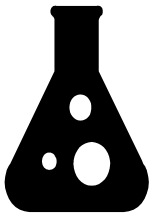
Introduction Name: _____

AP Chemistry Lecture Outline

Chemistry: the study of matter and its changes

Chemistry is not about memorizing facts; it is about understanding the world around you.



Areas of Chemistry

organic: the study of carbon-containing compounds

inorganic: studies everything except carbon (e.g.,)

biochemistry: the chemistry of living things

physical: measuring physical properties of substances

matter: anything having mass and volume

mass: the amount of matter in an object

weight: the pull of gravity on an object

volume: the space an object occupies

units: conversions:

state of matter: solid, liquid, or gas

atom: a basic building block of matter

Elements contain only one type of atom.

(a) monatomic elements consist of unbonded, "like" atoms

e.g.,

(b) polyatomic elements consist of several "like" atoms bonded together

-- diatomic elements:

-- others:

(c) allotropes: different forms of the same element in the same state of matter

molecule: a neutral group of bonded atoms

Elements may consist of...

Chemical symbols for elements appear on the periodic table; only the first letter is capitalized.

Compounds contain two or more different types of atoms.

-- have properties that differ from those of their constituent elements

e.g., Na (sodium): explodes in water

Cl_2 (chlorine): poisonous gas

Atoms can only be altered by *nuclear* means. Molecules can be altered by *chemical* means.

e.g., electrolysis of water $2\ H_2O(l) \rightarrow 2\ H_2(g) + O_2(g)$

** In a chemical reaction, the atoms are rearranged.

All samples of a given compound have the same composition by mass.

EX. A 550 g sample of chromium (III) oxide (Cr_2O_3) has 376 g Cr. How many grams of Cr and O are in a 212 g sample of Cr_2O_3?

composition: what the matter is made of

copper:

water:

Properties describe the matter.

e.g., what it looks like, smells like, how it behaves

Chemistry tries to relate the macroscopic and microscopic worlds.

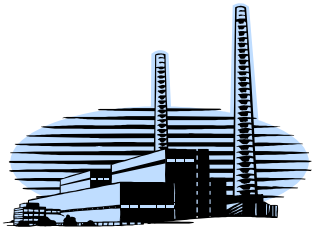
The Scope of Chemistry

-- petroleum products

-- synthetic fibers

-- pharmaceuticals

-- bulk chemical manufacturing



All fields of endeavor are affected by chemistry. Chemistry is the central science.

States of Matter

SOLID LIQUID GAS

vapor:

Changes in State

Energy put into system:

Energy removed from system:

Classifying Matter

(Pure) Substances have a fixed composition and fixed properties.

--

ELEMENTS COMPOUNDS

Mixtures contain two or more substances mixed together.

-- have varying composition and varying properties

-- The substances are NOT chemically bonded; they retain their individual properties.

Two types of mixtures…	homogeneous: (or solution)	heterogeneous:
	particles are microscopic;	different composition
	sample has same composition	and properties in the
	and properties throughout;	same sample;
	evenly mixed	unevenly mixed

alloy: a homogeneous mixture of metals

e.g., bronze (Cu + Sn)

brass (Cu + Zn)

pewter (Pb + Sn)

suspension: settles over time

e.g.,

Separating mixtures involves physical means, or physical changes.

-- No chemical reactions are needed because...

1. sorting: by color, shape, texture, etc.
2. filtration: particle size is different
3. magnetism: one substance must contain iron
4. chromatography: some substances dissolve more easily than others
5. density: "sink vs. float"; perhaps use a centrifuge

   -- decant: to pour off the liquid
6. distillation: different boiling points

   Volatile substances evaporate easily.

Properties of Matter

CHEMICAL properties tell how a substance reacts with other substances.

PHYSICAL properties can be observed without chemically changing the substance.

EXTENSIVE properties depend on the amount of substance present.

INTENSIVE properties do NOT depend on the amount of substance.

Examples:

electrical conductivity	reactivity with water
ductile: can be drawn (pulled) into wire	brittle
malleable: can be hammered into shape	magnetism

-- Base Units

mass
length
time
electric current
temperature
amount of substance

Temperature Units

Kelvin scale is based on absolute zero, which is derived from theory of gases.

The Kelvin and Celcius scales have equal-sized units.

The Fahrenheit scale is still used in the U.S., but not for scientific work.

$K = {}^{o}C + 273.15$ $\quad\quad$ $^{o}F = 1.8(^{o}C) + 32$

derived units: units are combined by X or

e.g., area → density → volume → momentum →

Density → how tightly packed the particles are

** Density of water = 1.0 g/mL = 1.0 g/cm^3

The density of a liquid or solid is nearly constant, no matter what the sample's mass.

EX. A student needs 15.0 g of ethanol, which has a density of 0.789 g/mL. What volume of ethanol is needed?

Accuracy and Precision

All numerical data are the result of uncertain measurements.

precision: a measure of the degree of fineness of a measurement; it depends on the extent to which the instrument is calibrated

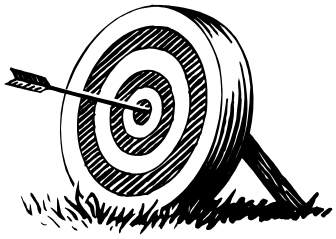
e.g.,

When repeated, precise measurements yield similar answers each time.

e.g., precise…

imprecise…

accuracy:



Significant Figures: *Is a digit significant?*

1. All non-zeroes are significant.
2. Zeroes sandwiched between non-zeroes are significant.
   e.g.,
3. Zeroes on the left side of a number ARE NOT significant.
   e.g.,
4. Zeroes to the right of the decimal point and the right of non-zeroes are significant.
   e.g.,
5. Zeroes to the right of non-zeroes and to the left of an unwritten decimal point ARE NOT significant.
   e.g.,
6. In scientific notation, all figures to the left of the "x 10^{exp}" are significant. The exponent has no effect on the number of sig. figs.

Round correctly.

Calculator says…	2 sig. figs.	3 sig. figs.	5 sig. figs.
75.6			
0.528396			
387600			
4200			
8.4845E-4			

Significant Figures and Mathematical Operations

1. When multiplying or dividing, the answer must have the same number of sig. figs. as does the quantity with the fewest sig. figs.

   e.g., 1.52 C 3.431 s =

   0.0251 N x 4.62 m 3.7 s =

2. When adding or subtracting, the answer must be rounded to the place value of the least precise quantity.

   e.g., 2.53 s + 7.4 s =

   2.11 m + 104.056 m + 0.1205 m =

3. Because conversion factors are <u>exact numbers</u>, they do NOT affect the number of sig. figs. Your answer should have the same number of sig. figs. as does the quantity you start with.