Acids and Alkalis

Acids, Bases, and Alkalis

Term	Definition	Properties
Acid	a family of chemicals that react in similar ways and have a pH less than 7	• some are edible and found in foods (e.g. citrus fruits) but lab acids may be harmful • taste sour (never tasted in lab) • can be corrosive and cause chemical burns • concentrated acids are more corrosive
Base	a family of chemicals that react in similar ways and have a pH greater than 7	• taste bitter (never tasted in lab) • some are soluble in water (called alkalis)
Alkali	a soluble base; has a pH greater than 7	• many cleaning products are alkalis e.g. bleach • taste bitter (never tasted in lab) • can feel slippery or soapy • can be corrosive and cause chemical burns • concentrated alkalis are more corrosive
All alkalis are bases, but not all bases are alkalis because some bases are insoluble		

Hazard signs to be aware of when dealing with acids and alkalis:


corrosive


moderate health hazard (irritant)

Other chemical hazard symbols:


oxidising


flammable


serious health hazard


toxic


environmental hazard

Risks of Working With Acids and Alkalis	Control Measures
Splashes of acids or alkalis can damage eyes.	Wear eye protection.
People may not know how to work with acids and alkalis.	Educate people how to work with acids and alkalis.
Strong acid or alkali fumes can irritate the lungs.	Use in a well-ventilated area.
Some acids and alkalis can react with other chemicals.	Store away from reactive chemicals, in labelled, corrosion-resistant containers.
Acids or alkali spills can harm wildlife or the environment.	Dispose of acids and alkalis carefully and follow instructions.

Acids and Alkalis

Indicators and pH Scale

- Solutions can be acidic, alkaline or neutral.
- Acidic solutions form when acids dissolve in water.
- Alkaline solutions form when alkalis dissolve in water.
- Solutions that are neither acidic nor alkaline are neutral.
- Pure water is neutral.

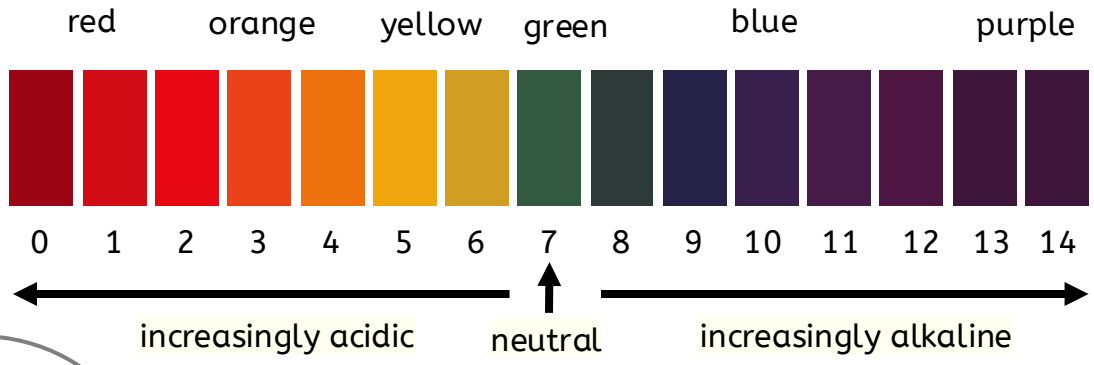
An **indicator** changes colour to show whether a solution is acidic, neutral or alkaline.

Many flowers, fruits and vegetables (plants) contain chemicals called pigments that change colour in acids or alkalis. These can be extracted and made into a solution that acts as a simple indicator.

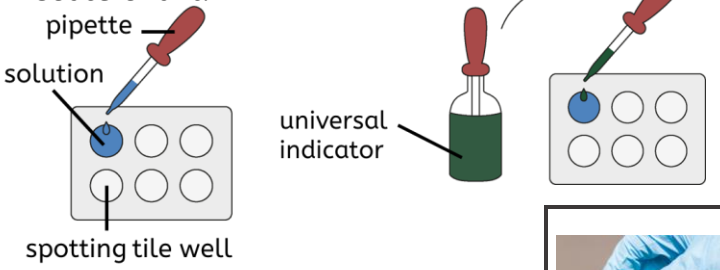
	Acidic Solution	Alkaline Solution	Neutral Solution
Blue litmus	turns red	stays blue	stays blue
Red litmus	stays red	turns blue	stays red

- Simple indicators like litmus paper do not tell you the pH of an acid or alkali - only if it is acid or alkali.
- They can't tell how acidic or how alkaline a solution is.

- Universal indicator can tell us how acidic or how alkaline a solution is.
- This is measured using the pH scale, which runs from pH 0 to pH 14.
- Neutral solutions are exactly pH 7.
- Acidic solutions have a pH less than 7. The closer to pH 0, the more acidic a solution is.
- Alkaline solutions have a pH more than 7. The closer to pH 14, the more alkaline a solution is.



Universal indicator can be used to determine the pH of a range of solutions. Once added to a solution, the colour can be observed and compared to colours on the pH scale chart.



A pH meter is an electric device which measures pH and provides a specific pH value. It provides a more accurate and precise measurement of pH, rather than a colour that is then compared to a reference.

Acids and Alkalis

Acids and Metals

Reacting Metals With Acids

metal + acid → metal salt + hydrogen

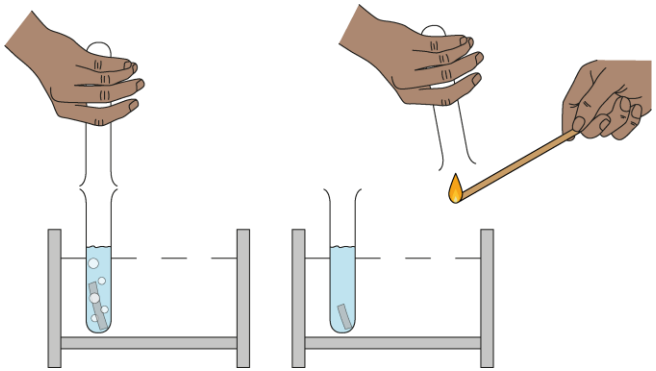
e.g. zinc + hydrochloric acid → zinc chloride + hydrogen

- When an acid reacts with a metal, bubbles of hydrogen gas can be observed.
- The metal will get smaller as it reacts with the acid (corrosion of the metal).
- The reaction is usually exothermic, indicated by an increase in temperature.

- first name of salt = metal
- surname of salt = from the name of the acid

Name of Acid	Chemical Formula	Type of Salt
hydrochloric acid	HCl	chloride
sulfuric acid	H_2SO_4	sulfate
nitric acid	HNO_3	nitrate

The presence of hydrogen can be tested for using a lit splint. Hold the lit splint to the gas and listen for a squeaky pop sound. This indicates the presence of hydrogen.



Neutralisation

The pH of a solution can be changed by adding an acid or base/ alkali.

- Adding an acid to water will decrease the pH from 7.
- Adding a base/ alkali to water will increase the pH from 7.

- When acids and bases or alkalis are mixed in the correct quantities, a neutral solution is made.
- When bases/ alkalis are added to acids, the pH increases, becoming less acidic and more neutral.
- When acids are added to bases, the pH decreases, becoming less alkaline and more neutral.

When an acid reacts with an alkali (or base) in the correct quantities, a neutral salt solution is formed. This is called **neutralisation**.

acid + alkali → salt + water

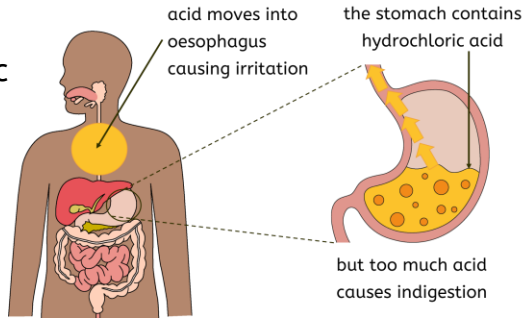
e.g. sodium hydroxide + hydrochloric acid → sodium chloride + water

The salt formed is named after the metal in the alkali (base) and the name of the acid in the reaction.

Acids and Alkalis

Neutralisation (Continued)

Indigestion is caused by excess hydrochloric acid in the stomach. The acid moves into the oesophagus causing irritation and a burning sensation. Indigestion remedies,



called antacids, are bases that alleviate symptoms by reacting with stomach acid and neutralise it.

It is possible to test different antacids by reacting them with acid to see which one is the most effective at neutralising it.

If a different group or a different method gives the same results, the data is **reproducible**. This shows that when compared to data from other enquiries, the results are still consistent and therefore trustworthy.

Metal Oxides and Non-Metal Oxides

- A metal oxide is a compound that consists of metal atoms chemically joined to oxygen atoms.
- A non-metal oxide is a compound that consists of non-metal atoms chemically joined to oxygen atoms.

Metal Oxides	Non-Metal Oxides
usually solids at room temperature	often gases at room temperature e.g. sulfur dioxide
act as bases, with a pH greater than 7	most are soluble in water and react with water to form acidic solutions e.g. carbonic acid
some react with water to form an alkali (e.g. sodium hydroxide)	

- Metal oxides are bases and can react with acids to neutralise them.
- The general equation for the neutralisation reaction between a metal oxide and acid is: acid + metal oxide → salt + water
  e.g. hydrochloric acid + copper oxide → copper chloride + water

The salt formed is named after the metal in the metal oxide (base) and the name of the acid in the reaction.

Acid Rain

- All rain is naturally slightly acidic (around pH 5.5) because carbon dioxide dissolves in it.
- Acid rain has a pH below 5 and is caused by pollutant gases such as:
  - sulfur dioxide - released when fossil fuels that contain sulfur are burned.
  - nitrogen oxides - form when nitrogen and oxygen in the air react at high temperatures in vehicle engines and power stations
- These gases react with water vapour, oxygen, and other chemicals to form sulfuric acid and nitric acid, which dissolve in rain.
- Acid rain reacts with metals (causing corrosion) and rocks (chemical weathering), damaging buildings, statues and metal structures. It makes lakes and rivers more acidic, which can kill fish and other aquatic organisms.
  It damages the waxy cuticle of leaves, reducing photosynthesis, and removes minerals from soil, slowing plant growth.

Pollutants travel. Acid rain can fall far from where pollutants were released.