

26.2 Homogeneous and heterogeneous catalysts

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS catalyst 催化剂 • heterogeneous 多相 • heterogeneous catalyst 多相催化剂 • homogeneous 均相 • homogeneous catalyst 均相催化剂

Objective

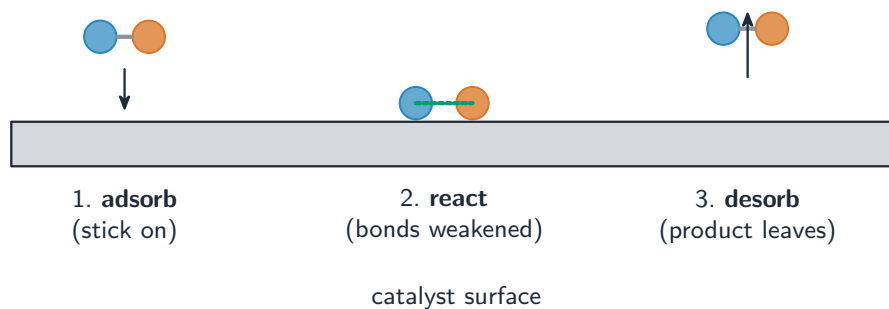
Build the skills to answer exam questions on the **mode of action of catalysts** 催化剂作用方式 — **heterogeneous** 多相 and **homogeneous** 均相 catalysis.

You must be able to:

- describe heterogeneous catalysis (adsorption, bond weakening, desorption)
- describe homogeneous catalysis (used in one step, reformed in a later step)
- give the examples in the syllabus

1 Worked examples

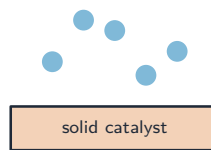
■ Heterogeneous catalysis



*A heterogeneous catalyst works at its surface: **adsorption** of reactants → **bond weakening** → reaction → **desorption** of products*



homogeneous
(same state,
mixed in)



heterogeneous
(different state,
a surface)

Homogeneous versus heterogeneous catalysis

Examples: **iron** in the Haber process; **Pt/Pd/Rh** in catalytic converters (removing NO_x).

■ Homogeneous catalysis

A homogeneous catalyst (same state as the reactants) is **used in one step and reformed in a later step**. Examples: oxides of nitrogen catalysing $\text{SO}_2 \rightarrow \text{SO}_3$ in the atmosphere; $\text{Fe}^{2+}/\text{Fe}^{3+}$ catalysing the $\text{I}^-/\text{S}_2\text{O}_8^{2-}$ reaction (the Fe ion is regenerated, so it is a catalyst not a reactant).

2 Practice

2.1 State the three stages of heterogeneous catalysis. [3]

2.2 State what “homogeneous” means for a catalyst. [1]

3 Exam-style questions

3.1 In heterogeneous catalysis, the reactant molecules first: [1]

- A desorb from the surface
- B adsorb onto the catalyst surface
- C dissolve in the catalyst
- D evaporate

3.2 The iron catalyst in the Haber process is an example of a: [1]

- A homogeneous catalyst

- **B** heterogeneous catalyst
 - **C** reactant
 - **D** product
-

3.3 Explain how a heterogeneous catalyst speeds up a reaction at its surface. [3]

3.4 Fe^{2+} catalyses the reaction between iodide ions and peroxodisulfate ions. Explain why it is described as a homogeneous catalyst, not a reactant. [2]

Solutions

2.1 adsorption of the reactants onto the surface; reaction (bonds weakened); desorption of the products.

2.2 it is in the same physical state as the reactants.

3.1 B. Reactants first adsorb onto the catalyst surface.

3.2 B. Solid iron with gaseous reactants is a heterogeneous catalyst.

3.3 reactant molecules adsorb onto the catalyst surface; this weakens their bonds and holds them close together, lowering the activation energy; the products then desorb, freeing the surface.

3.4 the Fe^{2+} is used in one step but is regenerated (reformed) in a later step, so it is not used up overall — it is a catalyst, in the same (aqueous) state as the reactants.