

8 Rate of reaction – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word *three times*. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
effective collisions	有效碰撞	_____
catalyst	催化剂	_____
activation energy	活化能	_____
Boltzmann distribution	玻尔兹曼分布	_____
enthalpy change	焓变	_____
homogeneous catalyst	均相催化剂	_____
heterogeneous catalyst	多相催化剂	_____

Recall

From Part 1 you know reactions need **effective collisions** 有效碰撞. Here we look at how **temperature** and a **catalyst** 催化剂 change the rate.

- The **activation energy** 活化能 is the least energy a collision needs.
- A graph called the Boltzmann distribution shows which molecules have enough.

New ideas

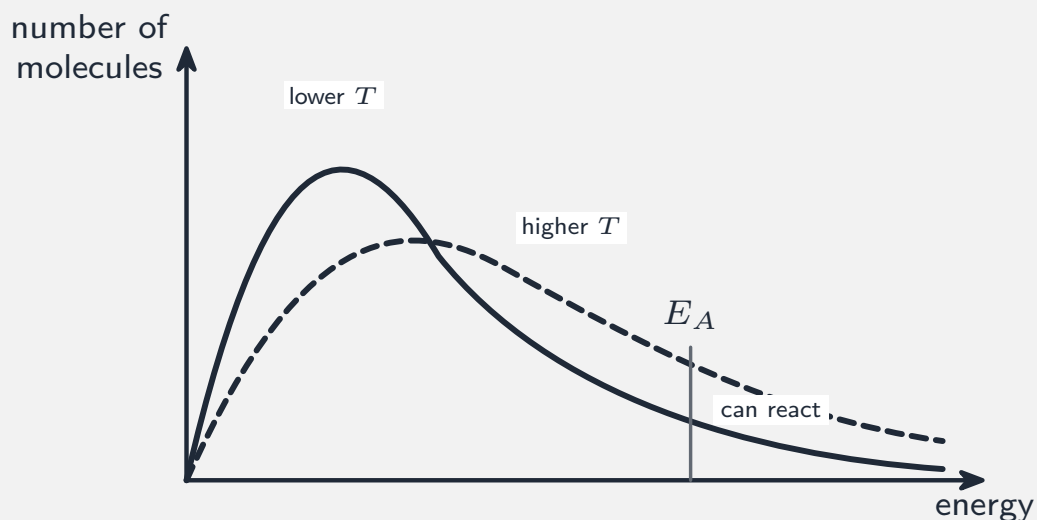
Read these first, then do the Practice.

■ 1 The Boltzmann distribution

The **Boltzmann distribution** 玻尔兹曼分布 shows how the molecules' energies are spread at one temperature. Only the molecules to the **right** of the **activation**

energy 活化能 (E_A) have enough energy to react.

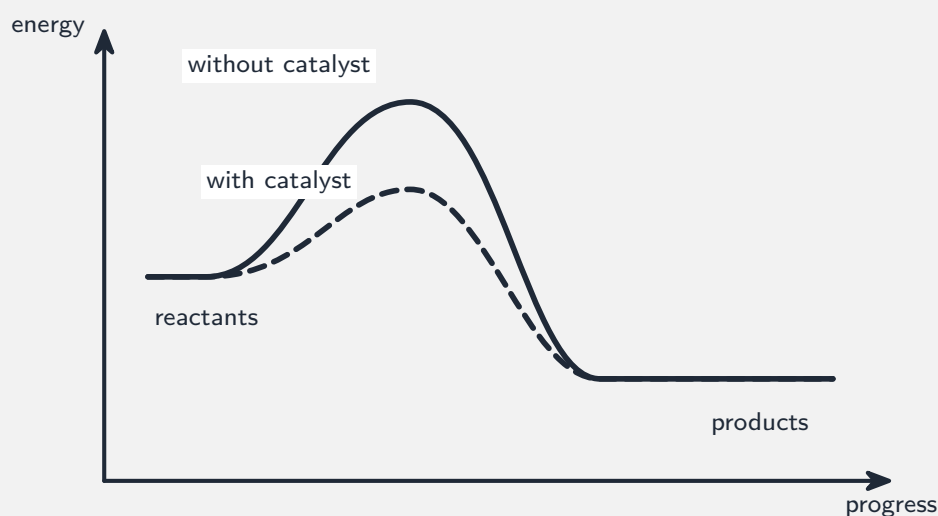
Raising the temperature **spreads the curve to the right**, so a **much larger fraction** of molecules now have energy above E_A —this is why a small temperature rise gives a big rise in rate.



■ 2 Catalysts

A **catalyst** 催化剂 speeds up a reaction but is **not used up**. It gives a new route with a **lower activation energy**, so more collisions are effective.

- the **enthalpy change** 焓变 (ΔH) is **not** changed.
- a **homogeneous catalyst** 均相催化剂 is in the **same** state as the reactants.
- a **heterogeneous catalyst** 多相催化剂 is in a **different** state (e.g. a solid surface).



Watch out: a catalyst lowers the *activation energy* by giving an alternative route—it does *not* change ΔH (the reactant and product energies are unchanged), and it is not used up.

Practice

Try these in order.

8.1 What does the activation energy mean? [1]

8.2 On the Boltzmann distribution, which molecules are able to react? [1]

8.3 Explain why a small rise in temperature gives a large rise in rate. [2]

8.4 How does a catalyst speed up a reaction? [2]

8.5 Does a catalyst change the enthalpy change, ΔH , of a reaction? [1]

8.6 State the difference between a homogeneous and a heterogeneous catalyst. [2]

8.7 Challenge. Using the Boltzmann distribution, explain why a catalyst speeds up a reaction even at the *same* temperature. [2]
