Welcome to AP Physics 1

Mr. Allan

What's AP Physics all about?

- 2 Semester, algebra-based physics course, equivalent to a 1st semester college physics class
- At least 25% of time spent in lab - need to keep a "lab notebook"
  - Ruler/Straight Edge
  - Calculator
- Course description and details found on **AP Classroom** (Code: **XEX7Q7**)
  - **Mrallansciencegfc.com**
- Focus will be on group work, inquiry, and developing understanding together

AP Physics 1 Test

Section 1 - MCQs:
- 50 multiple choice questions
- 1 hour 30 minutes
- 50% of test score

Questions are either discrete questions or question sets, in which students are provided with a stimulus or a set of data and a series of related questions.

Multi-select questions: 5 of the 50 questions have two correct answers - must choose both to get it right

Section 2 - FRQs:
- 5 free response questions
- 1 hour 30 minutes
- 50% of test score

Question Types:
- Experimental Design (1)
- Qualitative/Quantitative Translation (1)
- Short Answer: Paragraph Argument (1)
- Short Answer (2)

Suggested timing will be given

Course Outline

Unit 1 – **Kinematics in 1 and 2 Dimensions**
- Measurements; Velocity; Acceleration; Vectors
- 16 – 19 days
- 12-18% AP Exam Weighing

Unit 2 – **Dynamics**
- Forces; Newton’s Laws; Friction and Dynamics
- 21-24 days
- 16-20% AP Exam Weighing

Unit 3 – **Circular Motion and Gravitation**
- Uniform circular motion/dynamics; Gravity
- 8 – 10 days
- 6 – 8% AP Exam Weighing

Course Outline

Unit 4 – **Energy and Conservation of Energy**
- Work; Power; Kinetic Energy; Potential Energy
- 22 – 25 days
- 20 – 28% AP Exam Weighing

Unit 5 – **Momentum**
- Impulse; Momentum; Collisions, Conservation of Momentum
- 14 – 17 days
- 12 – 18% AP Exam Weighing

Course Outline

Unit 6 – **Simple Harmonic Motion**
- SHM; Graphing of SHM; Simple Pendulum; Springs
- 4 – 7 Days
- 4 – 6% AP Exam Weighing

Unit 7 – **Rotational Motion, Torque, and Angular Momentum**
- Torque; Rotational Quantities
- 14 – 19 Days
- 12 – 18% AP Exam Weighing

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 different types of measurements
  - Length
  - Time
  - mass

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
Kilo-	k	x 1000
Base Unit		x 1
Centi-	cm	x 1/100
Milli-	m	x 1/1000
Micro-	µ	X 1/1,000,000
Nano-	n	X 1/1,000,000,000

SI Units

- **Base Units**

Base SI Units

- *Le Systéme Internationale* (SI) units are standard in science

Quantity	*Base Unit*	*Symbol*
length	meter	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K

- **Derived Units**
  - Built from base SI units

Derived Units

- built from base SI units

area	length x length	m^2
velocity	length/time	m/s
density	mass/volume	kg/m^3

- Example: *Give derived units for force and for energy.*

Dimensional Analysis

The Dimensional Analysis method was developed to:

- Can change one set of units to another
- Equalities (i.e., conversion factors) are set up in fraction form
- Equalities lined up sequentially and units used on the top and bottom of neighboring fractions are alternated so that units cancel

Two steps to problems:

Step 1: State the given quantity (number and units) and unknown

Step 2: Start with what you know

Factor Label Example

55.0 km/hr = ? m/s

1 km = 1000m

1 hr = 60 min

1 min = 60 sec

- Must cancel units
- Must show units
- Box answer

$$\left(\frac{55.0\ \text{km}}{1\ \text{hr}}\right)\left(\frac{1000\ \text{m}}{1\ \text{km}}\right)\left(\frac{1\ \text{hr}}{60\ \text{min}}\right)\left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = \boxed{15.3\ \text{m/sec}}$$

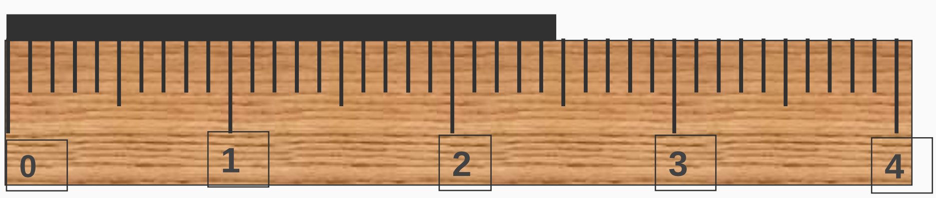
Significant Figures

Certain → 2.4 | Guess → 7

2.47

All three numbers are important.

There are three "Significant Figures".



Significant Figure Rules

Nonzero integers always count as sig figs
- 3456 has 4 sig figs

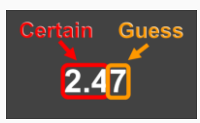
Leading zeros do not count as sig fig
- 0.0486 has 3 sig figs

Captive zeros always count as sig fig
- 16.07 has 4 sig fig

Trailing zeros are only significant only if the number contains a decimal point
- 9.300 has 4 sig fig
- 9300 has 2 sig fig

2.47 kilometers
3 sig figs

8.2 millimeters
2 sig figs



2,470 meters
3 sig figs

0.0082 meters
2 sig figs

2,470,000 millimeters
3 sig figs

0.0000082 kilometers
2 sig figs

Zeros are NOT “significant” when they are merely place holders.

Sig Fig Rules

Multiplication & Division

- The value with the fewest sig figs determines the number of sig figs in the answer
- **Least amount**

6.38 x 2.0 = 12.76

= 13 (2 sig figs)

Addition & Subtraction

- The number of decimal places in the result equals the number of places in the least precise measurement
- **Least precise** (poorest measurement)

6.8 + 11.934 =18.734

= 18.7

$$\boldsymbol{How\ many\ \frac{mi}{hr}\ is\ 42.5\frac{m}{s}}?$$

$m \rightarrow km \rightarrow mi$

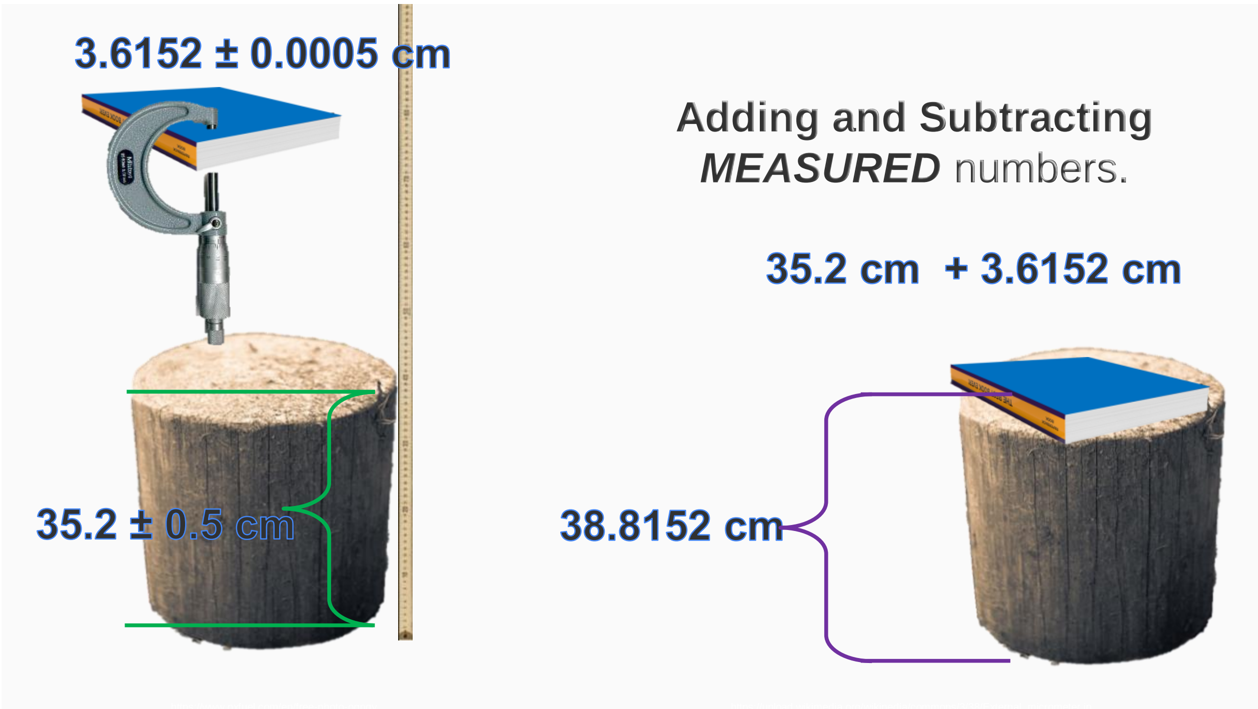
$s \rightarrow min \rightarrow hr$

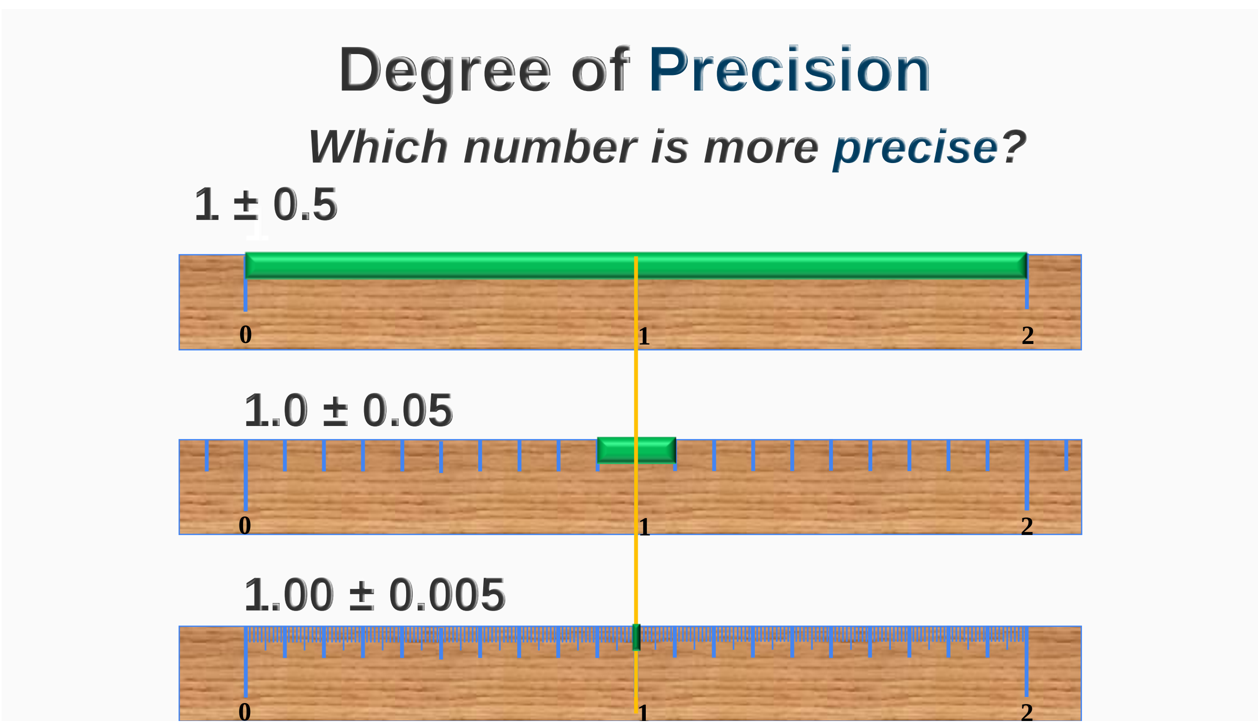
$$\frac{42.5\,m}{s}\ \frac{1\,km}{1000\,m}\ \frac{1\,mi}{1.609\,km}\ \frac{60\,s}{1\,min}\ \frac{60\,min}{1\,hr}$$

$$\frac{42.5 \cdot 60 \cdot 60\,mi}{1000 \cdot 1.609\,hr}$$

$$95.09011808576756\ \frac{\text{mi}}{hr}$$

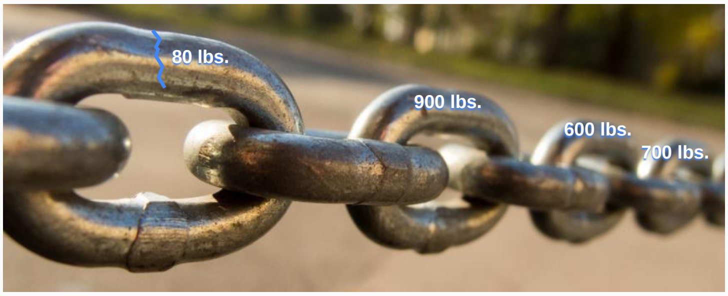
$$\mathbf{95.1}\,\frac{\text{mi}}{hr}$$


3.6152 ± 0.0005 cm
Adding and Subtracting
MEASURED numbers.
35.2 cm + 3.6152 cm
35.2 ± 0.5 cm
38.8152 cm


Degree of Precision
Which number is more precise?
1 ± 0.5
0
1
2
1.0 ± 0.05
0
1
2
1.00 ± 0.005
0
1
2

Adding and Subtracting MEASURED Numbers

A chain is only as strong as its weakest link!



= 5.21 - 0.083 + 87.5
= 92.627= 92.6

Using Scientific Notation to Properly Show Sig Figs.

256 x 39.0625 = 10,000

3 sig figs — 6 sig figs — 3 sig figs

$= 1.00 \times 10^4$

3 sig figs

Review Graphing

1. Identify the variables

Independent variable – X axis

Manipulated variable

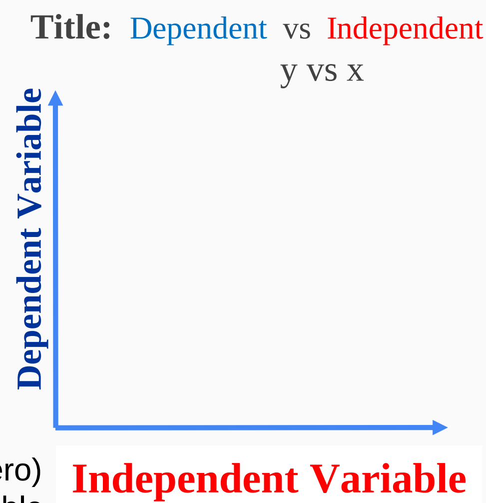
Factor adjusted by experimenter

Dependent Variable – Y Axis

Responding variable

Depends on the independent variable

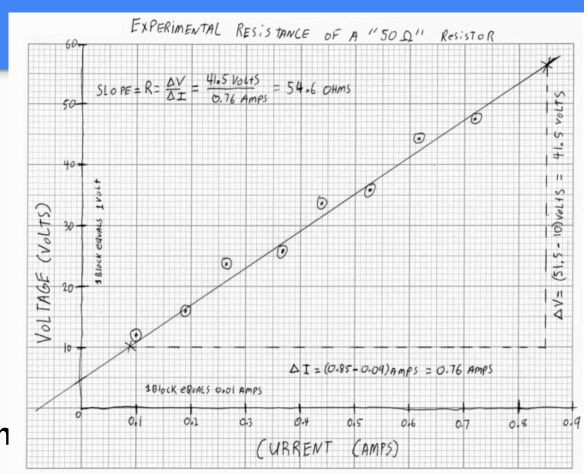
Variable that is expected to change



2. Determine the variable range

Subtract the lowest data value (usually zero) from the highest data value for each variable

Review Graphing



3. Determine the scale of the graph

Determine the numerical value for each grid unit that best fits the range of each variable

$\frac{\text{Range}}{\text{\# of Lines}}$ = round to 1, 2, 5, 10 etc

4. Number & label each axis and title

4. Determine the data points & plot on graph

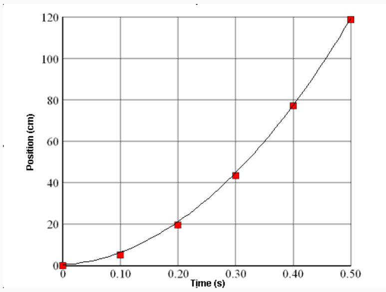
Don't use a small dot, it will get lost

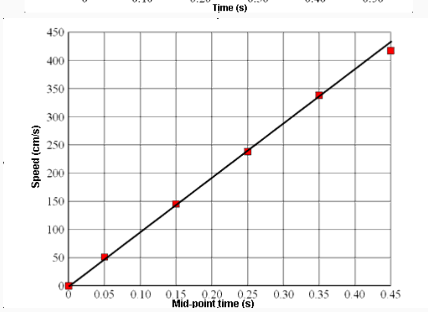
5. Draw the graph

Draw a curve or a line that best fits the data points. Do not connect the dots

Use a ruler or straight line

Scientific Graphs





- Most scientific graphs are made as **line** graphs. There may be times when other types would be appropriate, but they are rare.
- The lines on scientific graphs are usually drawn either **straight** or **curved**. These "smoothed" lines do not have to touch all the data points, but they should at least get close to most of them. They are called **best-fit lines**.
- In general, scientific graphs are not drawn in connect-the-dot fashion.

Reviewing Graphing

Independent variable – X axis

•Manipulated variable

•Factor adjusted by experimenter

Dependent Variable – Y Axis

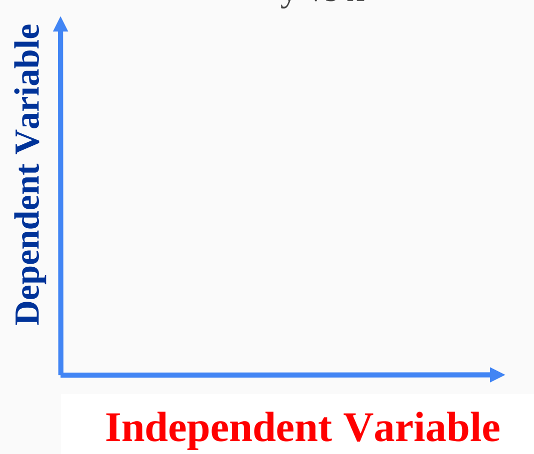
•Responding variable

•Depends on the independent variable

•Variable that is expected to change

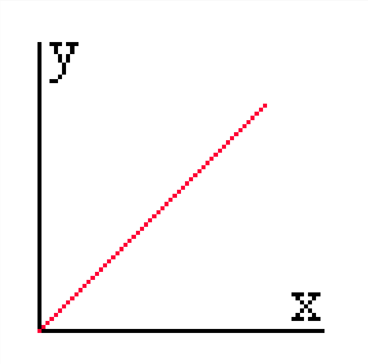
Title: Dependent vs Independent

y vs x



Directly Proportional and Inversely Proportional Graphs

Directly Proportional



As the **independent variable increases (X)**, the **dependent variable (Y)** increases as well.

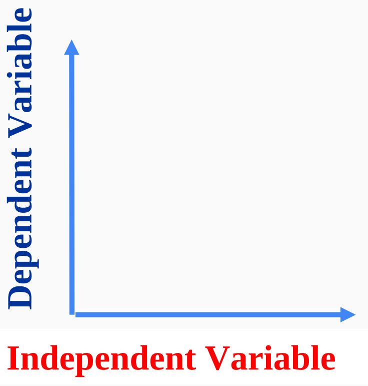
Inversely Proportional

As **the independent variable increases (x)**, the **dependent variable decreases (Y).**

How to Construct a Line Graph

1. **Identify the variables**
   - **Independent variable**
   - **Dependent variable**

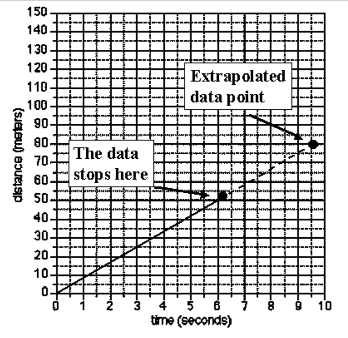
2. **Determine the scale of the Graph**
   - Determine **Range** – Highest value on data table minus lowest(or Zero)
   - Determine **Scale** (numerical value for each square) that best fits the range of each variable
   - Unless there's a good reason, plot from (0,0)
   - Choose easy to work with scales (multiples of 2,5,10) and make the graph as large as possible

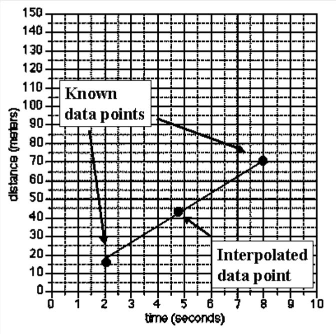


How to Construct a Line Graph

3. **Number and Label Each Axis**
   - This tells what the lines on your graph represent. Label each axis with appropriate units
4. **Plot the Data Points**
   - Make data points obvious. Small dots get lost.
5. **Draw the Graph**
   - draw a curve or line that best fits the data points.
6. **Title the Graph**
   - Your title should clearly tell what the graph is about
   - If your graph has more than one set of data, provide a key to identify the different lines.

Predicting Data on a Graph





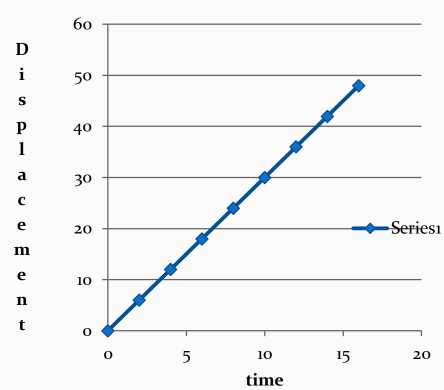
- Graphs are a useful tool in science. The visual characteristics of a graph make trends in data easy to see.
- One of the most valuable uses for graphs is to "**predict**" data that is not measured on the graph.
  - **Extrapolate**: extending the graph, along the same slope, above or below measured data.
  - **Interpolate**: predicting data between two measured points on the graph.

Interpolate vs Extrapolate

- **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

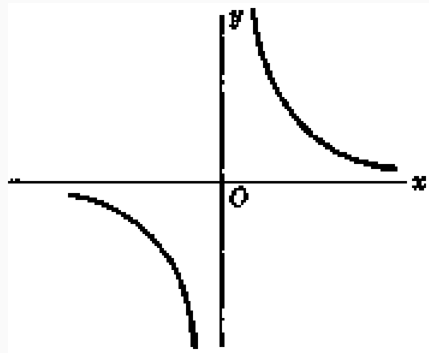
Linear Relationship

- y = **m**x + **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
- **b** - y-intercept - Point at which the line goes through the y-axis



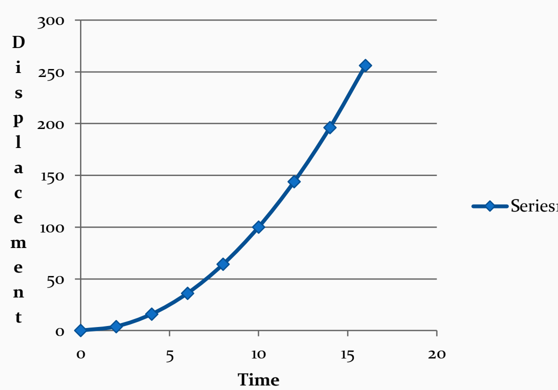
Inverse Relationship

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



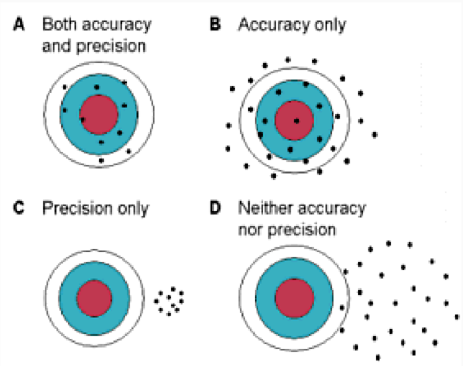
Quadratic Relationship

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



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.**



Extra- Uncertainty in Measurement

There are two kinds of numerical data: exact and inexact. Exact data are numbers that are known exactly. Inexact data are numbers that are not known and have a degree of uncertainty. When experiments are carried out, there will always be a degree of uncertainty. Uncertainty of measurement is the **doubt that exists about the result of a measurement**. There is always a margin of error for any instrument. Usually, the margin of error is expressed as +/-, which provides a range that the actual measurement falls within.

Laboratory glassware usually lists the uncertainty directly on the instrument. But just in case, the uncertainty of analog instruments (such as graduated cylinders & burets) is +/- half of the smallest division. The uncertainty of digital instruments (electronic balances, timers & thermometers) is +/- the smallest scale division.

Example: A stick that is 30 centimeters with an uncertainty of +/- 1cm means that the stick is actually between 29 and 31 centimeters long. Most electronic balances read to 0.01g, but others (ones used in precise analytical experimentation) read to 0.0001 or better.

Extra - 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'