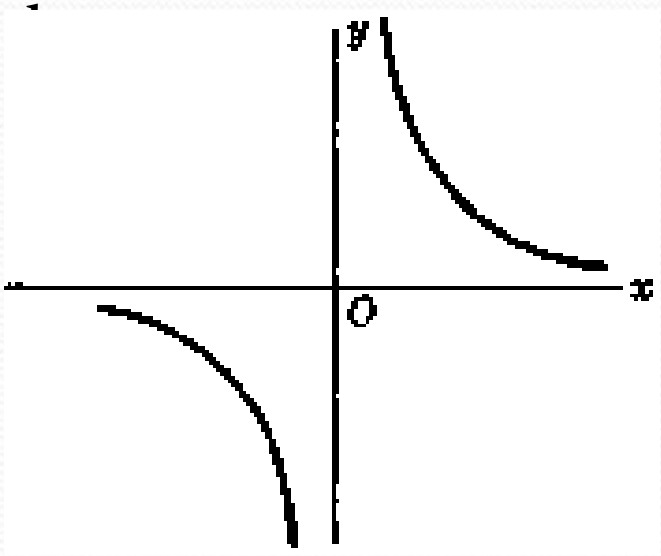
Linear Relationship

- y = mx + b
- The two variables are directly proportional
- m - Slope—rise/run = change in y/ change in x
  - For linear relationship the Slope more specifically tells the relationship between x and y
- y-intercept (b) ……Point at which the line goes through the y-axis



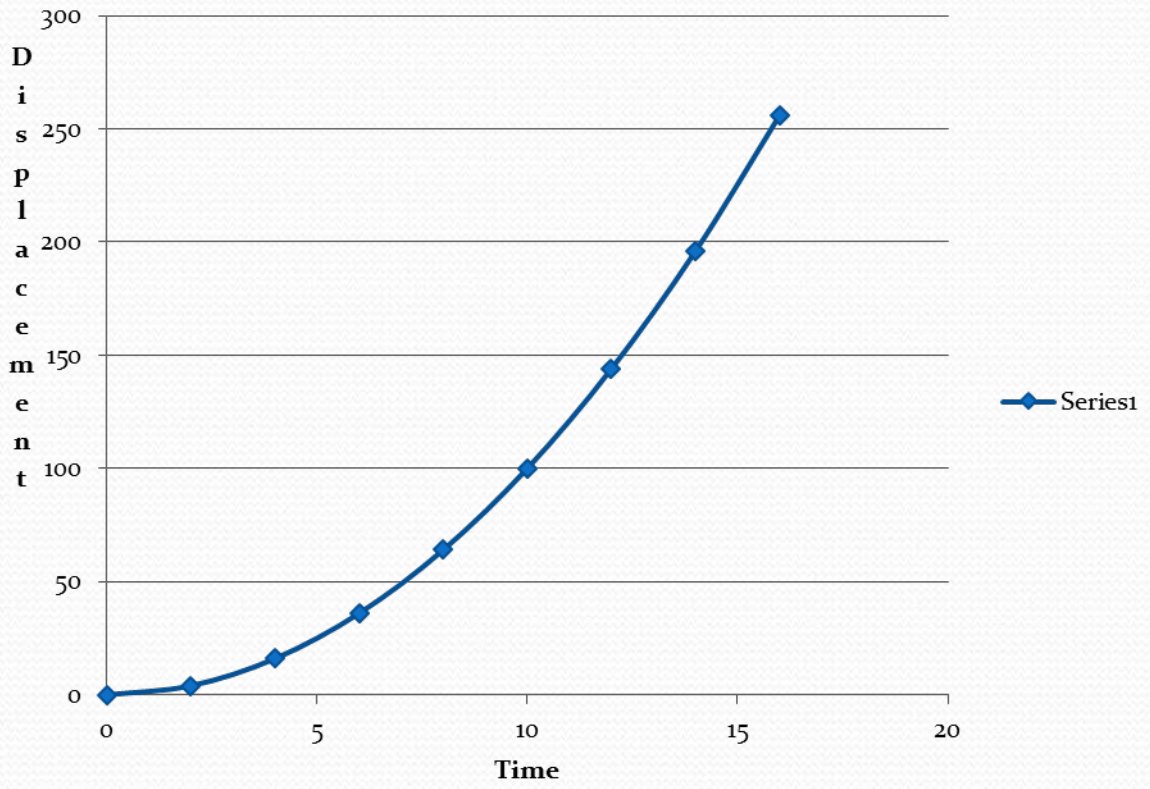
Inverse Relationship

- $y = a/x$ hyperbola
- The variables x and y are inversely related to each other
- As one goes up, the other goes



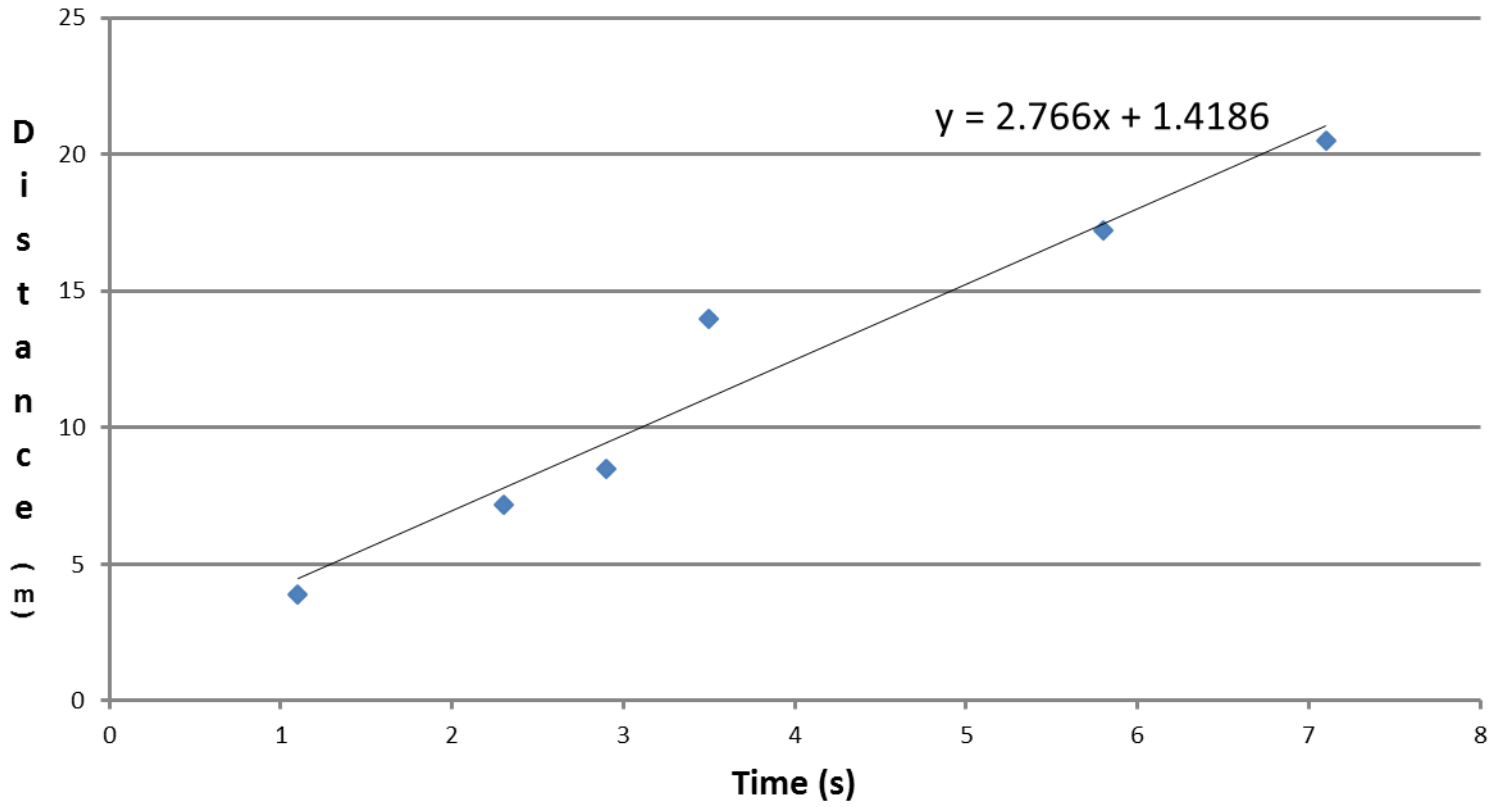
Quadratic Relationship

- $y = ax^2 + bx + c$ Parabola
- This is a square relationship
- y is proportional to x^2



- Interpolate
  - Predicting an unknown data point within the range of the a known (experimented) data set
- Extrapolate
  - Predicting an unknown data point outside of the range of a known data set
  - For Both we use a trend (usually an equation from that trend) established from known data set to predict unknown data points, inside or outside of known range

Graph of a the motion of a bike.



- **Extrapolate** - On the above graph how far will the bike have gone after 15 seconds?
  - Insert 15 sec in for 'x' in the equation and solve for 'y'. Since distance is the 'y' value and time is the 'x' value on the graph 'x' and 'y' represent 'time' and 'distance', respectively.
- **Interpolate** – On the above graph how far did the bike go after 5 seconds?
  - Similarly insert 5 sec into the equation for 'x' and solve for 'y'. Again 'y' represents 'distance' and 'x' represents 'time' BECAUSE time is on the x axis of the graph and distance is on the y axis of the graph.