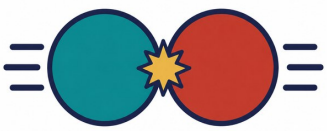
Kinetics Map

Edexcel International A Level Chemistry · Unit 2 · Topic 9A Kinetics

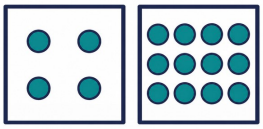
1 Collision theory 9.2

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



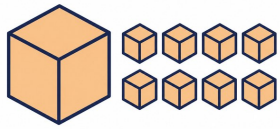
2 Concentration, pressure 9.1

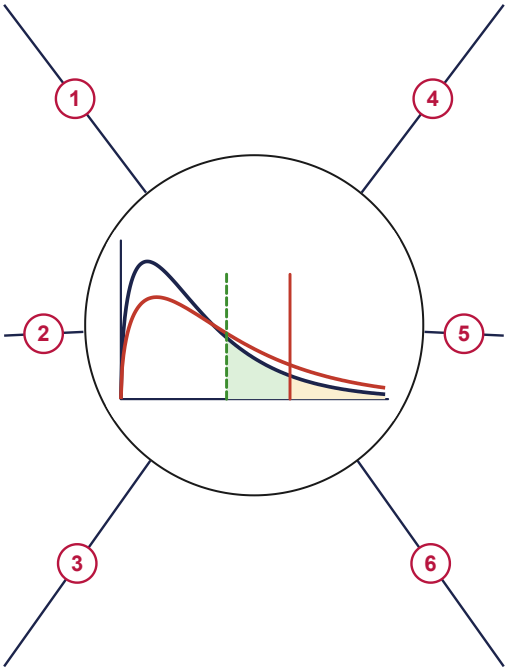
- More particles **per unit volume**
- **More collisions per second**
- Same fraction succeed
- Gases: pressure = particles closer



3 Surface area 9.1

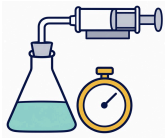
- Only **surface** particles are hit
- Smaller pieces, same mass: more surface
- More collisions per second
- Same amount of product





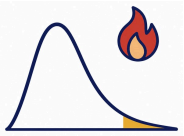
4 Measuring rates 9.3

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



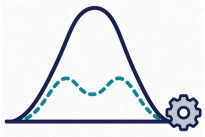
5 Temperature 9.1, 9.4

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



6 Catalysts 9.5–9.8

- **Alternative route**, lower E_a
- Profile: two humps, **intermediate**
- Same curve; E_a(cat) to the left
- Less energy, higher atom economy



What each change does

the rate depends on the number of successful 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 Unit 4 (Topic 11); equilibria in Topic 9B.

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