

8.3 Homogeneous and heterogeneous catalysts

Name: _____ Class: _____ Date: _____

Total: 13 marks

KEY WORDS catalyst 催化剂 • heterogeneous catalyst 多相催化剂 • mechanism 反应机理
• homogeneous 均相 • reaction pathway diagram 反应路径图

Objective

Build the skills to answer exam questions on **catalysts** 催化剂 — how a catalyst works, and the difference between **homogeneous** 均相 and **heterogeneous** 多相 catalysts.

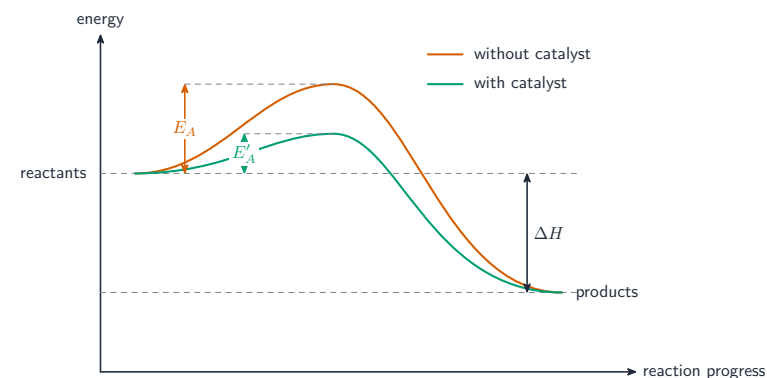
You must be able to:

- explain that a catalyst gives a different mechanism of lower activation energy
- explain the catalytic effect using the Boltzmann distribution
- construct and interpret reaction pathway diagrams with and without a catalyst

1 Worked examples

■ How a catalyst works

A **catalyst** speeds up a reaction without being used up. It provides a different **mechanism** 反应机理 with a **lower activation energy**.



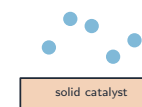
The catalysed route has a lower E_A ; ΔH is unchanged

On the Boltzmann distribution, lowering E_A moves the line left, so more molecules can react → faster rate.

■ Homogeneous vs heterogeneous



homogeneous
(same state,
mixed in)



heterogeneous
(different state,
a surface)

Homogeneous: same state as the reactants (e.g. acid in solution). Heterogeneous: a different state (e.g. solid iron with gases)

2 Practice

2.1 State what a catalyst does and what happens to it during the reaction. [2]

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

3 Exam-style questions

3.1 A catalyst increases the rate of a reaction by: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A increasing the activation energy
 - B providing a route with a lower activation energy
 - C making the reaction more exothermic
 - D raising the temperature

3.2 Which property of a reaction is **not** changed by adding a catalyst? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A the rate
 - B the activation energy
 - C the enthalpy change, ΔH
 - D the mechanism

3.3 (a) Explain, using the Boltzmann distribution, why a catalyst speeds up a reaction.[2]

(b) Sketch a reaction pathway diagram showing the catalysed and uncatalysed routes for an exothermic reaction. [3]

3.4 Iron is used in the Haber process. State whether it is a homogeneous or heterogeneous catalyst, and explain your answer. [2]
