# Chapter 1

- Scientific Method
- Metric System & SI Units
- Precision and Accuracy
- Significant Figures
- Scientific Notation
- States of Matter and Phase Changes
- Physical & Chemical Changes & Properties

# Scientific Method

The scientific method is a procedure that is designed to solve a problem. The typical problem solving method is...

1) Define the problem - make observations and decide what needs to be solved.
2) Hypothesis - Form an "educated guess" as to how to solve the problem.
3) Experiment - Design and conduct a procedure on how to test hypothesis.
4) Observations - Anything that you notice about experimental results.

## *Scientific Method*

5) Data Collecting - Results are documented.

6) Conclusion - Decision on whether hypothesis is good or bad.

Theory - explanation of a result that is based on many observations and experiments. A theory can be proven incorrect.

Law - a "rule of nature", or something in nature that is always true or present.

# Metric System & SI Units

The SI units are somewhat different from what you are used to. They are as follows:

| Measurement | Base |
| --- | --- |
| Length | meter |
| Mass | gram |
| Time | second |
| Temperature | Kelvin |
| Volume | liter |

American to Metric Units:

Occasionally you will need to change American to Metric units and vice versa.

# Significant Figures

- When writing numbers, some zeros are not significant, and are used simply as place holders, to make the number smaller or bigger.

Rules for Significance:

1) All non-zero digits are significant
2) Any zero between non-zero digits is significant
3) Zeros at the beginning of a number are never significant

# Significant Figures

Rules for Significance (cont'd)

4) Zeros that fall both at the end of a number and after a decimal point are always significant.

5) When a number ends in zero but contains no decimal point, the zeros may or may not be significant - it depends on how the number would be listed in scientific notation.

# *Functions w/ Sig Figs*

- When adding and subtracting with sig figs, the answer is expressed according to the least exact factor
  - expressed same # of number places as factor farthest to the left
- When multiplying & dividing, answer is expressed with same # of sig figs as factor with least sig figs

# Scientific Notation

- When we attempt to write very large and very small numbers, it becomes difficult to write out all the zeros present.
- By using scientific notation we can omit the zeros before or after the significant numbers by multiplying by a power of 10.
- PROCESS

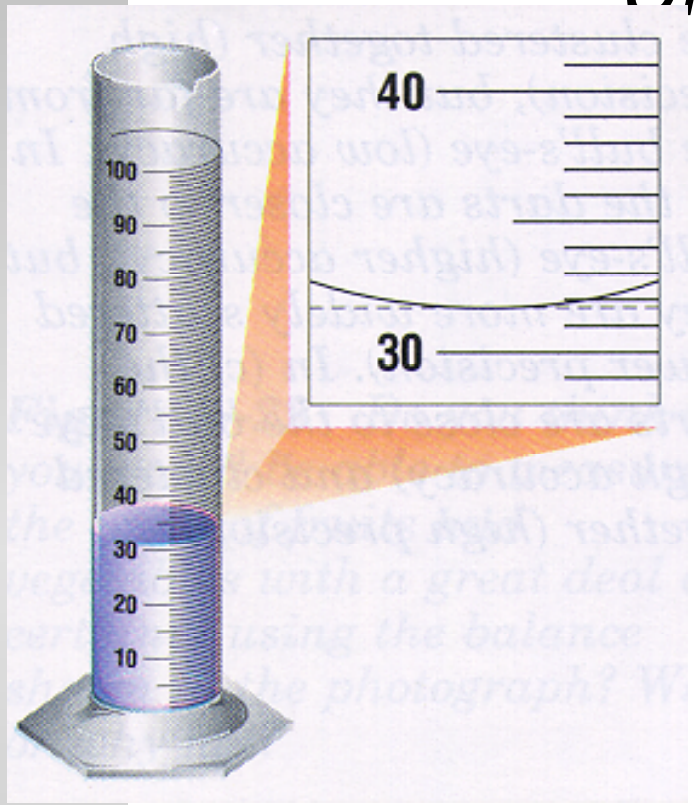
  - write the first significant number, followed by a decimal point, then the rest of the sig figs. Then, multiply by the appropriate power of ten.

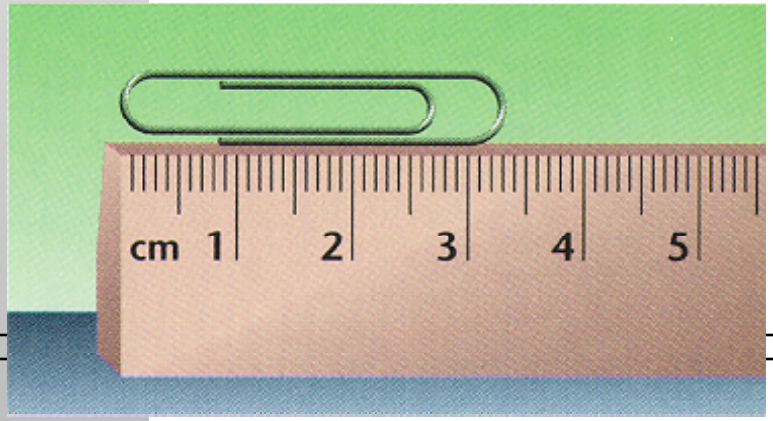
## *Changing Unit to Unit*

Changing from one unit to another:

1) Write down what you start with.
2) In conversion factor, place unit you want in the numerator
3) Place unit you have in denominator
4) Fill in conversion factor numbers (place numbers so they're equal)
5) Multiply/Divide out, cancelling out units as you go.

# Uncertainty in Measurements



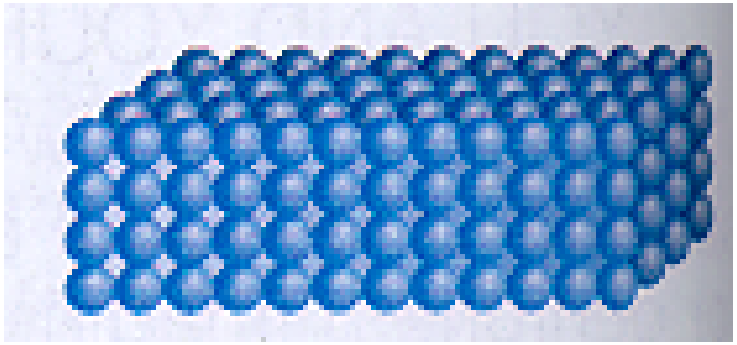




- All measurement instruments have a certain degree of uncertainty in them. When you take measurements, you will need to estimate one digit beyond the lowest mark on the measuring device. All measurements have one estimated number
- Sometimes, in addition, numbers are written like this:

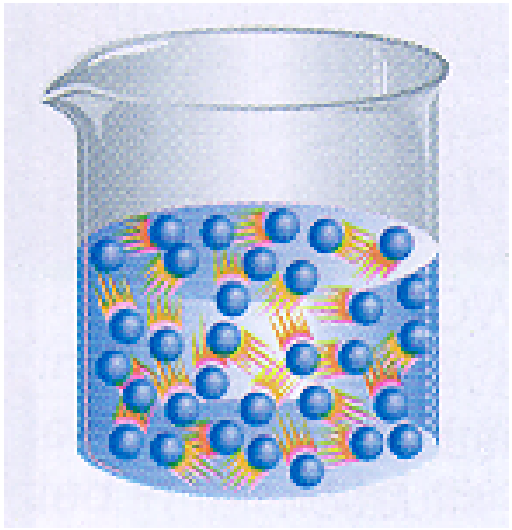
  $31.7 \pm 0.1$

# States of Matter

1) Solid - high density
   - non-compressible
   - has definite shape



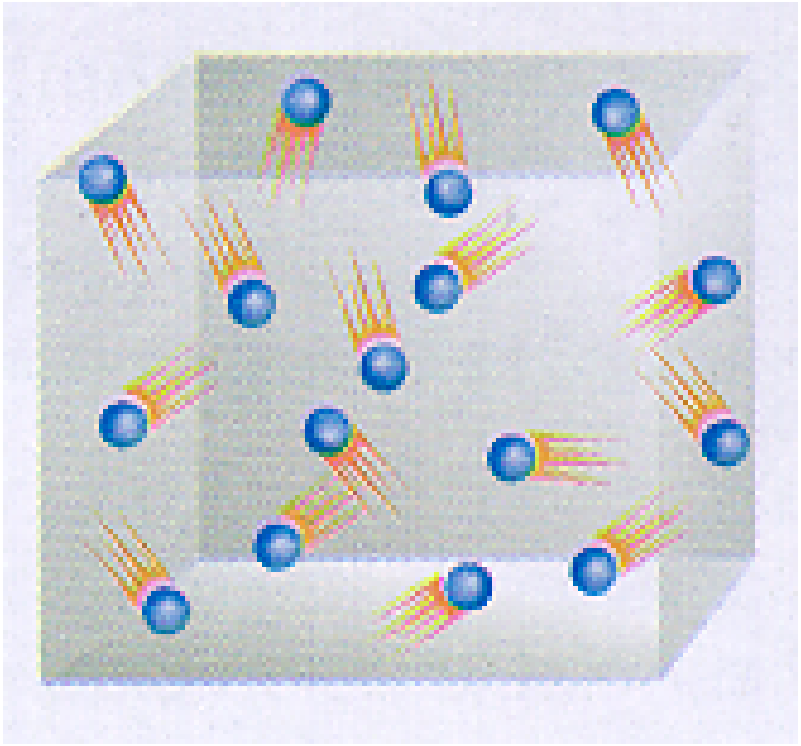
2) Liquid - high density
   - non-compressible
   - takes shape of container



# States of Matter

3) Gas- low density
- compressible
- expands to fill container

4) Plasma - low density
- compressible
- expands to fill container
- exists only at high temp.



# Phase Changes

Solid to Liquid ---> Melting

Liquid to Solid ---> Freezing

Liquid to Gas ---> Vaporization

Gas to Liquid ---> Condensation

Solid to Gas ---> Sublimation

Gas to Solid ---> Deposition

# *Physical Properties of Matter*

Physical properties are properties of a substance that can be observed without changing the make up of the substance.

Examples include

- mass
- volume
- color
- shape
- solubility
- freezing point
- boiling point
- luster
- conductivity
- magnetic

# Types of Matter

1) Pure Substances:

Element - substance that cannot be separated into simpler substances.

Compound - 2 or more elements combined.

2) Mixtures:

Homogeneous - commonly called solutions - 2 or more pure substances without visibly different parts.

Heterogeneous - 2 or more pure substances with visibly different parts.

# Types of Heterogeneous Mixtures

Colloid - Mixture in which small particles within the mixture will scatter light due to the Tyndall effect.

- These particles are sometimes small enough they cannot be seen to the unaided eye.

Suspension - Mixture in which particles of one substance settle to the bottom.

# Pure Substances

Atoms/Element

- The building block of matter
- The smallest part of an element that still retains the physical properties of that element

Molecules/Compounds

- Two or more atoms chemically bonded to one another.