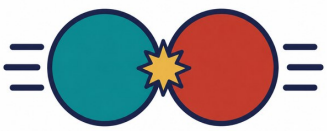
Kinetics Map

AQA A-level Chemistry · 3.1.5 Kinetics

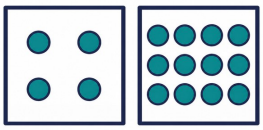
1 Collision theory 3.1.5.1

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



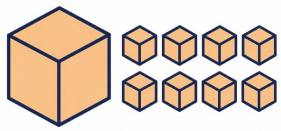
2 Concentration, pressure 3.1.5.4

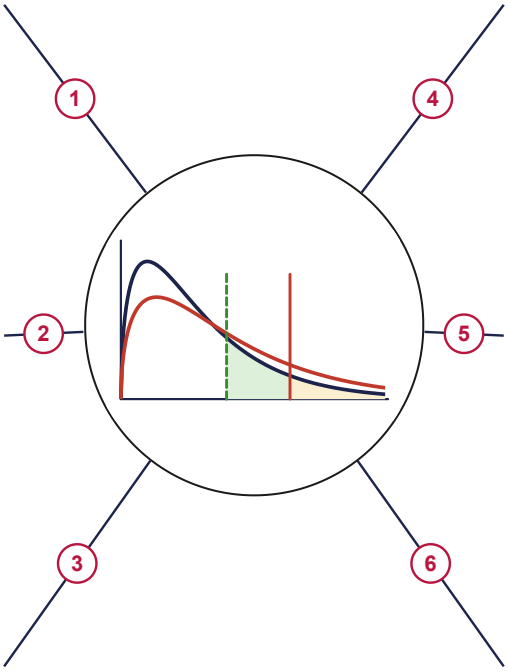
- More particles **per unit volume**
- **More collisions per second**
- Same fraction succeed
- Gases: pressure = particles closer



3 Surface area recall

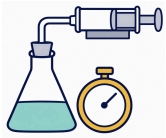
- Only **surface** particles are hit
- Smaller pieces, same mass: more surface
- More collisions per second
- Same amount of product





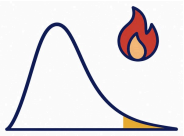
4 Measuring rates 3.1.5.3

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



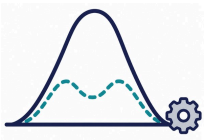
5 Temperature 3.1.5.2–3

- 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 3.1.5.5

- **Alternative route**, lower E_a
- Unchanged in **composition and amount**
- Same curve; E_a(cat) to the left
- More molecules with $E \geq E_a$(cat)



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 and the Arrhenius equation follow in 3.1.9 (A-level); equilibria in 3.1.6.

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