Chemical Reactivity

Elements are rarely found in atomic form (a single atom of the element). Most of them exist as **compounds**. The reason for this is that all atoms want to be **stable**. In order to become stable, an atom must have a full outer orbit of electrons (the Noble Gases are the only elements with full outer orbits).

Atoms can become stable in several ways:

- lose some electrons (give them to another atom)
- gain some electrons (take them from another atom)
- share some electrons (with another atom)

When atoms use the above methods to become stable, they form **compounds**. (e.g. sodium and chlorine)

Two questions arise:

1. How do you know if an atom will gain or lose electrons?

2. How many electrons will an atom gain or lose?

Alkali Metals

- have one valence electron
- must lose one or gain seven to have a full outer orbit
- will lose one electron (because it's easier)

Alkaline Earth Metals

- have two valence electrons
- must lose two or gain six to have a full outer orbit
- will lose two electrons (because it's easier)

Chalcogens

- have six valence electrons
- must lose six or gain two to have a full outer orbit
- will gain two electrons (because it's easier)

Halogens

- have seven valence electrons
- must lose seven or gain one to have a full outer orbit
- will gain one electron (because it's easier)

Noble Gases

- have full outer orbits
- already stable
- will not gain or lose electrons; do not generally form compounds

Hydrogen

- has one valence electron
- must lose one or gain one to have a full outer orbit
- will do either (because neither is easier)

How easily will an element react?

This is determined by the number of valence electrons an element has. In general, the less electrons an element must gain/lose to become stable, the more easily it will react.

Compounds

Recall:

1. All matter is made of atoms.

2. An element is a pure substance that can't be broken down chemically.

3. An atom is the smallest part of an element that has the properties of that element.

Some matter is made of one element. Most, however, consists of two or more elements combined in a specific way. This type of matter is called a **compound**.

The smallest part of a compound that has the properties of that compound is called a **molecule**.

Example 1
When magnesium burns, it takes oxygen out of the air, forming a white, powdery substance. The powder is a compound called magnesium oxide.

Instead of writing out the names of compounds, we use the element symbols to write a **chemical formula** for the compound. A chemical formula shows the type and number of each element in a compound.

Example 2
The formula for magnesium oxide is

$$MgO$$

The formula for a compound tells us two things:

1. The elements the compound is made of.

2. How many atoms of each element make up a single molecule of the compound.

Example 3 (see handout)
The chemical formula of water (H_2O) tells us that water is made of two elements: hydrogen and oxygen. It also tells us that a single molecule of water contains two atoms of hydrogen and one atom of oxygen.

Example 4
For each compound in the following list, determine what elements the compound is made of and how many atoms of each element are contained in a single molecule.

1. $NaCl$

2. N_2O_3

3. $KHCO_3$

4. $FeSO_3$

5. $C_6H_{12}O_6$

6. $Mg(OH)_2$