THREE TYPES OF SOLUTIONS

There are three types of solutions: acid, neutral and alkali.

Acids

Hydrochloric acid, Sulphuric acid and Nitric acid are all acids we use in the chemistry laboratory.

Vinegar, lemonade, soda water and Coke are all acids we are more familiar with at home.

Neutral

e.g. Water and Sodium chloride solution.

Alkali

Sodium hydroxide, Limewater and Ammonia solution are all alkalis we use in the chemistry laboratory.

Baking soda, oven cleaner, dishwashing powder, bleach and soap are more commonly used at home.

pH Scale

To measure whether a solution is acidic, alkaline or neutral we use the pH scale which ranges from below 0 to above 14.

Acid							Neutral	Alkali						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
pH														

We can measure a solution's pH in three ways:

1. Universal Indicator

This is a liquid whose colour changes with pH:

pH:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Colour:	<- RED ->		ORANGE	YELLOW		YEL/GREEN		GREEN		GREEN/BLUE		PURPLE			

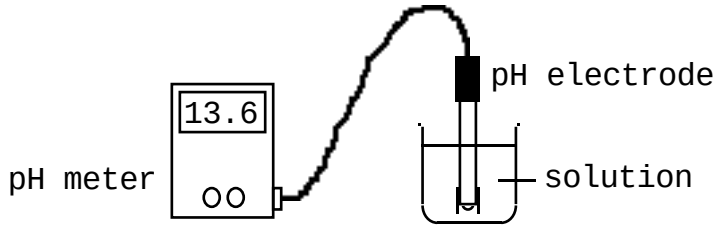
Many flower pigments are natural indicators.
Dissolve these coloured substances from a few flowers and investigate their colours in acids and alkalis.

2. pH paper

This is paper whose colour changes with pH.
The colours are similar to those of Universal Indicator above.

3. pH meter

This is an instrument which measures pH directly. Just insert the the pH electrode into the solution and the pH is shown on the meter.



The lower the pH of an acid the greater the acidity. Strong acids such as Sulphuric acid have pH's between 0 and 2. Weak acids such as Vinegar have pH's between 3 and 6.

The higher the pH of an alkali the greater the alkalinity. Strong alkalis such as Sodium hydroxide solution have pH's between 12 and 14. Weak alkalis such as Ammonia solution have pH's between 8 and 11.

If we dilute an acidic solution the acidity decreases and the pH rises.

If we dilute an alkaline solution the alkalinity decreases and the pH falls.

	Acid						Neutral			Alkali				
pH =	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Diluting acidic solutions raises the pH

Diluting alkaline solutions lowers the pH

Neutralisation

Alkalis react with acids forming neutral solutions. The pH of the acid moves up towards 7; the pH of the alkali moves down towards 7. We call this type of reaction **NEUTRALISATION**.

Examples:

1. Neutralisation of **Hydrochloric acid** with Sodium hydroxide:

Hydrochloric acid	+	Sodium hydroxide	->	Sodium chloride	+	Water

2. Neutralisation of **Sulphuric acid** with Sodium hydroxide:

Sulphuric acid	+	Sodium hydroxide	->	Sodium sulphate	+	Water

3. Neutralisation of **Nitric acid** with Sodium hydroxide:

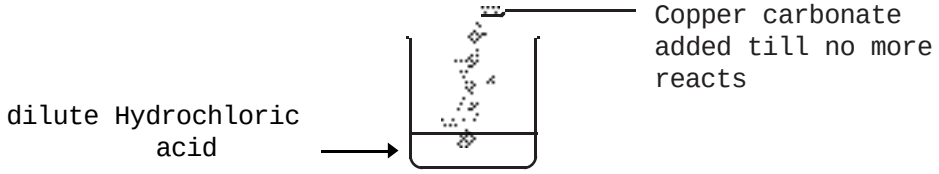
Nitric acid	+	Sodium hydroxide	->	Sodium nitrate	+	Water

The products are always Water and a compound called a **SALT** (Sodium chloride, Sodium sulphate and Sodium nitrate in the above examples).

Acids can also be neutralised by adding metal carbonates when, in addition to Water and a salt, Carbon dioxide gas is also formed.

Add Copper carbonate to Hydrochloric acid

Copper carbonate + Hydrochloric acid -> Copper chloride + Water + Carbon dioxide



When the reaction is over (no more bubbles of Carbon dioxide) the excess Copper carbonate can be filtered off since it is **not** soluble in Water. The Copper chloride is obtained by evaporation of the filtrate.

Everyday examples of neutralisation include:

* the treatment of acid indigestion with Magnesium hydroxide tablets (Milk of Magnesia)

* the use of vinegar to neutralise the alkali in a wasp sting.

Acid Rain

Fossil fuels (coal, oil and natural gas) contain Carbon and Sulphur. When we burn fossil fuels the Carbon reacts with Oxygen forming Carbon dioxide gas:

Carbon + Oxygen -> Carbon dioxide

The Sulphur also reacts with Oxygen forming Sulphur dioxide gas:

Sulphur + Oxygen -> Sulphur dioxide

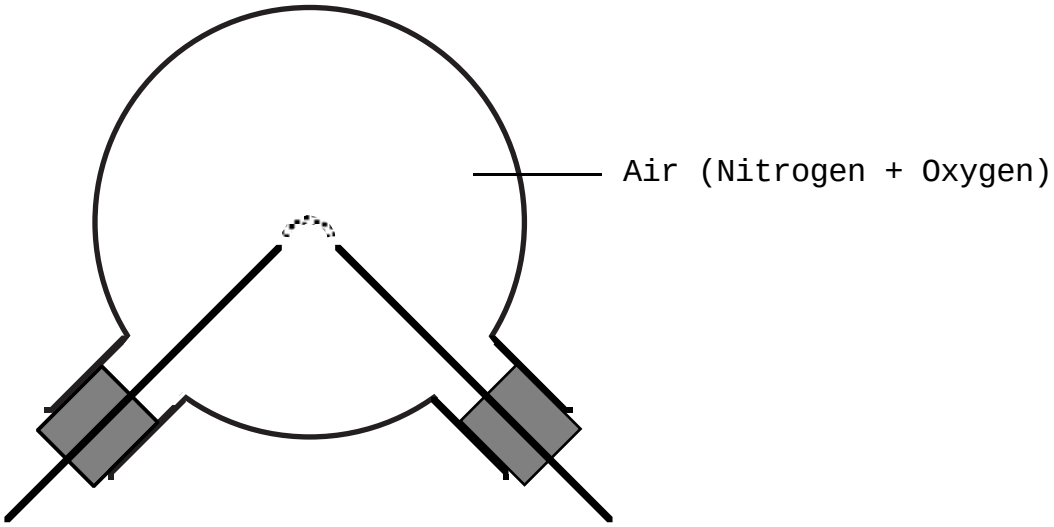
The Carbon dioxide and Sulphur dioxide dissolve in rain water forming acids. We call this **acid rain**. Lochs and rivers become polluted.

Another source of acid rain is the motor car. The sparking of air in the car engine causes Nitrogen and Oxygen in the air to react forming Nitrogen dioxide:

Nitrogen + Oxygen -> Nitrogen dioxide

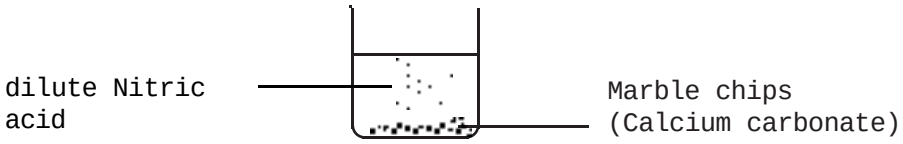
Nitrogen dioxide also dissolves in rain water forming an acid.

If we spark air in the laboratory, the Nitrogen and Oxygen present in the air, react forming Nitrogen dioxide - a brown gas.

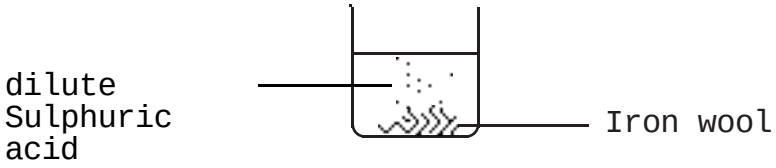


Shaking some of this Nitrogen dioxide with Water produces an acidic solution - it turns Universal Indicator red.

Acid rain damages buildings made of carbonate rock.
e.g. Marble (Calcium carbonate) dissolves slowly in Nitric acid giving off Carbon dioxide.



Acid rain also damages structures made of Iron or steel.
Iron wool dissolves slowly in Sulphuric acid giving off Hydrogen.



Acid rain also destroys soils, plant and animal life.

The problem can be tackled in two ways:

1. Prevention

   If we burned less fossil fuels and relied less on our cars the amount of acid rain could be reduced.

2. Neutralisation

   Acidic lochs can be neutralised by adding Calcium hydroxide.