A-LEVEL CHEMISTRY • EXERCISE SHEET

8.1 Rate of reaction

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

Objective

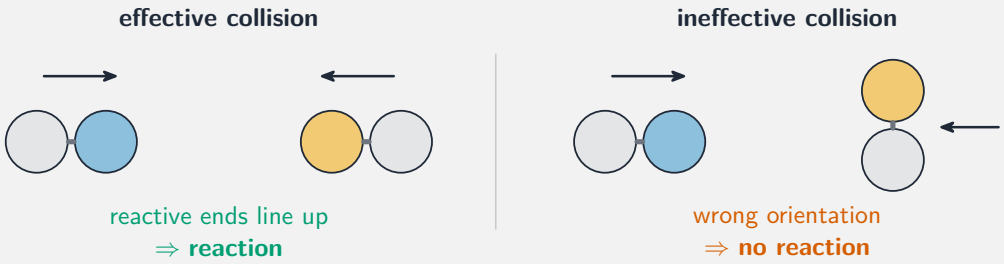
Build the skills to answer exam questions on **rate of reaction** —**collision** 碰撞 theory, **effective collisions** 有效碰撞, and the effect of concentration and pressure.

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

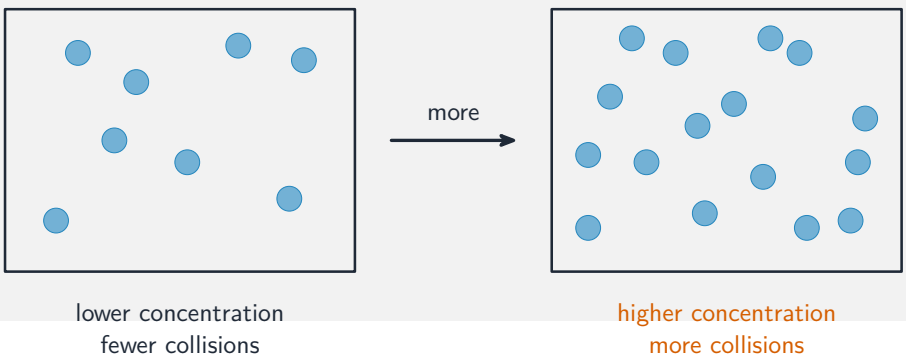
Collisions and rate



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]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **8.1 Rate of reaction** past-paper sheet in the Library, or try these in **Practice mode**:

- 9701/12 N25 —Q14 (rates)
- 9701/33 N25 —Q1 (rates practical, calculation)

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.