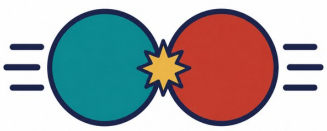
Reaction Kinetics Map

Cambridge International AS & A Level Chemistry · Topic 8 Reaction kinetics

1 Collision theory

8.1.1, 8.2.1

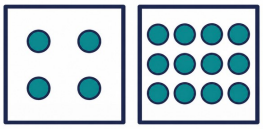
- Particles must **collide** to react
- **Activation energy, E_A**: the minimum energy
- Only **$E \geq E_A$** collisions succeed
- Rate: effective collisions per second



2 Concentration, pressure

8.1.2

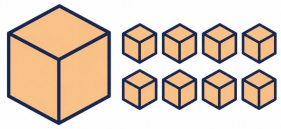
- More particles **per unit volume**
- **More collisions per second**
- Same fraction succeed
- Gases: pressure = particles closer

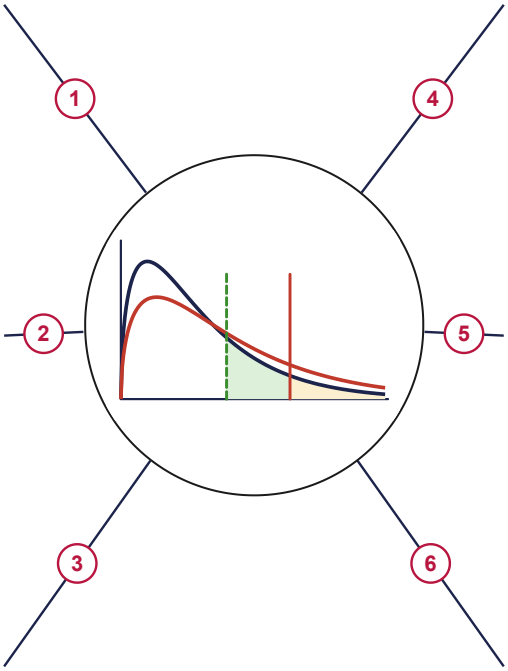


3 Surface area

8.1.2

- Only **surface** particles are hit
- Smaller pieces, same mass: more surface
- More collisions per second
- Same amount of product

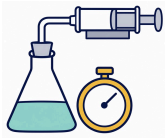




4 Measuring rates

8.1.3

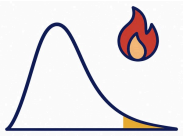
- Gas volume, mass, colour, precipitate
- Clock reactions: **rate ∝ 1/time**
- **Tangent**: gradient = rate
- Initial rate: tangent at t = 0



5 Temperature

8.2.2–8.2.3

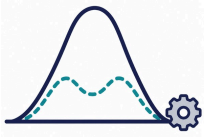
- Boltzmann: **same area**
- Hotter: peak **lower, further right**
- **Far more molecules with $E \geq E_A$**
- Collisions a little more often too



6 Catalysts

8.3.1

- A different mechanism: **lower E_A**
- Reaction pathway diagram: **two humps**
- Same curve; E_A(cat) to the left
- More **effective collisions** per second



What each change does

the rate depends on the number of effective collisions per second

Change	Collisions per second	Fraction with $E \geq E_A$	Rate
Higher concentration	more	same	faster
Higher pressure (gases)	more	same	faster
Larger surface area	more	same	faster
Higher temperature	a few % more	much larger	much faster
Catalyst	same	larger (lower E_A)	faster
Lower temperature	fewer	much smaller	much slower

Worked examples

Rate from 1/time

- cross vanishes in 40 s
- 1/40 = **0.025 s^{-1}**
- 16 s: 0.0625, 2.5 × faster

Initial rate

- tangent at t = 0
- through (0, 0) and (30, 60)
- **2.0 cm^3 s^{-1}**

Atom economy

- $CH_3OH + CO \rightarrow CH_3COOH$
- one product: **100 %**
- catalyst makes it fast

Rate equations, orders and the Arrhenius equation follow in Topic 26 (A Level); equilibria in Topic 7.

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