# Reaction rate and Reversible reaction.

## Reaction rate

- The rate of a reaction is a measure of how quickly a reactant is used up, or a product is formed.
- Different chemical reactions occur at different rates. Some examples are illustrated in Table.

| Type of reaction | Fast reaction | Slow reaction |
|---|---|---|
| **Reaction involving liberation of a gas** | Bubbles of carbon dioxide gas liberate rapidly when sodium carbonate powder reacts with dilute hydrochloric acid. $Na_2CO_3$ (s) + 2HCl(aq) → 2NaCl(aq) + $CO_2$ (g) + $H_2O$(l) | In photosynthesis, carbon dioxide reacts with water very slowly in the presence of sunlight and chlorophyll to produce glucose and oxygen gas. $6CO_2$(g) + $6H_2O$(l) → $C_6H_{12}O_6$ (s) + $6O_2$ (g) |
| **Precipitation reaction** | When silver nitrate solution is added to sodium chloride solution, a white precipitate of silver chloride is formed immediately. $AgNO_3$ (aq) + NaCl(aq) → AgCl(s) + $NaNO_3$ (aq) | When dilute hydrochloric acid is added to sodium thiosulphate solution, a yellow precipitate of sulphur appears only after a few seconds. $Na_2SO_4$ (aq) + 2HCl(aq) → 2NaCl(aq) + S(s) + $SO_2$ (g) + $H_2O$(l) |
| **Heating a metal in air** | When a small piece of potassium is heated in air, it burns rapidly to form a white solid of potassium oxide. 4K(s) + $O_2$ (g) → $2K_2O$(s) | When a small piece of copper is heated in air, it reacts slowly with oxygen in the air to form a black solid of copper (II) oxide. 2Cu(s) + $O_2$ (g) → 2CuO(s) |

## Measuring reaction rate

This is done by observing either the amount of reactants consumed or the amount of products formed per unit time. Some of the measurable visible changes in a chemical reaction are;

- Volume of gas liberated.
- Change in mass during a reaction.
- Colour changes.

<u>Examples to illustrate how the rate of reaction is measured.</u>

Reaction between magnesium and dilute sulphuric acid

$$Mg(s) + H_2SO_4 (aq) \rightarrow MgSO_4 (aq) + H_2 (g)$$

- In the reaction between dilute sulphuric acid and a magnesium ribbon, the following two changes are observed:
    - The mass of magnesium (the reactant) decreases with time.
    - The volume of hydrogen gas (the product) increases with time.
- Hence, the rate of reaction between dilute sulphuric acid and magnesium can be determined by measuring the *change in the mass of magnesium* or the *volume of hydrogen gas* per unit time.

## Collision theory and activation energy

- For particles to react, they have to collide with sufficient energy. (that means if they collide with less energy nothing happens)
- This sufficient energy is called **activation energy**.
- *The activation energy is the minimum amount of energy needed for a collision to be successful.*
- A collision that produces a reaction is called a **successful collision**.
- The greater the number of 'successful' collisions, the faster the rate of a reaction. This is called the **'collision theory'**.

The diagram below show activation energy for a reaction