AP CHEMISTRY • EXERCISE SHEET

5.1 How Fast a Reaction Goes

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

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 $L^{-1}s^{-1}$.

■ 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** 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]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **5.1 How Fast a Reaction Goes** lesson on the **Learn** page;
- read the **How Fast a Reaction Goes** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 The change in concentration of a reactant or product per unit time.

2.2 Any two: higher concentration, higher temperature, larger surface area, a catalyst.

2.3 A powder has a larger surface area, so more particles are exposed to collide.

3.1 B —more particles per volume means more frequent collisions.

3.2 (a) 40°C. (b) Particles move faster (more frequent collisions) and more of them have energy above the activation energy (more successful collisions).

3.3 A catalyst provides an alternative pathway with a lower activation energy, so more collisions succeed; it is regenerated at the end, so it is not consumed.