

Exercise walk-through

2.4.1

Rates: gradients, energy distributions and catalysts

Pearson Edexcel · International A-Level · Chemistry

Controls distinguish chemical evidence from contamination

- 1 Set up** Match measured amounts, particle size, apparatus and heating rate; compare sample temperature at a consistent decomposition criterion.
- 2 Reason** CO_2 : milky limewater; O_2 : glowing splint relights; NO_2 : brown and acidic.
- 3 Conclude** Clean flame-test wire and keep the flame region/loading consistent. Na yellow, K lilac, Ca brick-red, Sr crimson-red; sodium carry-over can mask another colour.

Equilibrium is dynamic

- 1** Forward and reverse rates are equal in a closed system; concentrations need not be equal.
- 2** Higher pressure favours fewer gas moles; higher temperature favours the endothermic direction.
- 3** A catalyst reaches the same equilibrium sooner. Industrial operation balances rate, yield and cost.

Independent identification

Your turn

$\text{C}_3\text{H}_6\text{O}$ has a carbonyl IR absorption and gives a positive Fehling's test. Which structure fits all evidence?

- A. CH_3COCH_3
- B. $\text{CH}_3\text{CH}_2\text{CHO}$
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D. CH_3COOH

Exercises 2.1·2.3

2.1 Two trials reach the same visible endpoint in 40 s and 25 s. Calculate their comparative rates and their rate ratio, second/first. [3]

2.2 Explain why powdered calcium carbonate reacts faster than equal mass of large chips with the same excess acid. [2]

2.3 State two changes in a Maxwell–Boltzmann curve on raising temperature for the same number of molecules, and identify the area relevant to successful collisions. [3]

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2.1 $1/40 = 0.0250 \text{ s}^{-1}$; $1/25 = 0.0400 \text{ s}^{-1}$; ratio $0.0400/0.0250 = 1.60$.

2.2 Explain why powdered calcium carbonate reacts faster than equal mass of large chips with the same excess acid. [2]

2.2 Powder has greater exposed surface area, so acid particles collide with accessible carbonate more frequently. It does not automatically increase the final CO_2 amount.

2.3 State two changes in a Maxwell–Boltzmann curve on raising temperature for the same number of molecules, and identify the area relevant to successful collisions. [3]

2.3 Peak becomes lower and shifts to higher energy. Area beyond the activation threshold increases; total area remains constant.

Exercise 3.1

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3.1 rate = $\Delta V / \Delta t = (42 - 18) / (80 - 20) = 0.40 \text{ cm}^3 \text{ s}^{-1}$. Final volume/time is an

Exercise 3.2

3.2 A catalyst gives a two-step exothermic route. Draw the uncatalysed and two-step catalysed profiles on the same labelled axes, including the intermediate, and explain two different possible industrial benefits without saying a catalyst always raises atom economy. [4]

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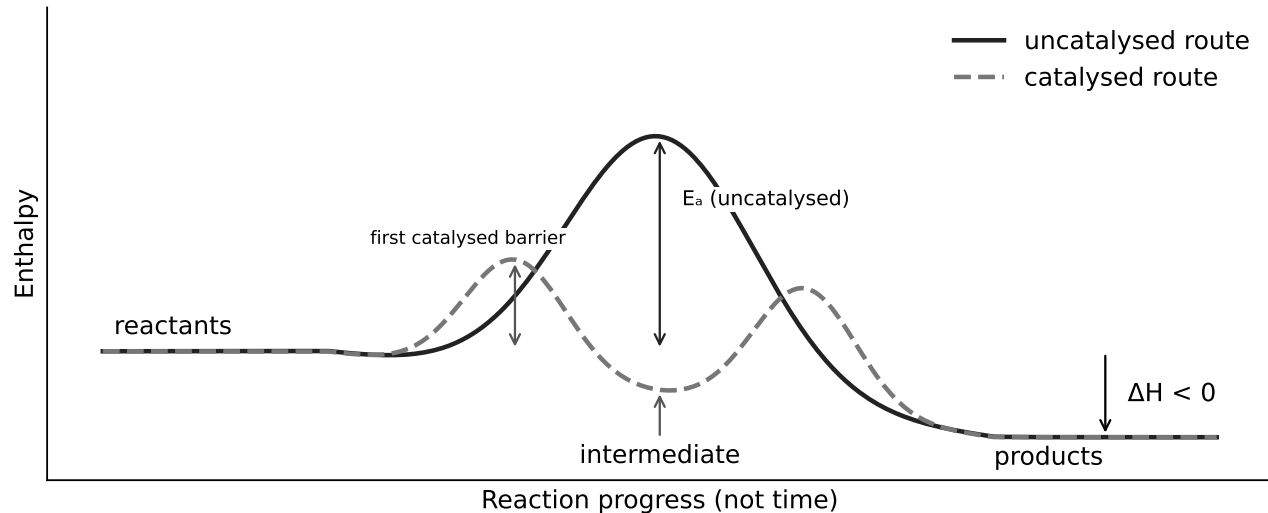
3.2

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— uncatalysed route
 - - - catalysed route

Full solution 3.2

3.2



Two catalysed maxima with an intermediate minimum; lower activation barriers and unchanged initial/final levels/ ΔH . Adequate rate at lower temperature saves energy. A selective catalyst may reduce unwanted products and improve atom economy; this depends on the reaction pathways.