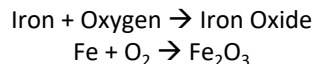


# C5: Chemical Changes: Chemistry Specification

## Metal Oxides

Metals react with oxygen to produce metal oxides. Oxidation is when substances gain oxygen while reduction is when substances lose oxygen. This means that the reactions between metals and oxygen are oxidation reactions. For example:



## Soluble Salts

Soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates. The solid is added to the acid until no more reacts and the excess solid is then filtered off to produce a solution of the salt. The salt solutions can then be crystallised to produce solid salts. To make copper chloride salts you could add copper oxide to warm hydrochloric acid and stir it. You would then filter the solution to remove the excess copper oxide and you would be left with a copper chloride solution. To remove the water you would then crystallise it using a Bunsen burner and evaporating dish.

## The Reactivity Series

When metals react with other substances the metal atoms form positive ion and the reactivity of a metal is related to its tendency to form positive ions. Metals can be arranged in order of their reactivity in a reactivity series. We can do this by observing their reactions with acids and water. The non-metals hydrogen and carbon are often included in the reactivity series. A more reactive metal can displace a less reactive metal from a compound.

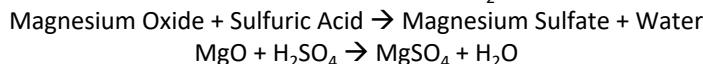
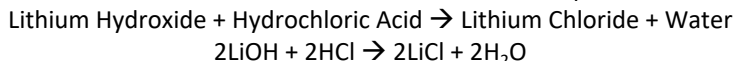
### Most Reactive

Potassium  
Sodium  
Calcium  
Magnesium  
Aluminium  
Carbon  
Zinc  
Iron  
Tin  
Lead  
Hydrogen  
Copper  
Silver  
Gold

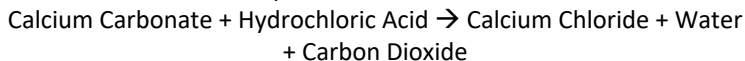
### Least Reactive

## Neutralisation

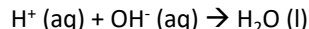
Acids are neutralised by alkalis and bases such as metal hydroxides and metal oxides to make salts and water. For example:



Acids can also react with metal carbonates to make salts, water and carbon dioxide. For example:

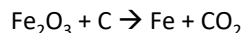
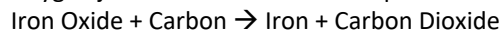


In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to make water. This can be represented by the equation:



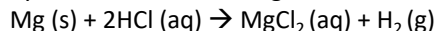
## Extraction of Metals

Most metals are found as compounds in the Earth's crust and so chemical reactions are needed to extract the metal. Gold is unreactive and so is found as a pure metal. Metals less reactive than carbon they can be extracted by reduction with carbon. The metals will lose the oxygen joined to them. For example:

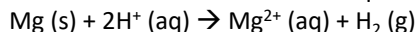


## Oxidation and Reduction

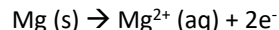
Oxidation is the loss of electrons and reduction is the gain of electrons. For example:



This equation can be summarise with the ionic equation:

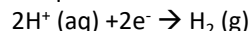


This equation can then be divided into two half equations:



This half equation show that a magnesium atom is becoming a magnesium ion by losing electrons. This means it is being oxidised.

The other part of the half equation is:



This half equation show that 2 hydrogen ions are becoming a hydrogen molecule by gaining electrons. This means they are being reduced. Overall in this reaction electrons are lost and gained and so this is called a redox reaction.

## Metals and Water

To determine the reactivity of metals you could add them to water and record your observations. Most metals do not react very quickly with water, while may don't react at all. However the alkali metals do react with water. This means that they are more reactive than other metals. When the alkali metals are added to water they form a alkaline solution and hydrogen. Potassium reacts the quickest and so is the most reactive, this is followed by sodium and then lithium.

## pH Scale

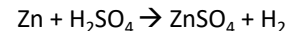
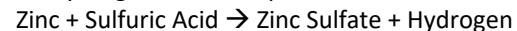
Acids produce hydrogen ions  $\text{H}^+$  in solutions while alkalis contain hydroxide ions  $\text{OH}^-$ . The pH scale, from 0 to 14, is a measure of the acidity or alkalinity of a solution, and can be measured using universal indicator or a pH probe. A solution with pH 7 is neutral while solutions below 7 are acidic and solutions with a pH above 7 are alkaline.

## Strong and Weak Acids

A strong acid such as hydrochloric, nitric and sulfuric acids is completely ionised in aqueous solution. A weak acid such as ethanoic, citric and carbonic acids is only partially ionised in aqueous solution. This means that if you have a strong and weak acid of the same concentration, the strong acid will have a lower pH. As the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10.

## Metals and Acids

Acids react with some metals to produce salts and hydrogen. For example:



Sulfuric Acid has the formula  $\text{H}_2\text{SO}_4$  and makes sulfates. Hydrochloric Acid has the formula  $\text{HCl}$  and makes chlorides.