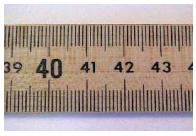
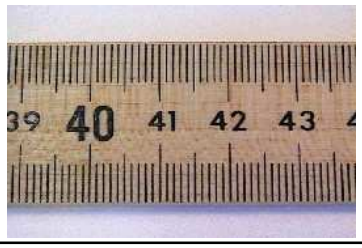
Units and Measurement

Chemistry
Ms. C



A) SI Units, Scientific Notation, Measurement, Accuracy, Precision, Error



Math and Units

- Math- the language of Science
- SI Units – International System
  - MKS
    - Meter m
    - Mass kg
    - Time s
- National Bureau of Standards
- Prefixes

SI Unit Prefixes

Name	Symbol	
giga-	G	10^{9}
mega-	M	10^{6}
kilo-	k	10^{3}
deci-	d	10^{-1}
centi-	c	10^{-2}
milli-	m	10^{-3}
micro-	μ	10^{-6}
nano-	n	10^{-9}
pico-	p	10^{-12}

Scientific Notation

$M \times 10^{n}$

- M is the coefficient $1<M<10$
- 10 is the base
- n is the exponent or power of 10

Other Examples:

5.45E6

5.45 x 10^6

Numbers less than 1 will have a negative exponent.

A millionth of a second is:

0.000001 sec	**$1x10^{-6}$**
1.0E-6	**1.0x10^-6**

Limits of Measurement

- Accuracy and Precision

- Accuracy - a measure of how close a measurement is to the true value of the quantity being measured.

Example: Accuracy

- Who is more accurate when measuring a book that has a true length of 17.0cm?

Susan:
17.0cm, 16.0cm, 18.0cm, 15.0cm

Amy:
15.5cm, 15.0cm, 15.2cm, 15.3cm

- Precision – a measure of how close a series of measurements are to one another. A measure of how exact a measurement is.

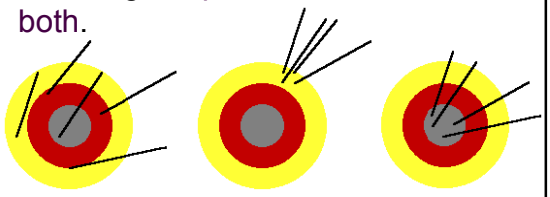
Example: Precision

Who is more precise when measuring the same 17.0cm book?

Susan:
17.0cm, 16.0cm, 18.0cm, 15.0cm

Amy:
15.5cm, 15.0cm, 15.2cm, 15.3cm

Example: Evaluate whether the following are precise, accurate or both.



Accurate	Not Accurate	Accurate
Not Precise	Precise	Precise

Error

Error= experimental –accepted value

Percent Error

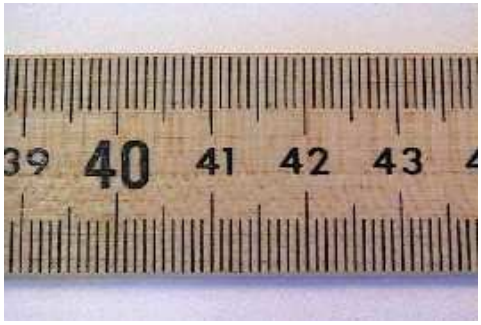
% Error= |experimental –accepted| x100
accepted value

B) Significant Figures

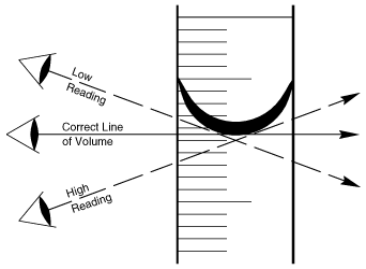
Significant Figures

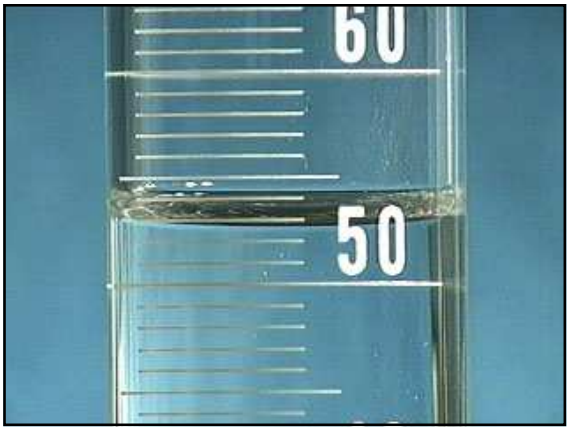
- The significant figures in a measurement include all of the digits that are known, plus one last digit that is estimated.

Centimeters and Millimeters



Graduated Cylinder - Meniscus





How many sig figs are there in a given measurement?

Sig Figs

- When the decimal is present, start counting from the left.
- When the decimal is absent, start counting from the right.
- Zeroes encountered before a non zero digit do not count.

How many sig figs?

100	10302.00
0.001	
10302	1.0302×10^4

Sig Figs in Addition/Subtraction

The result has the same number of decimal places as the number in the operation with the least decimal places.

Ex: 2.33 cm
+3.0 cm
5.3 cm

Sig Figs in Multiplication/Division

- The answer has the same sig figs as the factor with the least sig figs.
- Ex: 3.22 cm
  x 2.0 cm
  6.4 cm^2

Counting Numbers

- Counting numbers have infinite sig figs.
- Ex: 3 apples

C) International System of Units and Prefixes

Base SI Units

Quantity	Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Temperature	kelvin	K
Time	second	s
Amount of Substance	mole	mol
Luminous Intensity	candela	cd
Electric Current	ampere	a

Derived SI Units (examples)

Quantity	unit	Symbol
Volume	cubic meter	m^3
Density	kilograms per cubic meter	kg/m^3
Speed	meter per second	m/s
Newton	kg m/ s^2	N
Energy	Joule (kg m^2/s^2)	J
Pressure	Pascal ($kg/(ms^2)$)	Pa

Units for Volume

m^3

cm^3

dm^3

L Liter

mL

1 dm^3 = 1L

1cm^3= 1mL

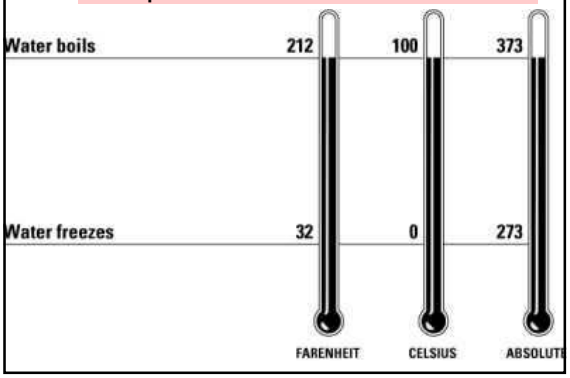
Temperature

A measure of how hot or how cold an object is.

SI Unit: the kelvin (K)

- Note: not a degree
- Absolute Zero= 0 K

Temperature Scales



Celsius and Kelvin

$K = {}^{o}C + 273$

Farenheit and Celsius

$^{o}F = (1.8\ ^{o}C) + 32$

Unit for Weight

1 Newton

$1\ N = kg\ m/s^2$

Units for Energy

- Joule J
- calorie 1 cal= 4.184 J

1 cal = quantity of heat needed to raise the temp of 1g of water by 1 ^{o}C.

Note:

1 Cal = 1kcal =1000cal

SI Unit Prefixes

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centi-	c	10^{-2}
milli-	m	10^{-3}
micro-	μ	10^{-6}
nano-	n	10^{-9}
pico-	p	10^{-12}

SI Unit Prefixes for Length

Name	Symbol		Analogy
gigameter	Gm	10^{9}	
megameter	Mm	10^{6}	
kilometer	km	10^{3}	
decimeter	dm	10^{-1}	
centimeter	cm	10^{-2}	
millimeter	mm	10^{-3}	
micrometer	μm	10^{-6}	
nanometer	nm	10^{-9}	
picometer	pm	10^{-12}	

D)
Factor Label Method of Unit Conversion-
Dimensional Analysis

Factor-Label Method

- Example: Convert 5km to m:

NEW UNIT

$5\text{km} \times \frac{1{,}000\text{m}}{\text{km}} = 5{,}000\text{m}$

OLD UNIT

Convert 7,000m to km

$7{,}000\text{m} \times \frac{1\ \text{km}}{1{,}000\text{m}} = \mathbf{7\ km}$

Convert 2.45cs to s

- 2.45cs x $\frac{1\ s}{100cs}$ = **0.0245s**

Convert 55.00 km/h to m/s

55.00 $\frac{km}{h}$ x $\frac{1000\ m}{1\ km}$ x $\frac{1\ h}{3600\ s}$ = **15.28m/s**