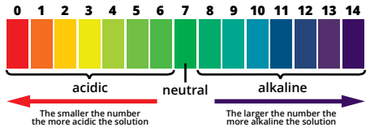
2.2 Acids, Bases and Salts

Indicators and the pH Scale:

- Indicators are substances that **change colour** when they are added to acids and alkalis.
- **Litmus** is the most well-known indicator.
- It turns red in acid and blue in alkalis.
- Universal indicator is most commonly used in the laboratory. When added to a solution, it changes to a colour that shows the pH of the solution.



Acidic = pH < 7
Neutral = pH 7
Alkaline = pH > 7

Acids, Bases and Alkalis:

- Acids and alkalis are commonly used both in industry and at home.

Acids:

- Acids produce hydrogen ions, H^+, when they dissolve in water, e.g. for hydrochloric acid:

$$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$$

Bases:

- A base is chemically opposite to an acid. A base that dissolves in water is called an alkali.

Alkalis:

- Alkalis produce hydroxide ions, OH^-, when they dissolve in water, e.g. for sodium hydroxide:

$$NaOH(aq) \rightarrow Na^+(aq) + OH^-$$

Whilst some acids and alkalis are dangerous, others, such as those in vinegar or lemon juice, can be sprinkled on our food! Those that are dangerous have the **corrosive** hazard warning symbol on their containers.

Neutralisation:

- A neutralisation reaction happens when an acid and an alkali 'cancel each other out'. The reaction always produces a **salt** and **water**.

acid + alkali → salt + water

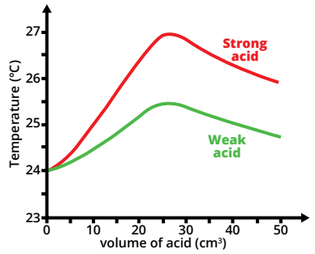
- The **H^+ ions** from the acid react with the **OH^- ions** from the alkali to form **water**. (HT only)

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

- The name of the **salt** produced depends upon the acid and alkali that react.

Strong and Weak Acids (SS only):

- Strong acids **fully dissociate** (ionise) in water whereas weak acids only partially dissociate.
- Strong acids have **high numbers of H^+ ions** in their solutions, so low pH values.
- Strong acids react more quickly than weak acids.



The graph shows that the temperature rise during the reaction between magnesium and a strong acid is higher than that with a weak acid.

Note – acid strength and concentration are not the same thing!

- » The **strength** of an acid is a measure of the degree of its **dissociation**.
- » The **concentration** of an acid is a measure of the **number of moles** of acid **in 1 dm³ of solution**.

Reactions of acids:

- Acids react with metals, bases and carbonates to form **salts**.
- The name of a salt formed has **two parts**. The first part comes from the metal, base or carbonate. The second part comes from the acid.

Acids and Metals:

- Acids will react with **metals** to make a **salt** and **hydrogen** gas.

acid + metal → salt + hydrogen

hydrochloric acid + zinc → zinc chloride + hydrogen

$$2HCl + Zn \rightarrow ZnCl_2 + H_2$$

- The hydrogen causes **bubbling** during the reaction. The reaction is **exothermic**.
- The **more reactive the metal**, the **faster** the reaction is, resulting in **more bubbling** and a **bigger temperature rise**.

Acids and Alkalis/Bases:

- Acids react with **alkalis** and **bases** to make a **salt** and **water**.
- **Alkalis** are commonly **metal hydroxides**.

acid + alkali → salt + water

nitric acid + sodium hydroxide → sodium nitrate + water

$$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$$

- **Bases** are commonly **metal oxides**.

acid + base → salt + water

sulfuric acid + zinc oxide → zinc sulfate + water

$$H_2SO_4 + ZnO \rightarrow ZnSO_4 + H_2O$$

- The reactions of acids with alkalis and bases are **exothermic**.

Acids and Carbonates:

- Acids will react with carbonates to make a **salt**, **water** and **carbon dioxide** gas.

acid + carbonate → salt + water + carbon dioxide

nitric acid + sodium carbonate → sodium nitrate + water + carbon dioxide

$$2HNO_3 + Na_2CO_3 \rightarrow 2NaNO_3 + H_2O + CO_2$$

- The **carbon dioxide** causes **bubbling** during the reaction. The reaction is **exothermic**.