S2 CfE Science
ACIDS & ALKALIS

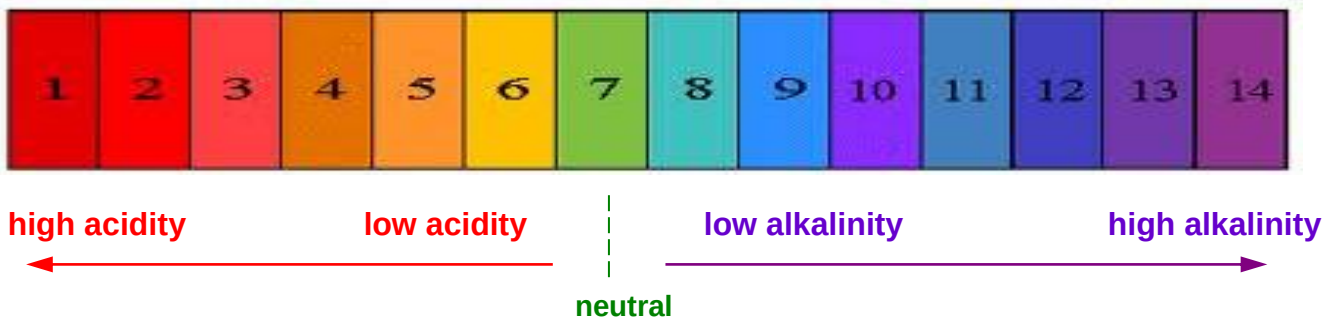
Acids and alkalis can be found all around us. Some are useful and are found in food and in our bodies. For example, vinegar and vitamin C are acids and carbonic acid is in fizzy drinks. Hydrochloric acid is in our stomachs to help us digest food. However many are also dangerous, as both acids and alkalis are corrosive.

pH Scale and Indicators

We can tell whether something is an acid or an alkali using indicators. These are special chemicals which change colour depending on whether the substance is an acid or alkali.

Universal indicator and pH paper have a full range of colours which means they can tell you whether something is an acid, alkali or neutral. It can also tell **how** acidic an acid is or **how** alkaline an alkali is.

When added to a substance the Universal indicator or pH paper changes colour. These colours are then related to a number using the pH scale.



Acids have a pH less than 7.
Alkalis have a pH greater than 7
Neutral substances have a pH equal to 7.

pH of Household Substances

Acids	Neutral Substances	Alkalis
Vinegar	Salt	Cleaning chemicals
Fruit juices	Sugar	Milk of magnesia
Fizzy drinks	Toiletries	Toothpaste

Oxide Compounds and pH

Metal oxides are **alkaline**, if soluble in water.

Non-metal oxides are **acidic**, if soluble in water.

Ions in Acids and Alkalis

Ions are charged particles. This is shown by a '+' or '-' sign to the top right of the chemical symbol.

For example: Na^+, F^-.

Sometimes it can be '2+' or even '3+'.

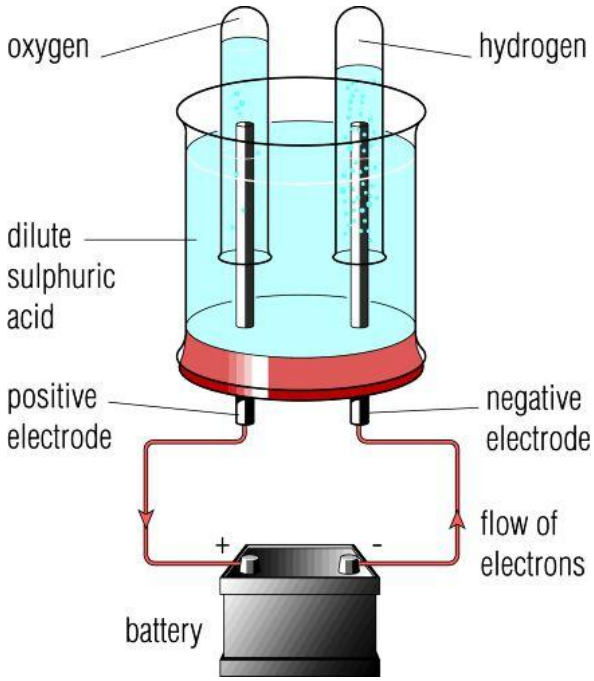
For example: S^{2-}, Ca^{2+}, Al^{3+}.

Acids and alkalis both contain **ions**.
Acids contain lots of hydrogen ions, which have the symbol $\mathbf{H^+}$.
Alkalis contain lots of hydroxide ions, symbol $\mathbf{OH^-}$.

Water is neutral because the number of hydrogen ions is equal to the number of hydroxide ions.

Electrolysis of an Acid

Electrolysis breaks compounds down using electricity. It also proves that hydrogen ions in acids have a positive charge.



Since hydrogen was given off at the **negative** electrode, the hydrogen ions must have a **positive** charge.

Effect of diluting Acids

Concentration of an acid is measured in moles per litre (mol l^{-1}). Adding water **decreases** the concentration of the acid.

When doing this, the pH of the acid **increases** towards 7. It does not reach 7 though.

Diluting an alkali would see the pH **decrease** towards 7, again without reaching 7.

Reactions of Acids

When acids react, their pH increases to 7. There are 4 main reactions of acids.

1. alkali (metal hydroxide) + acid → salt + water
2. metal oxide + acid → salt + water
3. metal carbonate + acid → salt + water + carbon dioxide
4. reactive metals (MAZINTL) + acid → salt + hydrogen

The first 3 reactions are known as **neutralisation** reactions.
Number 4 is a **displacement** reaction.
The name (and type) of salt depends on which acid is involved.

Acid	Name of salt
Hydrochloric acid	_____ chloride
Sulphuric acid	_____ sulphate
Nitric acid	_____ nitrate

Uses of Neutralisation Reactions

There are many examples of **neutralisation** reactions in the world around us:

Lime (an alkali) is added to acidic **soil** and **lakes** to increase the pH. Acid rain can cause the soil and lakes to become acidic.
Toothpaste is **alkaline** to neutralise the acid produced by plaque on our teeth. This acid causes our teeth to rot.
Bee stings are **acidic**, so are treated with an alkali, such as **milk of magnesia**.
Wasp stings are **alkaline**, so are treated with an acid, such as **vinegar**.
Indigestion is caused by too much acid in our stomach. So **indigestion tablets** are alkaline.
Ammonium nitrate is a **salt** made by a neutralisation reaction. This is an important **fertiliser** for plants.