

Reversible Reactions and Equilibrium

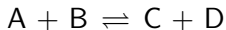
GCSE Chemistry

March 10, 2025

Reversible Reactions

In some chemical reactions, the products can react to form the original reactants.

Representation:



Key Point: The direction of reversible reactions can be changed by altering the conditions (e.g., temperature or pressure).

Energy Changes in Reversible Reactions

Exothermic and Endothermic Reactions:

- ▶ If a reversible reaction is **exothermic** in one direction, it is **endothermic** in the opposite direction.
- ▶ The same amount of energy is transferred in both directions.

Example:



Endothermic and Exothermic Reactions

Endothermic Reactions:

- ▶ Absorb energy from the surroundings.
- ▶ Result in a temperature **decrease** in the surroundings.
- ▶ Example: Photosynthesis or dissolving ammonium nitrate in water.

Exothermic Reactions:

- ▶ Release energy to the surroundings.
- ▶ Result in a temperature **increase** in the surroundings.
- ▶ Example: Combustion or neutralisation reactions.

Key Point: In reversible reactions, if one direction is endothermic, the other is exothermic.

Equilibrium

Dynamic Equilibrium:

- ▶ Achieved in a **closed system** where no reactants or products can escape.
- ▶ At equilibrium, the forward and reverse reactions occur at the **same rate**.

Key Concept: At equilibrium, the concentrations of reactants and products remain constant, but the reactions continue to occur.

Le Chatelier's Principle

When a system at equilibrium is disturbed:

- ▶ The system responds to **counteract the change**.
- ▶ The equilibrium position shifts to minimise the disturbance.

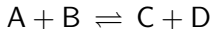
Key Idea: The effects of changing conditions (e.g., concentration, temperature, pressure) can be predicted using **Le Chatelier's Principle**.

Effect of Changing Concentration (HT)

Key Points:

- ▶ Increasing the concentration of a reactant shifts the equilibrium towards the **products**.
- ▶ Decreasing the concentration of a product shifts the equilibrium towards the **reactants**.
- ▶ The system adjusts until equilibrium is restored.

Example:



Increasing **A** or **B** leads to more **C** and **D**.

Effect of Changing Temperature (HT)

Key Points:

▶ For Endothermic Reactions:

- ▶ Increasing temperature shifts equilibrium towards the **products**.
- ▶ Decreasing temperature shifts equilibrium towards the **reactants**.

▶ For Exothermic Reactions:

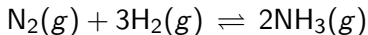
- ▶ Increasing temperature shifts equilibrium towards the **reactants**.
- ▶ Decreasing temperature shifts equilibrium towards the **products**.

Effect of Changing Pressure (HT)

For gaseous reactions at equilibrium:

- ▶ Increasing pressure shifts equilibrium towards the side with **fewer molecules**.
- ▶ Decreasing pressure shifts equilibrium towards the side with **more molecules**.

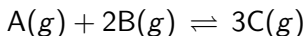
Example:



- ▶ Increasing pressure favours **ammonia (NH₃)** formation (fewer molecules).

Practice Problems

1. What happens to the equilibrium position when:
 - ▶ The concentration of a reactant is increased?
 - ▶ The temperature is decreased for an exothermic reaction?
2. Predict the effect of increasing pressure on the following reaction:



3. Explain Le Chatelier's Principle in your own words.

Answers to Practice Questions

1. What happens to the equilibrium position when:

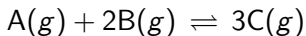
- ▶ **The concentration of a reactant is increased?**

The equilibrium shifts towards the **products** to reduce the concentration of the reactant.

- ▶ **The temperature is decreased for an exothermic reaction?**

The equilibrium shifts towards the **products**, as the system releases more heat to counteract the decrease in temperature.

2. Predict the effect of increasing pressure on the reaction:



Increasing pressure shifts the equilibrium towards the side with **fewer molecules** of gas. In this case, towards **A and B**. 3.

Explain Le Chatelier's Principle:

If a system at equilibrium is disturbed by changing the conditions, the equilibrium shifts to **counteract the change**.