

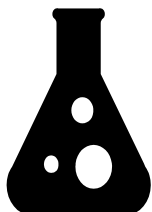
Introduction

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.

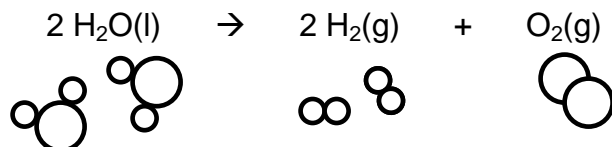
-- have properties that differ from those of their constituent elements

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

Cl₂ (chlorine): poisonous gas

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

e.g., electrolysis of water



** 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 (Cr₂O₃) has 376 g Cr. How many grams of Cr and O are in a 212 g sample of Cr₂O₃?

composition: what the matter is made of

copper:

water:

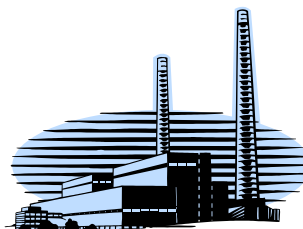
Properties describe the matter.

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

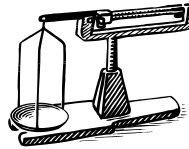


All fields of endeavor are affected by chemistry. Chemistry is the central science.

Activities of the Scientific Method

Observe events.

-- Quantitative data are most useful.



Propose a hypothesis:



Carry out controlled experiments:

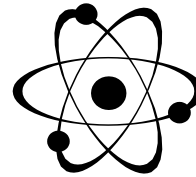
Draw a valid conclusion.

law: states what happens

- does NOT explain why
- we don't change laws
- e.g., law of gravity, laws of conservation

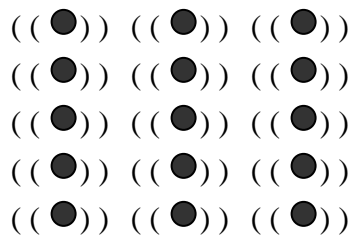
theory: tries to explain why or how something happens

- are modified as new evidence becomes available
- e.g., theory of gravity, atomic theory

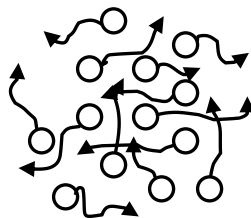


States of Matter

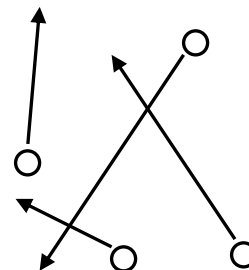
SOLID



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

e.g.,

COMPOUNDS

e.g.,

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)

particles are microscopic;
sample has same composition
and properties throughout;
evenly mixed
e.g.,

heterogeneous:

different composition
and properties in the
same sample;
unevenly mixed
e.g.,

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

ONE OF
THESE

CHEMICAL properties tell how a substance reacts with other substances.

PHYSICAL properties can be observed without chemically changing the substance.

AND

ONE OF
THESE

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

10^{exp}

SI System

-- Base Units

mass

length

time

electric current

temperature

amount of substance

luminous intensity

Prefix	Symbol	Meaning
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}

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.

$$K = ^\circ C + 273.15$$

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

derived units: units are combined by X or \div

e.g., area \rightarrow

density \rightarrow

volume \rightarrow

momentum \rightarrow

Density → how tightly packed the particles are

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \rightarrow \boxed{D = \frac{m}{V}}$$

** Density of water = 1.0 g/mL = 1.0 g/cm³

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

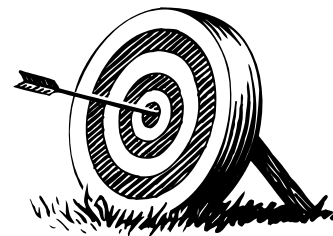
e.g.,

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., $1.52 \text{ C} \div 3.431 \text{ s} =$

$0.0251 \text{ N} \times 4.62 \text{ m} \div 3.7 \text{ s} =$

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

e.g., $2.53 \text{ s} + 7.4 \text{ s} =$

$2.11 \text{ m} + 104.056 \text{ m} + 0.1205 \text{ m} =$

3. Because conversion factors are exact numbers, 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.

Conversion Factors and Unit Cancellation

EX. How many kilometers is 15,000 decimeters?

EX. For the rectangular solid: $L = 14.2 \text{ cm}$ $W = 8.6 \text{ cm}$ $H = 21.5 \text{ cm}$...

Find volume.

Convert to mm^3 .