Strong Acid, Weak Acids and their reactions

- In aqueous solutions, acids ionise to produce hydrogen ions (H^+). An aqueous solution just means 'dissolved in water', so water is the solvent. The strength of an acid depends on how much it ionises in water.

Strong acids

- In aqueous solutions, strong acids completely ionise to form H^+ ions, making the solution highly acidic. Below are some examples of strong acids:

  I. Hydrochloric acid: $HCl\ (aq) \rightarrow H^+\ (aq) + Cl^-\ (aq)$
  II. Sulfuric acid: $H_2SO_4\ (aq) \rightarrow 2H^+\ (aq) + SO_4^{2-}\ (aq)$
  III. Nitric acid: $HNO_3\ (aq) \rightarrow H^+\ (aq) + NO_3^-\ (aq)$

- As all of the acid molecules fully ionise in water.

Weak acids

- In aqueous solutions, weak acids only partially ionise, so the solution is less acidic than with strong acids. Below are some examples of weak acids:

  I. Ethanoic acid: $CH_3COOH\ (aq) \rightleftharpoons H^+\ (aq) + CH_3COO^-\ (aq)$
  II. Carbonic acid: $H_2CO_3\ (aq) \rightleftharpoons H^+\ (aq) + HCO_3^-\ (aq)$

- We can identify a weak acid by the reversible reaction symbol ($\rightleftharpoons$). This symbol means that the reaction is in a state of equilibrium, where the amount of product and reactant is constant. This means that only a small proportion of the acid molecules ionise in water, resulting in a relatively low concentration of H+ ions.

Don't confuse strong Acid with concentrated Acids:

- Weak and strong should not be mistaken for dilute and concentrated.
- **Acid strength** with strong or weak tell us what proportion of acid molecules ionise in water.
- **Concentrations of an Acid is Different:** Concentration measure how much Acid there is in certain volume of water.

I. A **dilute acid** has the acid molecules mixed with a large amount of water, so that there is only a low concentration of H^+ ions.

II. **Concentrated acids** have little to no water molecules mixed with the acid molecules, meaning the concentration of H^+ ions is high.

Hydrogen Ion Concentration or pH of An Acid

- In aqueous solutions, the concentration of hydrogen ions (H^+) can be measured using the pH level.

I. A higher concentration of hydrogen ions (H^+) in a solution results in a lower pH level
II. A lower concentration of hydrogen ions (H^+) in a solution results in a higher pH level

- Strong acids fully ionise, producing a higher concentration of H^+ ions, while weak acids only partially ionise. Therefore, the more concentrated the solution of an acid, the lower the pH level will be.

- As the pH scale decreases by one unit, the concentration of H^+ ions increases by a factor of 10. For example, a solution with a pH of 1 has a concentration that is 10 times greater than a solution with a pH of 2, and 100 times greater than a solution with a pH of 3.

General Reactions

- When **acids** react with different chemicals, they can make different products. Using different acids will create **salts** that have different names. In the table below you can see how each of these acids affects the name of the possible salt:

Acids	**hydrochloric acid**	**sulfuric acid**	**nitric acid**
salt name	metal **chloride**	metal **sulfate**	metal **nitrate**

1. Acids + Metals

- A salt and hydrogen are produced when acids react with metals.

acid + metal → salt + hydrogen

I. hydrochloric acid + magnesium → magnesium chloride + hydrogen

$2HCl(aq) + Mg(s) \rightarrow MgCl_2(aq) + H_2(g)$

2. Acids + Metal Oxides

➤ A salt and water are produced when acids react with metal oxides.

acid + metal oxide → salt + water

I. nitric acid + lithium oxide → lithium nitrate + water

$2HNO_3(aq) + Li_2O(s) \rightarrow 2LiNO_3(aq) + H_2O(l)$

3. Acids + Metal Hydroxides

➤ A salt and water are produced when acids react with metal hydroxides.

acid + metal hydroxide → salt + water

I. sulfuric acid + sodium hydroxide → sodium sulfate + water

$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

4. Acids + Metal Carbonates

➤ A salt, water, and carbon dioxide are produced when acids react with metal carbonates.

acid + metal hydroxide → salt + water + carbon dioxide

I. sulfuric acid + calcium carbonate → calcium sulfate + water + carbon dioxide

$H_2SO_4(aq) + CaCO_3(s) \rightarrow CaSO_4(aq) + H_2O(l) + CO_2(g)$

Difference between Strong Acid and weak Acids

CONCENTRATED ACID	STRONG ACID
Concentrated acids are solutions containing a high amount of acid molecules, irrespective of their degree of ionization	Strong acids are acidic substances that fully dissociate into ions when dissolved in water, resulting in a high concentration of ions in solution
May or may not fully ionize in solution, depending on the specific acid and its concentration	Completely ionize in solution, releasing a high concentration of hydrogen ions
May exhibit lower conductivity if they do not fully ionize	Exhibit high conductivity due to complete ionization, facilitating the flow of electric current
Can be made dilute if more water is added to it	May remain strong even if it is diluted
pH of a strong acid solution is very low	pH of a weak acid solution is about 3-5
Acid dissociation constant is a higher value	Acid dissociation constant is a lower value
Release all the H+ ions to the solution	Do not release all H+ ions

Making Soluble Salts using insoluble Base

➤ To make a soluble salt, you can react an acid with an insoluble base. The following steps can be followed to create soluble salts:

1. Start by adding an excess of the insoluble base to an acid, such as dilute sulfuric acid (H_2SO_4).

- Make sure to allow all of the insoluble base to react with the acid before proceeding to the next step. Continue adding the base until you are confident that the reaction has finished.

- In reactions between metal carbonates and acids, there is effervescence (fizzing) due to the release of carbon dioxide.

2. After the reaction, remove any excess reactant using filtration.

- This ensures that the only compounds remaining in the beaker or container will be the salt and water.

3. To separate the salt and water, gently heat the solution to evaporate the water.

- This will leave salt crystals behind in the beaker.

For example, you can prepare copper (II) sulphate by reacting copper (II) oxide with dilute sulphuric acid:

$$\mathbf{CuO\ (s) + H_2SO_4\ (aq) \longrightarrow CuSO_4\ (s) + H_2O\ (l)}$$

4. Stop the heat and leave it to cool down. Crystal of salt should form which can be filtered out from the solution and dried it.this process is known as Crystallisation.