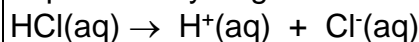


Acids and bases

Acids turn blue litmus paper red. Acids have a pH less than 7.

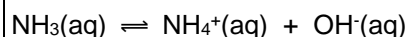
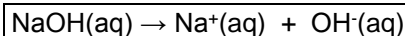
Acids are sources of hydrogen ions, H⁺.

When acids are in water they ionise (dissociate) to produce hydrogen ions - H⁺ (proton).



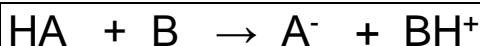
Alkalis turn red litmus paper blue. Alkalis have a pH greater than 7.

Alkalis are sources of hydroxide ions, OH⁻.



An alkali is formed when a base is dissolved in water.

An acid is a proton (H⁺) donor
A base is a proton (H⁺) acceptor



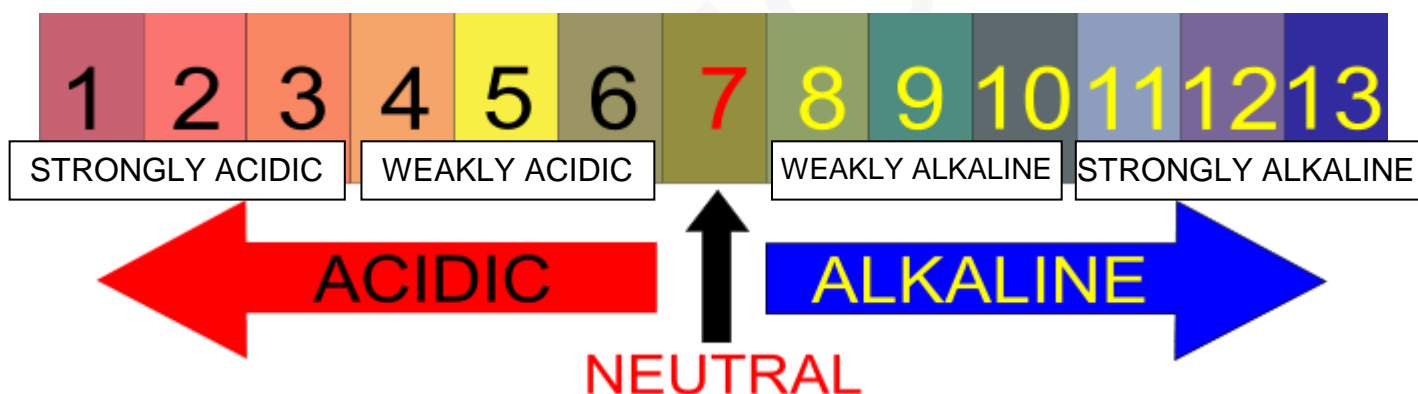
HA (acid) donates a proton (H⁺) to B (base);
 B (base) accepts a proton (H⁺) from HA (acid)

Indicators and the pH scale

Universal indicator can be used to measure the approximate pH value of a solution.

The pH scale is usually shown from pH 0 to pH 14

	Acid	Alkali
Blue Litmus Paper	Red	Blue
Red Litmus Paper	Red	Blue
Methyl orange	Red	Yellow
Phenolphthalein	Colourless	Pink
Universal Indicator	Red	Blue



Types of oxides

Metals form basic oxides – e.g. magnesium burns in oxygen with a bright white flame to form the white solid magnesium oxide (MgO).

Metal oxides, metal hydroxides and ammonia can act as bases.

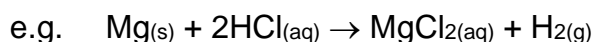
MgO is a basic oxide. MgO is only very slightly soluble in water and reacts to form a slightly alkaline solution: $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$

Non-metals form acidic oxides – CO₂ is an acidic oxide and dissolves in water to form an acidic solution

Reactions of acids

Reactions of acids with metals

Acids react with reactive metals such as magnesium to produce a salt and hydrogen gas:



'MASH'

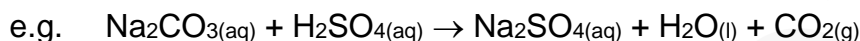
Parent acid	Salts
Sulfuric acid	Sulfates
Hydrochloric acid	Chlorides
Nitric acid	Nitrates

Unreactive metals such as copper do not react with dilute acids.

Aluminium is a reactive metal but does not react readily with acids at room temperature. This is because the aluminium is protected by an impermeable layer of aluminium oxide on its surface. It will, however, react when heated.

Reactions of metals with carbonates and hydrogencarbonates

Acids react with carbonates and hydrogencarbonates to produce a salt, carbon dioxide and water.



Reactions of metals with bases and alkalis

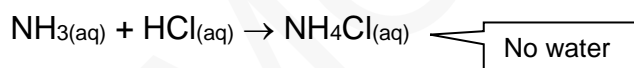
Bases are metallic oxides such as copper(II) oxide. These react with acids to form a salt and water. This is called a neutralisation reaction.



Alkalis are bases that dissolve in water and the reaction between an acid and alkali is the same as that between an acid and a base.



The reactions of ammonia solution, an alkali, with acids are often written slightly differently, i.e.



Solubility

SOLUBLE	INSOLUBLE
All common salts of sodium, potassium and ammonium	
All nitrates	
All common chlorides except	silver chloride and lead(II) chloride
All common sulfates except	barium sulfate, calcium sulfate, lead(II) sulfate
Sodium, potassium and ammonium carbonate	all other common carbonates
Sodium, potassium hydroxides, Calcium hydroxide is slightly soluble	All other common hydroxides

Note: ammonium hydroxide is equivalent to ammonia solution and is also soluble

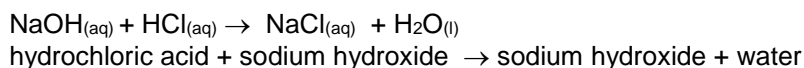
Most metal oxides are insoluble in water – those that are soluble dissolve to form alkalis. E.g. sodium oxide (sodium hydroxide solution), potassium oxide (potassium hydroxide solution)

Preparation of Salts

Soluble salts:

Method (a) Titration – used for making sodium, potassium and ammonium salts (which have soluble hydroxides – alkalis).

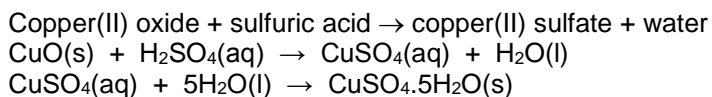
To make sodium chloride:



- Add a known volume of hydrochloric acid to a conical flask using a pipette.
- Add three drops of a suitable indicator (NOT universal indicator).
- Fill a burette with sodium hydroxide.
- Add sodium hydroxide from the burette slowly until the indicator just changes colour
- Repeat the titration using exactly the same quantities but without the indicator.
- Heat the resulting salt solution in an evaporating basin to evaporate off some of the water - until the solution is saturated.
- Allow the salt to crystallise
- Separate the crystals from the remaining solution (e.g. by filtration)
- Dry the crystals by leaving them in a warm place or by patting them with a paper towel.

Method (b) - used for making all other soluble salts. This method involves adding excess of an insoluble metal oxide (base), metal carbonate or metal to an acid. Excess is added to make sure that all the acid is neutralised.

Making copper(II) sulfate solution



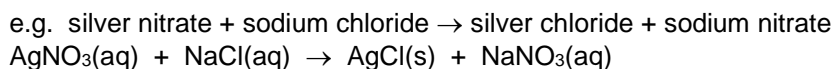
- Heat some dilute sulfuric acid in a beaker
- Add excess black copper(II) oxide and continue heating. Keep adding copper(II) oxide until there is copper(II) oxide left over.
- Filter off the excess copper(II) oxide
- Heat the filtrate (solution), which is blue, in an evaporating basin to evaporate off some of the water until the solution is saturated.
- Stop heating the reaction mixture and allow it to cool slowly at room temperature so that larger crystals can form.
- Remove the blue crystals from the reaction mixture by filtration or by just pouring off the remaining solution.
- The crystals can be blotted dry with a paper towel or left to dry in a warm place.

For carbonates and metals – you can tell excess has been added when there is no more fizzing and metal/carbonate left over. These do not need to be heated

Test for saturation by dipping a glass rod into the solution. If crystals form very quickly on the glass rod we know that solution is very close to saturated and crystals will also begin to form in the solution.

Insoluble salts

Method (c) Precipitation - Solutions of two soluble salts are mixed. They react together to form a precipitate of an insoluble salt (the other product must be a soluble salt). Use the nitrate of the metal part of the salt that you want and sodium or potassium salt of the other part.



Use lead(II) nitrate

Use sodium or potassium sulfate

Preparation of lead(II) sulfate

- Mix a solution of lead(II) nitrate in a beaker with a solution of sodium sulfate
- A white precipitate of lead(II) sulfate forms.
- Filter the reaction mixture.
- Wash the residue (white, lead(II) sulfate) with distilled water
- Put in a warm oven to dry