# 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 <sub>2</sub> CO <sub>3</sub> (s) + 2HCl(aq) $\rightarrow$ 2NaCl(aq) + CO <sub>2</sub> (g) + H <sub>2</sub> O(l)	In photosynthesis, carbon dioxide reacts with water very slowly in the presence of sunlight and chlorophyll to produce glucose and oxygen gas. $6\text{CO}_2(g) + 6\text{H}_2\text{O}(l) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(s) + 6\text{O}_2(g)$
Precipitation reaction	When silver nitrate solution is added to sodium chloride solution, a white precipitate of silver chloride is formed immediately.  AgNO <sub>3</sub> (aq) + NaCl(aq) → AgCl(s) + NaNO <sub>3</sub> (aq)	When dilute hydrochloric acid is added to sodium thiosulphate solution, a yellow precipitate of sulphur appears only after a few seconds. Na <sub>2</sub> SO <sub>4</sub> (aq) + 2HCl(aq) $\rightarrow$ 2NaCl(aq) + S(s) + SO <sub>2</sub> (g) + H <sub>2</sub> O(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. $4K(s) + O_2(g) \rightarrow 2K_2O(s)$	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. $2Cu(s) + O_2(g) \rightarrow 2CuO(s)$

## 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.

Examples to illustrate how the rate of reaction is measured.

Reaction between magnesium and dilute sulphuric acid

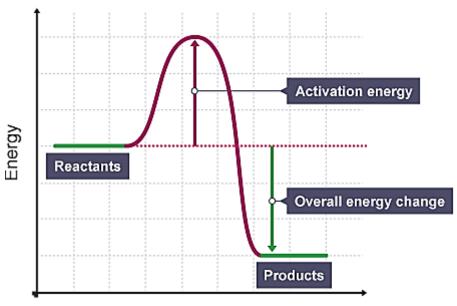
$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

- In the reaction between dilute sulphuric acid and a magnesium ribbon, the following two changes are observed:
  - o The mass of magnesium (the reactant) decreases with time.
  - o 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



Progress of reaction