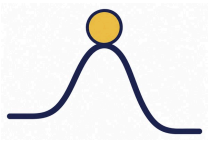
Activation Energy and Catalysis Map

Edexcel International A Level Chemistry · Unit 4 · Topic 11C Activation Energy and Catalysis

1 E_a and temperature

11.1 viii

- **E_a**: minimum energy to react
- Higher T: curve flatter, to the right
- More molecules with $E \geq E_a$
- k rises; rate equation unchanged



2 The Arrhenius equation

11.10

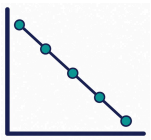
- **k = Ae^(−E_a/RT)** (given)
- E_a in J mol^{-1}, T in K
- R = 8.31 J K^{-1} mol^{-1}
- ln k = ln A − E_a/RT

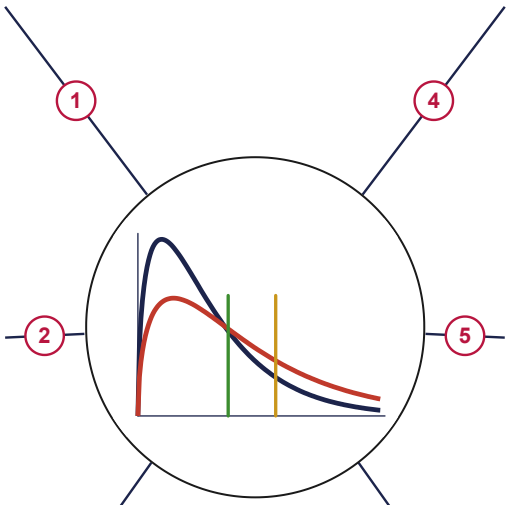


3 Arrhenius plot

11.10 b

- ln k against **1/T**
- Gradient = **−E_a/R**
- E_a = −gradient × R
- Intercept = ln A

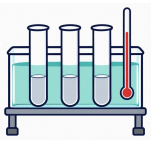




4 Core Practical 10

11.13

- Clock at several temperatures
- Same concentrations: **1/t ∝ k**
- Plot ln(1/t) against 1/T
- Errors: end point, T drift



5 Homogeneous catalysts

11.1 ix

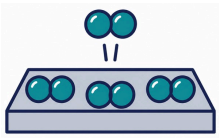
- **Same phase** as reactants
- Form an **intermediate**
- Regenerated: two lower humps
- H^+(aq), Fe^{2+}(aq), Cl atoms



6 Heterogeneous catalysts

11.11

- Solid surface, gas reactants
- **Adsorb**, weaken, react, **desorb**
- Support: large surface area
- **Poisons** block active sites



Catalysts at work

a catalyst lowers E_a; it does not change ΔH or the position of equilibrium

Process	Catalyst	Type	Poisoned or limited by
Haber: $N_2 + 3H_2 \rightleftharpoons 2NH_3$	iron	heterogeneous	sulfur compounds
Contact: $2SO_2 + O_2 \rightleftharpoons 2SO_3$	V_2O_5	heterogeneous	arsenic impurities
Catalytic converter: CO, NO, C_xH_y	Pt, Rh, Pd	heterogeneous	lead
Iodination of propanone	H^+(aq)	homogeneous	none: regenerated

Worked examples

k from E_a

- E_a 50 kJ, A 4.0 × 10^{10} s^{-1}
- E_a/RT at 300 K = 20.06
- **k = 78 s^{-1}**

E_a from a gradient

- gradient −7.22 × 10^3 K
- × 8.31
- **E_a = 60.0 kJ mol^{-1}**

A catalyst's effect

- E_a 80 → 60 kJ mol^{-1}, 300 K
- k × e^(20 000/RT)
- **about 3 × 10^3 times**

Catalysts return with the transition metals (Topic 17); E_a explains kinetic stability (Topic 12).

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