

Reversible Reactions \rightleftharpoons Reactants \rightleftharpoons Products

- A **reversible** reaction is a chemical change in which the products can be converted back to the original reactants under suitable conditions.
- In other words, you can change the position of the chemical
- A reversible reaction is shown by the sign \rightleftharpoons ,
 - a half-arrow to the right (direction of **forward reaction**),
 - and a half-arrow to the left (direction of **backward reaction**).
- Most reactions are not reversible (**irreversible**) and have the usual complete arrow \rightarrow only pointing to the right.

The thermal decomposition of ammonium chloride

- On heating strongly above 340°C, the white solid ammonium chloride, **thermally decomposes** into a mixture of two colourless gases ammonia and hydrogen chloride.
- On cooling the reaction is reversed and solid ammonium chloride reforms.
 - **Ammonium chloride + heat \rightleftharpoons ammonia + hydrogen chloride**
 - $\text{NH}_4\text{Cl}_{(s)} \rightleftharpoons \text{NH}_3(g) + \text{HCl}_{(g)}$
 - **Thermal decomposition** means using 'heat' to 'break down' a molecule into smaller ones.
 - The **decomposition is endothermic** (heat absorbed or heat taken in) and the **formation of ammonium chloride is exothermic** (heat released or heat given out).
 - This means if the direction of chemical change is reversed, the energy change is also reversed.
 - Similarly, **ammonium sulphate also sublimates** when heated above 235°C and thermally decomposes into ammonia gas and sulphuric acid vapour.



The thermal decomposition of hydrated copper(II) sulphate

- On heating the blue solid, hydrated copper(II) sulphate, steam is given off and the white solid of anhydrous copper(II) sulphate is formed.
- When the white solid is cooled and water added, blue hydrated copper(II) sulphate is reformed.
 - **blue hydrated copper(II) sulphate + heat \rightleftharpoons white anhydrous copper(II) sulphate + water**
 - $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}_{(s)} \rightleftharpoons \text{CuSO}_{4(s)} + 5\text{H}_2\text{O}_{(g)}$
 - The dehydration decomposition to give the white solid is the forward reaction and the 're-hydration' to reform the blue crystals is the backward reaction.
 - The **5H₂O** in the formula of hydrated copper(II) sulphate is called the **water of crystallisation** and forms part of the crystal structure when copper(II) sulphate solution is evaporated and crystals form.