IGCSE CHEMISTRY • EXERCISE SHEET

6.3 Reversible reactions and equilibrium

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS equilibrium 平衡 • reverse reaction 逆反应 • haber 哈伯法 • contact 接触法 • reversible reaction 可逆

Objective

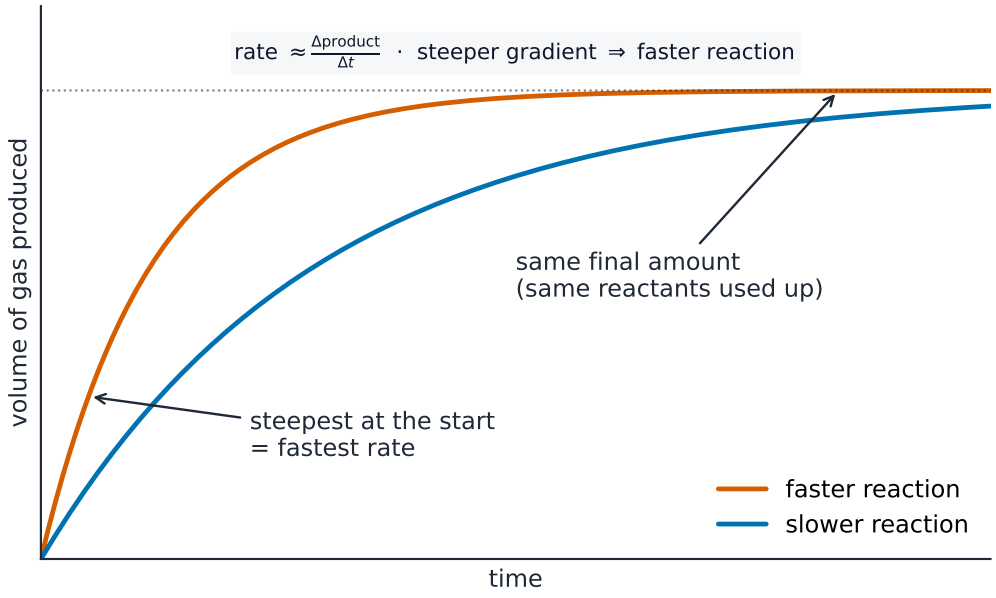
Build the skills to answer exam questions on **reversible reactions and equilibrium** 可逆反应与平衡 — the ⇌ symbol, **equilibrium** 平衡, moving the position, and the **Haber** 哈伯法 and **Contact** 接触法 processes.

You must be able to:

- describe a reversible reaction (e.g. hydrated/anhydrous salts)
- state the conditions for equilibrium in a closed system
- predict how temperature/pressure/concentration shift the equilibrium

1 Worked examples

■ Equilibrium and the Haber process



At equilibrium the forward and reverse rates are equal and concentrations stop changing

- **Haber:** $N_2 + 3H_2 \rightleftharpoons 2NH_3$; ~450 °C, ~200 atm, iron catalyst.
- **shifts:** more pressure → side with fewer gas molecules; add a substance → moves to use it up.
- a **catalyst** does **not** shift the position — only speeds up reaching equilibrium.

2 Practice

2.1 State the two conditions for a reaction at equilibrium. [2]

2.2 Give the catalyst used in the Haber process. [1]

3 Exam-style questions

3.1 Adding a catalyst to a reaction at equilibrium: [1]

- **A** moves the equilibrium to the products
- **B** moves it to the reactants
- **C** does not move the position, but reaches equilibrium faster
- **D** stops the reaction

3.2 In the Haber process $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$.

(a) State the effect of increasing the pressure on the amount of ammonia. [2]

(b) Explain why a temperature of about 450 °C is used, even though a lower temperature would give more ammonia. [2]

3.3 Anhydrous copper(II) sulfate is white; adding water turns it blue. State what this is used to test for, and why this is a reversible reaction. [2]

Solutions

2.1 the forward and reverse reactions occur at the same rate; the concentrations of reactants and products stay constant.

2.2 iron.

3.1 C. A catalyst does not change the position; it only speeds up reaching equilibrium.

3.2 (a) the amount of ammonia increases; because the equilibrium moves to the side with fewer gas molecules (2 vs 4).
(b) a lower temperature gives more ammonia but the reaction is too slow; 450 °C is a compromise that keeps a good rate.

3.3 it tests for water; the reaction can go both ways — losing water (heating) and gaining it again.