

5.1 How Fast a Reaction Goes

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS rate 反应速率 • catalyst 催化剂 • activation energy 活化能

Objective

Build the skills to answer exam questions on **reaction rate** — how fast a reaction goes and what changes it.

You must be able to:

- express **rate** 反应速率 as change in concentration per time
- list the factors that change rate (concentration, temperature, surface area, catalyst)
- explain each factor with collision ideas

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Rate as a change per time

The **rate** is how fast a reactant is used up or a product forms:

$$\text{rate} = \frac{\Delta[\text{concentration}]}{\Delta t},$$

usually in mol L⁻¹s⁻¹.

■ Factors that speed up a reaction

- Higher concentration** — more particles per volume ⇒ more collisions.
- Higher temperature** — faster particles, and more with enough energy.
- Larger surface area** — more exposed particles to collide with.
- A catalyst** — a lower-energy pathway.

■ The collision picture

A reaction happens when particles **collide** with enough energy and the right orientation. Anything that increases the **frequency** or **energy** of successful collisions speeds the reaction.

■ Reading a rate from a graph

On a concentration-vs-time graph, the rate is the **slope**. The reaction is fastest at the start (steepest) and slows as reactants run out.

2 Practice

Now apply the methods above.

2.1 Write the definition of reaction rate. [1]

2.2 State two factors that increase reaction rate. [2]

2.3 Why does a powder react faster than a lump of the same mass? [1]

3 Exam-style questions

3.1 Increasing the concentration of a reactant increases the rate because it [1]

A	B
C	D

- A lowers the activation energy
- B increases the collision frequency
- C changes the products
- D cools the mixture

3.2 A reaction is run at 20°C and again at 40°C.

(a) State which is faster. [1]

(b) Give two reasons, in terms of particle collisions, why raising temperature speeds a reaction. [2]

3.3 Explain, using collision ideas, why a catalyst speeds up a reaction without being used up. [2]