

## Chapter 2 – Matter

### 1) Basic Laws of Chemistry (Experimental Basis of the Atomic Theory)

- a) Law of Conservation of Mass – There is no detectable change in mass during a chemical reaction.

Example – If 100 g of calcium carbonate,  $\text{CaCO}_3$ , when heated decomposes to produce 56 g of calcium oxide,  $\text{CaO}$ . How many grams of carbon dioxide,  $\text{CO}_2$ , escape into the air?

$$\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$$

- b) Law of Definite Composition – A compound always contains the same elements in the same proportion by mass.

Example – Calcium oxide,  $\text{CaO}$ , is composed of 71.4% calcium and 28.6% oxygen. How many grams of oxygen must be combined with 40 g of calcium to make calcium oxide?

### 2) Sec 2.1 – The Particulate State of Matter

Matter - occupies space and has mass

Mass - the amount of matter something contains

Substance – A particular kind of matter that has a uniform and definite composition. All samples of a substance have identical physical properties.

Physical Property – A quality or condition of a substance that can be observed or measured without changing the substance's composition. Some examples of physical properties are:

Examples:

1. Color
2. Physical State (solid, liquid, or gas)
3. Odor (What is essential in order for something to have an odor?)
4. Taste (NEVER taste a chemical as a means to identification.)
5. Freezing Point or Melting Point (same temperature) – temperature at which both the solid and liquid states are in equilibrium at normal atmospheric pressure.
6. Boiling Point or Condensation Point (same temperature) – temperature at which both the liquid and the gas states are in equilibrium at normal atmospheric pressure.
7. Ability to sublime (to change directly from a solid into a gas)
8. Density - the ratio of a substance's mass to its volume
9. Solubility

All matter ultimately consists of tiny particles that come together. There is a great diversity of matter. However, all matter is ultimately composed of a small number of fundamental particles.

### 3) Sec 2.2 – Elements and Compounds

- a) Elements are the simplest forms of matter that can exist under normal conditions. They cannot be separated into simpler substances by ordinary chemical reactions.
- B) Compounds are substances that can be separated into simpler substances only by chemical reactions. The constituent elements in a compound are always present in the same proportions. The physical and chemical properties of the compound are not like those of the elements of which it is composed.

The elements are listed in the Periodic Table. Compounds are substances made up by bonding atoms of different elements together in specific ways. A specific compound consists of the same particles throughout, always in the same ratio.

In Chapter 3 we will learn that compounds can be made up of things called ions coming together chemically to form certain types of compounds or of other elements bonding together in another way to form molecules.

### 4) Sec 2.3 – States of Matter – There are three common states of matter: solid, liquid and gas.

Solids: A solid is rigid. It has its own shape and volume.

Liquids: A liquid flows. It has its own volume but will take the shape of its container.

Gases: A gas also flows. It will take both the shape and volume of its container.

Vapor describes a substance that, although in the gaseous state, is generally a liquid or solid at room temperature

### 5) Sec 2.4 – Physical and Chemical Properties and Changes

Substances have physical properties. One can also describe a substance in terms of its Chemical Properties which refer to the ability to form new substances.

Physical changes are changes in one or more physical properties but show no change in the fundamental substance. Such things as changes of state are physical changes because they do not affect the composition of the substance. A chemical change involves a change in the fundamental components of a substance. The substance changes into a different substance or substances. Chemical changes are often called chemical reactions. When a chemical reaction occurs, one can often identify this by a change in physical properties: Is it now a solid when it was a liquid? Does it now smell? Has there been a color change?

6) Sec 2.5 – Mixtures and Pure Substances

Mixtures consist of a physical blend of two or more substances. They have variable composition. The parts of the mixture retain their characteristics and can be separated by physical means.

- a) Heterogeneous mixture is not uniform in composition.
- b) A Homogeneous mixture has a completely uniform composition. A solution is what chemists call a homogeneous mixture.
- c) Mixtures of metals are called alloys.

Pure substances can either be elements or compounds. They always have the same composition.

There is a definite difference between compounds and mixtures. A compound only contains particles of identical composition and so is always the same. A compound can only be separated by chemical means. A mixture is a collection of compounds and/or elements that are present in varying amounts, and which can be separated by physical means.

7) Sec 2.6 – Some techniques Used to Separate the Components of a Mixture

- a) Filtration – Used to separate insoluble solids from liquids.
- b) Distillation – Used to separate soluble solids from liquids, or liquids from liquids.