Formula and equations

Chemistry is the study of pure substances and how they behave. One of the things we look at is their reactions when heated or when mixed with other substances. A **chemical reaction** occurs when the particles which make up a chemical substance change their structure in some way to become another type of particle and hence another type of substance.

A chemical reaction means that a new substance(s) is formed.

For example:

If a substance is made up of particles (molecules) containing four atoms in an arrangement ABBC and on heating it breaks up to give two different types of particle AB and BC, then we can see that two new substances have been formed and a chemical reaction had happened. This can be represented by an equation showing the situation before the reaction and the situation after.

ABBC $\longrightarrow$ **AB + BC**

Problem:

We must learn how to construct the formula of the chemicals which we are going to deal with. This may be done using the **valence table** and the method of matching the valencies of the component parts (elements or radicals).

For example:

Sodium oxide:

This is made of sodium (valency 1) and oxygen (valency 2). The valencies here are obviously not equal. The way to make the valencies equal is to have **two** sodium atoms (total valency 2) for each oxygen atom (valency 2) and so the formula of sodium oxide is **Na_2O**.

Calcium Nitrate

This consists of the calcium ions Ca^{2+} which have a valency of two, and nitrate ions NO_3^- with a valency of one. The valencies must match and so we need TWO nitrate ions for each calcium ion – the formula becomes $Ca(NO_3)_2$

Balancing chemical equations.

To construct chemical equations representing a chemical reaction we must follow **three steps**.

1. Write down the reactants on the left and the products on the right joined by an arrow

Reactants ⟶ **Products**

2. Write down the formula of each chemical taking part in the reaction underneath its name.

ABBA ⟶ **AB**

3. Balance the equation so that there are the same number of particles on both sides. This is done by putting **large numbers in front** of the formulae to multiply the whole of that formula by the number.

ABBA ⟶ **2AB**

The balanced equation has now been constructed. This process will be used many times in the course of your studies in chemistry. You <u>must</u> try to master it.

Example:

Iron II oxide + hydrochloric acid ⟶ Iron II chloride + water

FeO + HCl ⟶ $FeCl_2$ + H_2O

FeO + **2**HCl ⟶ $FeCl_2$ + H_2O

Example:

Lead (II) oxide + nitric acid ⟶ lead (II) nitrate + water

PbO + HNO_3 ⟶ $Pb(NO_3)_2$ + H_2O

PbO + 2HNO_3 ⟶ **$Pb(NO_3)_2$ + H_2O**