Part 3: Types of Chemical Compounds:

As we know one of the primary ways that science organizes and analyzes data is through ***classification***. Classification is the process of grouping objects/events according to similarities. Classification is a major prat of chemistry. Elements are classified on the periodic table into groups/families according to valence structure, into periods depending on the number of electron shells. The elements are separated into metal and non-metals.

More detailed classifications of the elements lead to categories such as: transition metals, metalloids, halogens, alkalis, alkalines, noble gases, diatomics, lanthanides, actinides and more!

Compounds can also be classified in different ways. We have already seen one major classification of compounds into ***ionic*** and ***covalent*** compounds. Now will next discuss some other ways that chemical compounds can be classified.

Acids and Bases (and Salts):

Acids are a group of compounds with the following properties:

* sour taste
* react with metals to produce H2 gas
* react with carbonates to form CO2 gas
* corrosive
* turn blue litmus red (pink)
* pH below 7

Acids are very common in nature. Most fruits are high in acid; citric acid gives lemons and limes their characteristic sour taste. Your stomach contains a strong acid (hydrochloric acid, HCl) that helps to digest the food you eat. Bee stings are acidic in nature. When you exercise the “burn” you may feel in your muscles is caused by a buildup of lactic acid. Acids have many used in industry as well.

Bases are a group of compounds with the following properties:

* bitter taste
* feel slippery
* react with some metals to produce H2 gas
* corrosive
* turn red (pink) litmus blue
* pH above 7

Bases are also common in nature. We generally find bitter flavours unpleasant, this is because most poisons produced by plants are highly basic (or alkaline). Bile is a fluid formed by our livers and used in the digestion of fats. Wasp stings are basic. Most household cleaners and soaps are also basic.

Salts are a group of compounds with the following properties:

* white solid
* crystalline structure
* taste salty
* soluble in water
* formed from the reaction of an acid with a base

Naming of Acids and Bases:

For the following discussion we shall be using the simple ***Arrhenius*** theory of acids and bases. Be aware that there are other more advanced theories including the ***Lewis*** theory and the ***Bronstead-Lowry*** theory.

**ACIDS**

Acids are ionic compounds, in solution with water, with H+ acting as the metal, in solution with water. Examples include *Hydrochloric Acid (HCl), Hydrofluoric Acid (HF), Hydronitric Acid (H3N), Sulfuric Acid (H2SO4) and Chlorous Acid (HClO2).* When these compounds are dissolved in water the H+ ions are released into solution. Although acids are simply ionic compounds, when they are dissolved in water (aqueous solution) they are named differently than typical ionic compounds. There are 3 general rules for naming acids:

**1. If the non-metal part of the acid is an *element* (Cl-, N3-, Br-…) the name of the acid is:**

Hydro \_\_\_\_\_\_\_\_\_\_ ic Acid

where the blank is the beginning of the element’s name:

EX: HCl : Hydro\_\_\_\_\_\_\_\_\_\_ic Acid

HBr : Hydro\_\_\_\_\_\_\_\_\_\_ic Acid

H2S : Hydro\_\_\_\_\_\_\_\_\_\_ic Acid

**2. If the non-metal is a polyatomic ion ending in “ATE” (CO32- carbonate, SO42- sulfate…) the name of the**

**acid is:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ic Acid

where the blank is the beginning of the name of the polyatomic ion.

\*NO HYDRO AT THE START

EX: H2CO3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ic Acid

H3PO4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ic Acid

HMnO4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ic Acid

**3. If the non-metal is a polyatomic ion ending in “ITE” (ClO2- chlorite, SO32- sulfite…) the name of the**

**acid is:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ous Acid

where the blank is the beginning of the name of the polyatomic ion.

\*NO HYDRO AT THE START

EX: H2SO3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ous Acid

H3PO3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ous Acid

HNO2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ous Acid

**BASES:**

Bases are ionic compounds with hydroxide, OH-, acting as the non-metal, in solution with water. When in aqueous solution the hydroxide ions are liberated. There is no special rule for naming them, we just name them as an ionic compound.

EX: NaOH : sodium hydroxide

Mg(OH)2 : magnesium hydroxide

Al(OH)3 : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**NEUTRALIZATION and SALTS:**

When an acid and a base are mixed a special sort of double replacement reaction occurs. The H+ cation from the acid and the OH- anion from the base combine to form water (HOH=H2O). The cation from the base and the anion from the acid then combine to form an ionic compound known as a salt.

The result is that the acid and base both disappear to become water and salt (depending, of course on the relative amount of each present), this is known as an acid/base neutralization reaction.

This reaction is outlined as reaction type 6 in the notes you were given on classifying reactions.

The salt is named as any ionic compound.

Examples:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ACID** | **+** | **BASE** | **→** | **WATER** | **+** | **SALT** |
| HCl | + | NaOH | → | H2O | + | NaCl |
| HBr | + | Mg(OH)2 | → | H2O | + | MgBr2 |
| H2SO4 | + | KOH | → | H2O | + | K2SO4 |
| H3PO3 | + | Ca(OH)2 | → | H2O | + | Ca3(PO3)2 |