

Exercise walk-through

4.1.2

Kinetic mechanisms and activation energy

Pearson Edexcel · International A-Level · Chemistry

Find the temperature boundary

Your turn

$\Delta H = +36.0 \text{ kJ mol}^{-1}$; $\Delta S(\text{system}) = +120 \text{ J mol}^{-1} \text{ K}^{-1}$. Which condition gives positive total entropy?

- A. T below 300 K
- B. T above 300 K
- C. Every temperature
- D. No temperature

Buffer after neutralisation

Your turn

0.0100 mol HA receives 0.00400 mol OH^- . Which HA:A⁻ ratio enters the buffer expression?

- A. 10:4
- B. 6:4
- C. 4:6
- D. 10:6

Independent structural identification

Your turn

$\text{C}_3\text{H}_6\text{O}$ has two carbon-13 signals, gives iodoform and no Tollens' silver. Which structure fits?

- A. Propanal
- B. Propanone
- C. Propan-1-ol
- D. Ethanoic acid

Exercises 2.1·2.3

2.1 A reaction is first order in RX and zero order in OH^- . State the simple substitution mechanism supported and the slow-step event. [2]

2.2 A plot of $\ln k$ against $1/T$ has gradient -6000 K . Given $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$,

2.3 Explain why doubling nucleophile concentration can double the rate of $\text{S}_{\text{N}}2$ but leave the simple $\text{S}_{\text{N}}1$ rate unchanged. [2]

Exercises 2.1·2.3

2.1 A reaction is first order in RX and zero order in OH^- . State the simple substitution mechanism supported and the slow-step event. [2]

2.1 $\text{S}_{\text{N}}1$; slow heterolytic C-X cleavage forming a carbocation and halide ion.

2.2 A plot of $\ln k$ against $1/T$ has gradient -6000 K . Given $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$,

2.2 $E_a = -R \times \text{gradient} = 49860 \text{ J mol}^{-1} = 49.9 \text{ kJ mol}^{-1}$.

2.3 Explain why doubling nucleophile concentration can double the rate of $\text{S}_{\text{N}}2$ but leave the simple $\text{S}_{\text{N}}1$ rate unchanged. [2]

2.3 Nucleophile participates in the $\text{S}_{\text{N}}2$ rate-determining collision; it attacks after the slow ionisation in the simple $\text{S}_{\text{N}}1$ sequence.

Exercises 3.1·3.2

3.1 For $A + B \rightarrow C$, measured $r = k[A]$. A proposed sequence is slow $A \rightarrow I$, then fast $I + B \rightarrow C$. Check its overall equation and rate consistency. Explain the limit of the conclusion. [4]

3.2 A solid catalyst loses activity when a strongly adsorbed impurity enters the feed. Explain using surface sites, then distinguish the effects of removing the impurity and raising temperature on an equilibrium yield at fixed pressure. [4]

Exercises 3.1·3.2

3.1 For $A + B \rightarrow C$, measured $r = k[A]$. A proposed sequence is slow $A \rightarrow I$, then fast $I + B \rightarrow C$. Check its overall equation and rate consistency. Explain the limit of the conclusion. [4]

3.1 Adding the steps cancels intermediate I and gives $A + B \rightarrow C$. Slow unimolecular A step gives rate proportional to $[A]$, and B reacts afterwards. Consistency supports this mechanism but other mechanisms may give the same law.

3.2 A solid catalyst loses activity when a strongly adsorbed impurity enters the feed. Explain using surface sites, then distinguish the effects of removing the impurity and raising temperature on an equilibrium yield at fixed pressure. [4]

3.2 Impurity blocks active sites, reducing available adsorption/reaction sites. Removing it restores rate but does not change the equilibrium constant at fixed temperature. Raising temperature changes K and yield according to the reaction enthalpy.