Chemistry 6A Fall 2007

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Friday 9/7/07

Office Hrs TBA on website.

Chem. 6A this week:

No Labs.
Lecture Friday: *Chapter 1*

Chem. 6A next week:

Lab: Check-in, Exercise 1 from lab manual (quiz 1)
Lecture: Chapter 1 & 2

I will post a copy of exercise 1 on the website "lab page" for those of you that don't have a lab book to download.

Please review appendix "A" in your text and sections 1.5 through 1.9 prior to coming to lab next week.

Chapter 1 Learning Goals:

- Explain what matter is in terms of the differences between physical and chemical properties and changes.
- Describe matter in terms of the Scientific Method and classify matter based on observations or information given.
- Understand the importance of measurement units and the units of the metric system.
- Use conversion factors to convert measurements from one set of units to another related unit, including temperature.
- Express and perform calculations involving numbers using scientific notation.
- Express the results of measurements and calculations with the correct number of significant figures.
- Use the factor-unit method (***dimensional analysis***) to solve problems, including percentages and density.

Matter & Measurement

Matter is the physical material of the universe.

Matter is anything that occupies space (volume) and has mass.

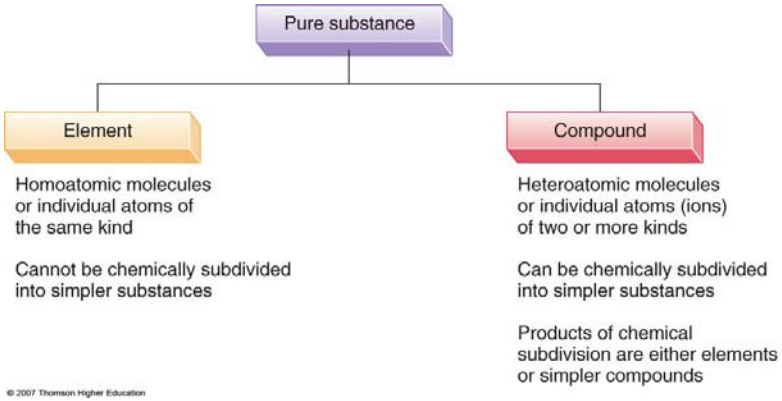
Matter is made up of relatively few elements.

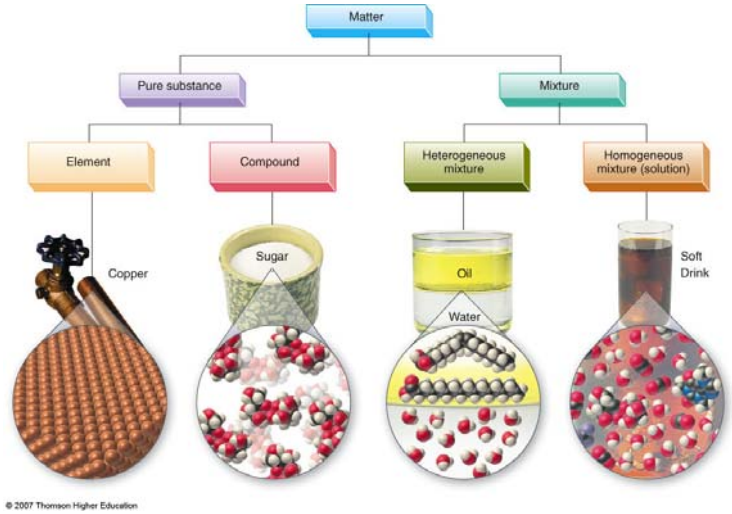
Matter consists of atoms and molecules.

Each element is a unique atom.

Atoms combine to form molecules

Classifying Matter:





Classify the following substances as:

pure substances
(element or compound)

Mixtures
(homogeneous or heterogeneous)

Carbon dioxide:	pure substance	*(compound)*
helium:	pure substance	*(element)*
milk:	mixture	*(homogeneous)*
granite:	mixture	*(heterogeneous)*

STATES OF MATTER

- SOLIDS — have rigid shape, fixed volume. External shape can reflect the atomic and molecular arrangement.
- LIQUIDS — have no fixed shape and may not fill a container completely.
- GASES — expand to fill their container.

Properties of Matter: (this is in your text)

- **Matter** is defined as anything that has both mass and takes up space.
- **Properties** are characteristics that can be used to describe or identify matter.
- **Intensive Properties** have values that do not depend on the amount of substance.
- **Extensive Properties** have values that do depend on the amount of substance.

- **Physical Properties** can be determined without changing the chemical make–up of the sample.
- **Examples of physical properties are:**
  - –Melting Point,Boiling Point, Density, Mass, Touch, Taste, Temperature, Size, Color, Hardness, Conductivity.
- **Examples of physical changes are:**
  - –Melting, Freezing, Boiling, Condensation, Evaporation, Dissolving, Stretching, Bending, Breaking

Chemical Properties are those that do change the chemical make–up of the sample.

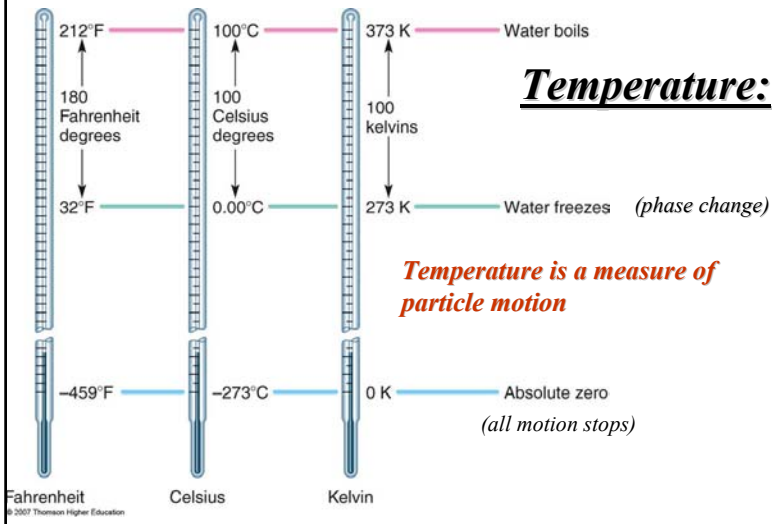
Examples of chemical properties are:

Burning, Cooking, Rusting, Color change, Souring of milk, Ripening of fruit, Browning of Apples, photography, Digesting food

Note: Chemical properties are actually chemical changes.

Mass and Weight:

Mass is a measurement of the amount of matter an object contains.	Weight is a measurement of the force of gravity acting upon an object.
Mass is measured by using a balance comparing a known amount of matter to an unknown amount of matter.	Weight is measured on a scale.
The Mass of an object is independent of an object's location.	Weight, conversely does change with location.



Temperature:

Temperature is a measure of particle motion

Units of Measure:

English Customary Weights and Measures		The International System of Units (SI)	
distance			
inch		meter	
foot	= 12 inches	micrometer	= 10^{-6} meters
yard	= 3 feet	centimeter	= 10^{-2} meters
mile	= 5280 feet	kilometer	= 10^{3} meters

Units with in a system can be represented by units within the system.

Units within the metric system are related by powers of 10

TABLE 1.2 Common prefixes of the metric system

Prefix[a]	Abbreviation	Relationship to basic unit	Exponential relationship to basic unit[b]
mega-	M	1,000,000 × basic unit	10^{6} × basic unit
kilo-	k	1000 × basic unit	10^{3} × basic unit
deci-	d	1/10 × basic unit	10^{-1} × basic unit
centi-	c	1/100 × basic unit	10^{-2} × basic unit
milli-	m	1/1000 × basic unit	10^{-3} × basic unit
micro-	μ	1/1,000,000 × basic unit	10^{-6} × basic unit
nano-	n	1/1,000,000,000 × basic unit	10^{-9} × basic unit
pico-	p	1/1,000,000,000,000 × basic unit	10^{-12} × basic unit

You need to memorize these values and have the ability to convert between.

Measurement and Units

Mass	kilogram	kg
Length	meter	m
Temperature	Kelvin	K (absolute scale)
	Celsius	C (metric)
Amount of matter	mole	mol

Derived units of measure:

Area	m^2			
Volume	m^3	cm^3	L	mL
Density	kg/m^3	g/cm^3	g/mL	
Force	N ($kg \cdot m/s^2$)			
Pressure	Pa (N/m^2)	atm	mmHg	
Energy	J ($kg \cdot m/s^2$)	cal	Cal	

Commonly used units of measure and conversion factors:

TABLE 1.3 Commonly used metric units

Quantity	Metric unit	Relationship to metric basic unit	Relationship to English unit
Length	meter (m)	Basic unit	1 m = 1.094 yd
	centimeter (cm)	100 cm = 1 m	1 cm = 0.394 in.
	millimeter (mm)	1000 mm = 1 m	1 mm = 0.0394 in.
	kilometer (km)	1 km = 1000 m	1 km = 0.621 mi
Volume	cubic decimeter (dm^3)	Basic unit	1 dm^3 = 1.057 qt
	cubic centimeter (cm^3 or cc)	1000 cm^3 = 1 dm^3	1 cm^3 = 0.0338 fl oz
	liter (L)	1 L = 1 dm^3	1 L = 1.057 qt
	milliliter (mL)[a]	1000 mL = 1 dm^3	1 mL = 0.0338 fl oz
Mass	gram (g)	1000 g = 1 kg	1 g = 0.035 oz
	milligram (mg)	1,000,000 mg = 1 kg	1 mg = 0.015 grain
	kilogram (kg)	Basic unit	1 kg = 2.20 lb
Temperature	degree Celsius (°C)	1°C = 1 K	1°C = 1.80°F
	kelvin (K)	Basic unit	1 K = 1.80°F
Energy	calorie (cal)	1 cal = 4.184 J	1 cal = 0.00397 BTU[b]
	kilocalorie (kcal)	1 kcal = 4184 J	1 kcal = 3.97 BTU
	joule (J)	Basic unit	1 J = 0.000949 BTU
Time	second (s)	Basic unit	Same unit used

[a]NOTE: 1 mL = 1 cm^3. [b]A BTU (British thermal unit) is the amount of heat required to increase the temperature of 1 pound of water 1°F.

Measurements

- Results of *Experiments*.
- *Experiments* yield numerical values or data.

numerical values

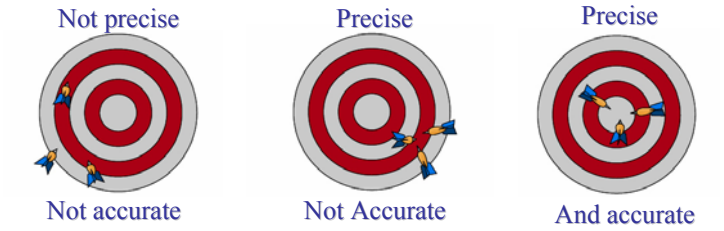
70 kilograms = 154 pounds

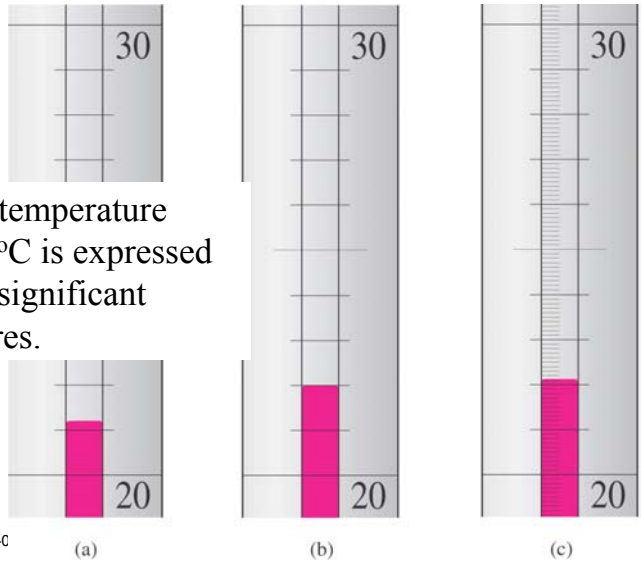
unit

Measurements:

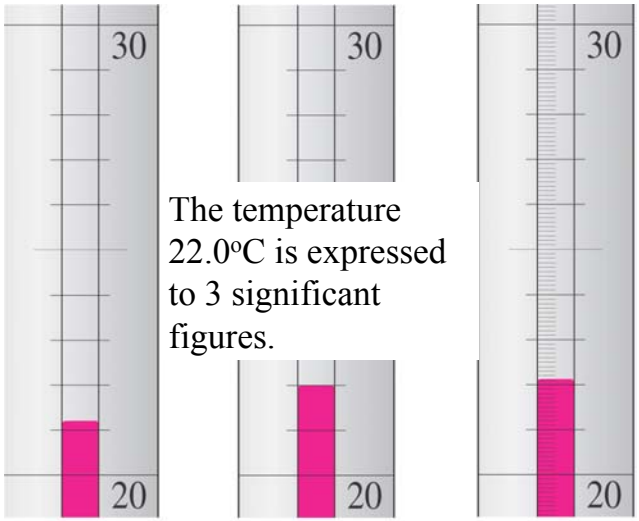
- Measurements are limited by the precision of the measuring device.
- The lower the uncertainty (i. e. ±) the greater the number of *significant figures* that are allowed.

Accuracy is defined as the "*closeness*" to an accepted value a measurement comes.

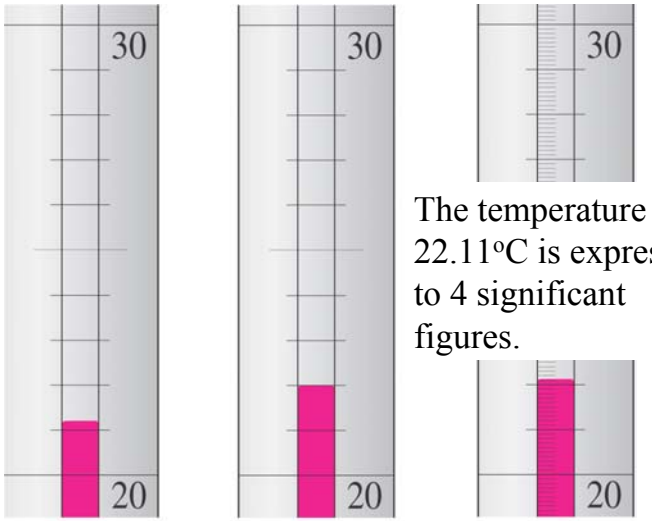




The temperature 21.2°C is expressed to 3 significant figures.



The temperature 22.0°C is expressed to 3 significant figures.



The temperature 22.11°C is expressed to 4 significant figures.

What are Significant Figures?

Significant figures communicate the *uncertainty* in a measurement.

Given the mass: With the uncertainty:

45. 8724g ± 0.001g

Which numbers are certain ? (significant)

The error (±) tells us which digit is uncertain:

45. 8724g ± 0.001

The uncertainty occurs at the thousands place:

Therefore, 45. 8724

These digits are certain

This digit is uncertain

The blue digits are significant,

or we say there are 5 significant figures

Counting Significant Figures

1. All non zero numbers are significant

2. All zeros between non zero numbers are significant

3. Leading zeros are **NEVER** significant. (Leading zeros are the zeros to the left of your first non zero number)

4. Trailing zeros are significant **ONLY** if a decimal point is part of the number. (Trailing zeros are the zeros to the right of your last non zero number).