

Ch. 3 Notes – MATTER – PROPERTIES AND CHANGES

NOTE: Vocabulary terms are in **boldface and underlined**. Supporting details are in *italics*.

I. Properties of Matter

A. pure substance vs. mixture

- 1) **pure substance**—*matter with the same definite composition and properties*
- 2) Pure substances can be elements or compounds.

a) **elements**

- 1) *simplest form of matter retaining the properties of that matter*
- 2) examples : Ag Pb O W
- 3) chemical symbols
 - each element has a different symbol
 - capitalize the first letter only
 - word roots from English and other languages (Latin)
- 4) organizing the elements: *periodic table of the elements*

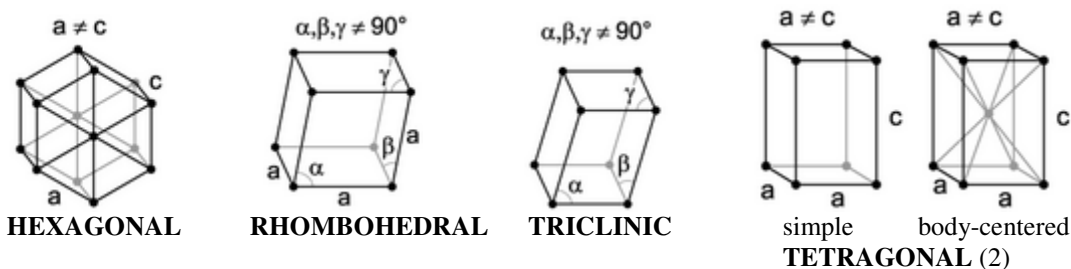
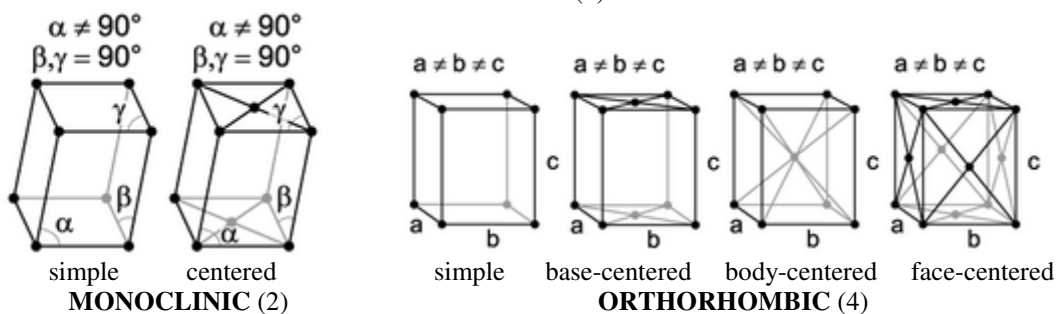
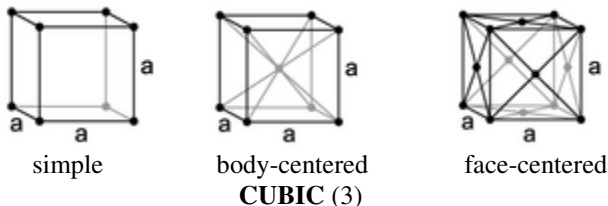
One of the main goals of this class is to “decode” the periodic table and learn how to derive information from it.

b) **compounds**

- i. *more than one element* in a type of matter
- ii. can only be separated by chemical methods
- iii. examples: NaHCO₃ CO H₂CO CaCO₃
- iv. **formula**—*correct combination of chemical symbols*

B. states of matter (more information later in the course)

- 1) **solid**—form of matter with fixed shape and volume (can be crystalline or amorphous)



- 2) **liquid**—form of matter with variable shape and fixed volume
 - 3) **gas**—form of matter with variable shape and volume
(**vapor** – if a substance is not commonly found as a gas at room temperature, and it is found as a gas, it is called a vapor)
 - 4) **plasma**—low-density ionized gases (found in lightning, plasma TVs, stars)
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II. Changes in Matter

A. physical changes and properties

- 1) **physical change**
 - a) *alterations that do not change the substance's identity and composition*
 - b) e.g.: paper that is shredded is still paper; sugar dissolved in water is still sugar
 - c) *key words: boil, freeze, melt, condense, dissolve, crush, break, cut...*
- 2) **physical properties**—*characteristics that can be observed and measured without changing the chemical composition of the substance*

conductivity	melting point	malleability
density	ductility	odor
solubility	boiling point	refractive index

 - a) **intensive property**—does not depend on the amount of matter
 - b) **extensive property**—depends on the amount of matter

B. chemical changes and properties

- 1) **chemical properties**—*ability to form new substances as a result of chemical reactions (rxns.)*
 - 2) **chemical changes**—*alterations that changes substance's identity and composition to something new, through a **chemical reaction***
 - a) e.g.: burning firewood, rotting of fruit
 - b) *key words: rust, decompose, corrode, burn, ferment, grow, decay...*
 - 3) **chemical reactions**—the changing of substance(s) into new ones
 - a) *reactants*—starting substances in a rxn.
 - b) *products*—new substances formed in a rxn.

(“Reactants react to produce the products.”) $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

 - c) *clues that a chemical rxn. has occurred*

<i>energy is given off (gets hotter)</i>	<i>color change</i>	<i>production of a gas</i>
<i>energy is absorbed (gets colder)</i>	<i>odor change</i>	<i>usually not easily reversible</i>
<i>production of a solid (precipitate; ppt.)</i>		
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III. Mixtures of Matter

- A. **mixture**—*physical blend of two or more substances*
(gas-gas, liquid-gas, gas-liquid, liquid-liquid, solid-liquid, solid-solid)
- B. mixtures can be *heterogeneous* or *homogeneous*
 - 1) *heterogeneous*—*not uniform*; has different “phases”
examples: granite, Italian salad dressing
 - 2) *homogeneous*—a called a **solution**; *uniform*; has one “phase”
examples: salt water, air, alloys
 - 3) *phase*—area of uniform composition and properties

- C. parts of a solution
 - 1) **solute**—*the substance being dissolved*
 - 2) **solvent**—*the substance doing the dissolving*
- D. **aqueous solutions** (*aq*)—*water containing dissolved materials*
- E. can be separated by physical means
 - 1) **filtration**—separation of solid from liquid through a barrier
 - 2) **distillation**—separation of liquids with different boiling points
 - 3) **crystallization**—separation of solid from an unstable solution (more information later in the course)
 - 4) **sublimation**—conversion of a solid directly to vapor (more info later)
 - 5) **chromatography**—separation of components due to density differences (more info later)

IV. Relevant Laws

- A. **Law of Conservation of Mass**—*in a physical or chemical change, matter cannot be created nor destroyed, it merely changes form*
 - 1) reactant mass = product mass
 - 2) exceptions are nuclear rxns.
- B. **Law of Conservation of Energy**— *in a physical or chemical change, energy cannot be created nor destroyed, it merely changes form*
- C. **Law of Definite Proportions**—*a compound is composed of the same elements in the same proportion by mass*

$$\text{PERCENT BY MASS} = \frac{\text{MASS OF ELEMENT}}{\text{TOTAL MASS OF COMPOUND}} \times 100$$

(more information later in the course)
- D. **Law of Multiple Proportions**— when two elements combine with each other to form more than one compound, the masses of one element that combine with a fixed mass of the other are in a ratio of small whole numbers