

8.3 Homogeneous and heterogeneous catalysts

Name: _____ Class: _____ Date: _____

Total: 13 marks

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.

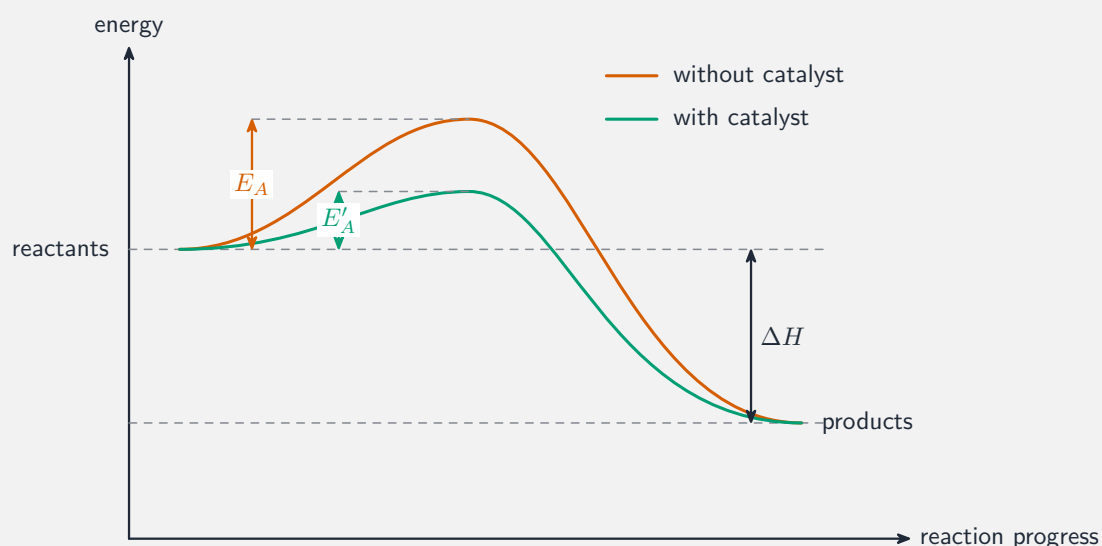
You must be able to:

- 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

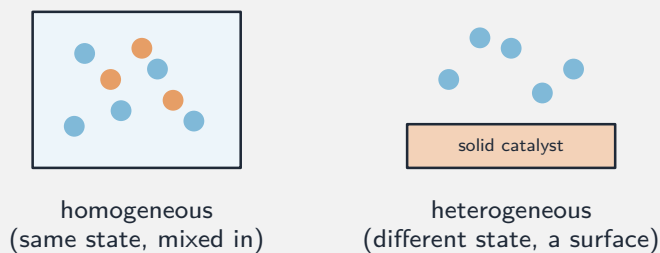
A **catalyst** speeds up a reaction without being used up. It provides a different **mechanism** 反应机理 with a **lower activation energy**.



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 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 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 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]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **8.3 Homogeneous and heterogeneous catalysts** past-paper sheet in the Library, or try these in **Practice mode**:

- 9701/11 N25 —Q15 (catalysts)
- 9701/14 N25 —Q14 (catalysis)
- 9701/24 N25 —Q2 (catalysts, structured)

Solutions

2.1 it speeds up the reaction; it is not used up / is regenerated.

2.2 homogeneous—in the same physical state as the reactants; heterogeneous—in a different state.

3.1 B. A catalyst provides a route with lower activation energy.

3.2 C. The enthalpy change is unchanged by a catalyst.

3.3 (a) the catalyst lowers the activation energy; so a larger fraction of molecules now exceed E_A and can react—more effective collisions per second.

(b) reactants higher than products (exothermic); two activation-energy humps, the catalysed one lower; same ΔH marked between reactants and products.

3.4 heterogeneous; the iron is a solid while the reactants (N and H) are gases—a different physical state.