A-LEVEL CHEMISTRY • EXERCISE SHEET

8.1 Rate of reaction

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

KEY WORDS rate of reaction 反应速率 • collision 碰撞 • effective collision 有效碰撞 • collision frequency 碰撞频率 • non-effective collision 无效碰撞

Objective

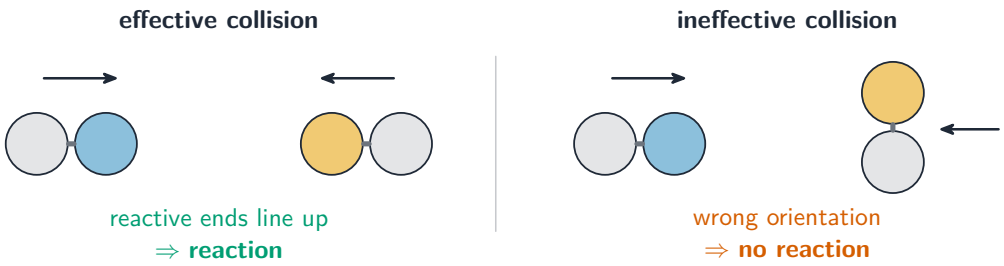
Build the skills to answer exam questions on **rate of reaction** — **collision** 碰撞 theory, **effective collisions** 有效碰撞, and the effect of concentration and pressure.

You must be able to:

- explain rate, collision frequency, and effective vs non-effective collisions
- explain the effect of concentration and pressure on rate
- calculate a rate from experimental data

1 Worked examples

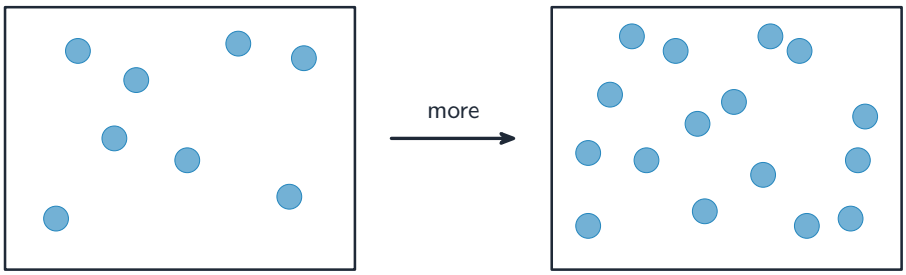
Collisions and rate



A collision only reacts with the right orientation and enough energy — an effective collision

The **rate** is the change in concentration (or amount) per unit time. It depends on the **frequency of effective collisions**.

Concentration and pressure



More particles in the same volume collide more often, so the rate rises

Increasing concentration (or gas pressure) packs particles closer → more effective collisions per second → faster rate.

2 Practice

2.1 State the **two** things a collision needs to be effective. [2]

2.2 Explain why increasing the concentration of a reactant speeds up a reaction. [2]

3 Exam-style questions

3.1 Increasing the pressure of a gas reaction increases the rate because: [1]

- **A** the particles gain activation energy
- **B** the particles are closer, so collide more often
- **C** the activation energy falls
- **D** the catalyst works better

3.2 A reaction produces 48 cm^3 of gas in 20 s. The mean rate of reaction is: [1]

- **A** 0.42 $cm^3\,s^{-1}$
- **B** 2.4 $cm^3\,s^{-1}$
- **C** 24 $cm^3\,s^{-1}$
- **D** 960 $cm^3\,s^{-1}$

3.3 A reaction makes carbon dioxide. The volume collected is 30 cm^3 at 15 s and 54 cm^3 at 45 s.

(a) Calculate the mean rate of reaction between 15 s and 45 s. [2]

(b) Explain why the rate is faster at the start of the reaction than near the end. [2]

Solutions

2.1 enough energy (at least the activation energy); the correct orientation/direction.

2.2 there are more particles in the same volume, so they collide more often — more effective collisions per second.

3.1 B. Higher pressure brings particles closer, so they collide more often.

3.2 B. $48/20 = 2.4\ \text{cm}^3\,\text{s}^{-1}$.

3.3 (a) $\dfrac{54-30}{45-15} = \dfrac{24}{30} = 0.80\ \text{cm}^3\,\text{s}^{-1}$.
(b) at the start the reactant concentration is highest, so collisions are more frequent and the rate is faster; as reactant is used up the rate falls.