

5.5 Why Collisions Do or Do Not React

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS activation energy 活化能 • orientation 取向 • collision theory 碰撞理论
• reaction rate 反应速率

Objective

Build the skills to answer exam questions on **collision theory** — why some collisions react and others do not.

You must be able to:

- state the two requirements for a successful collision (**energy** and **orientation** 取向)
- define **activation energy** 活化能 E_a
- link temperature to the fraction of successful collisions

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.

■ Two requirements

For a collision to react, the particles must collide with:

- at least the **activation energy** E_a (enough energy to break bonds), and
- the correct **orientation** (the right parts must meet).

Most collisions fail one of these, so only a fraction react.

■ Activation energy

E_a is the **minimum energy** needed to start the reaction — the barrier that must be climbed before products form.

■ Temperature and successful collisions

Raising temperature gives particles more kinetic energy, so a **larger fraction** exceed E_a . This is the main reason a small temperature rise can greatly speed a reaction.

■ The Maxwell-Boltzmann link

On the speed distribution, the molecules to the right of E_a can react. Heating shifts the curve right, moving **more** molecules past E_a .

2 Practice

Now apply the methods above.

2.1 State the two requirements for a successful collision. [2]

2.2 Define activation energy. [1]

2.3 Why does raising temperature increase the fraction of successful collisions? [1]

3 Exam-style questions

3.1 The activation energy is the [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** energy released by the reaction
B minimum energy needed for a collision to react
C average energy of the particles
D energy of the products

3.2 Two gas molecules collide but do not react.

(a) Give two possible reasons. [2]

(b) Explain how heating the gas would increase the reaction rate. [2]

3.3 On a Maxwell-Boltzmann distribution, explain what the area to the **right** of E_a represents and how it changes with temperature. [2]
