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**Reactions of Acids: Metals, Carbonates & Hydroxides**

This lesson will discuss what happens when acids are mixed with metals, carbonates, and hydroxides (bases), and will give the balanced equations and ionic equations for the reactions that take place.

What Is an Acid?

An acid is actually defined in a number of ways. In junior science we defined acids because of their physical properties (turn blue litmus paper red, taste sour etc). Here we will define acids as a proton donator – they release a H+ ion in a reaction. This means almost all the formulas of the common acids start (or contain) a H atom (HCl, H2SO4, HNO3, CH3COOH). Here we are more interested in the reactions of acids with other compounds.

* Acids and metals
* Acids and carbonates
* Acids and hydroxides

Acids and Metals

The first group of reactions we’ll discuss is when a metal and an acid are combined. The general reaction results in a salt and hydrogen gas. Not all metals react this way, as some, like gold for example, are unreactive with acids.

The reaction of **magnesium with hydrochloric acid** produces magnesium chloride (a salt) and hydrogen gas.

The balanced equation is as follows:

Mg (s) + 2HCl(aq) → MgCl2 (aq) + H2 (g)

When this reaction takes place, the hydrogen gas causes bubbles and the reaction releases heat (the solution gets hotter). This reaction is known as a **single displacement reaction**, because the magnesium displaces (and replaces) another element (hydrogen) in a compound.

Now let’s check out the full ionic equation. This describes the reaction in terms of showing any dissolved ionic compounds as ions.

Mg (s) + 2H+(aq) + 2 Cl-(aq) → Mg+2(aq) + 2 Cl-(aq) + H2 (g)

Usually a net ionic equation is used, and this means that the ions that are the same on both sides will be crossed off.

Mg(s) + 2H+(aq) → Mg+2(aq) + H2(g)

For our second example, let’s see what happens when iron is mixed with sulfuric acid. Here **iron and sulfuric acid** result in iron sulfate (a salt) and hydrogen gas. Take a look at the balanced equation:

Fe (s) + H2SO4 (aq) → FeSO4 (aq) + H2 (g)

Again, bubbles from the hydrogen gas are formed and the reaction releases heat. Just like the first reaction, this is a single displacement reaction (iron displaces hydrogen).

And the net ionic equation is:

Fe(s) + 2H+(aq) → Mg+2(aq) + H2(g)

Acids and Carbonates

Let’s move on to acids and carbonates. A **carbonate** contains a carbon bonded to three oxygen atoms (CO3) . The general reaction results in a salt, carbon dioxide gas, and water.

The reactions between carbonates and acids are called **neutralization reactions** because one of the products is water – a classic indicator that a neutralization reaction has occurred.

Let’s look at another example. When **magnesium carbonate reacts with hydrochloric acid** it produces magnesium chloride (salt), water, and carbon dioxide. The balanced equation is:

MgCO3(s) + 2HCl(aq) → MgCl2(aq) + H2O(l) + CO2(g)

Like the other reactions, bubbles are produced (this time due to the carbon dioxide) and heat is released.

The net ionic equation is: MgCO3(s) + 2H+(aq) → Mg+2(aq) + H2O(l) + CO2(g)

Now let’s look at **zinc carbonate and nitric acid**, which combine to form zinc nitrate (salt), water, and carbon dioxide. The balanced equation is:

ZnCO3(s) + 2HNO3(aq) → Zn(NO3)2(aq) + H2O(l) + CO2(g)

And you guessed it, since there’s a gas produced (carbon dioxide), bubbles appear. And, like the other reactions, heat is released.

The ionic equation is: ZnCO3(s) + 2H+(aq) → Zn+2(aq) + H2O(l) + CO2(g)

Acids and Bases

The last group we’ll focus on is the reaction with an acid and a bases. A **base** is actually difficulty to define chemically and is often thought of as a proton acceptor (such as CuO), or as a compound which releases OH- in solution (NaOH). All bases neutralize acids. Alkalis are bases which are soluble in water. The typical reaction between a base and an acid results in a salt and water.

The first reaction we’ll look at is the reaction of **hydrochloric acid and the alkali sodium hydroxide**, which results in sodium chloride (salt) and water.

The balanced equation is: HCl(aq) + NaOH(aq) → NaCl(aq) + H2O(l)

You may notice that no gases are formed, so there are no bubbles. However, heat is still released.

And the net ionic equation is: H+(aq) + OH–(aq) → H2O(l)

In this final reaction, **Copper Oxide and nitric acid** will form potassium nitrate (salt) and water. The balanced equation is:

CuO(s) + 2 HNO3(aq) → Cu(NO3)­2(aq) + H2O(l)

Like the other base reaction, no bubbles are formed; however, it will heat up.

And the ionic equation is: CuO(s) + 2 H+(aq) → Cu+2(aq) + H2O(l)