

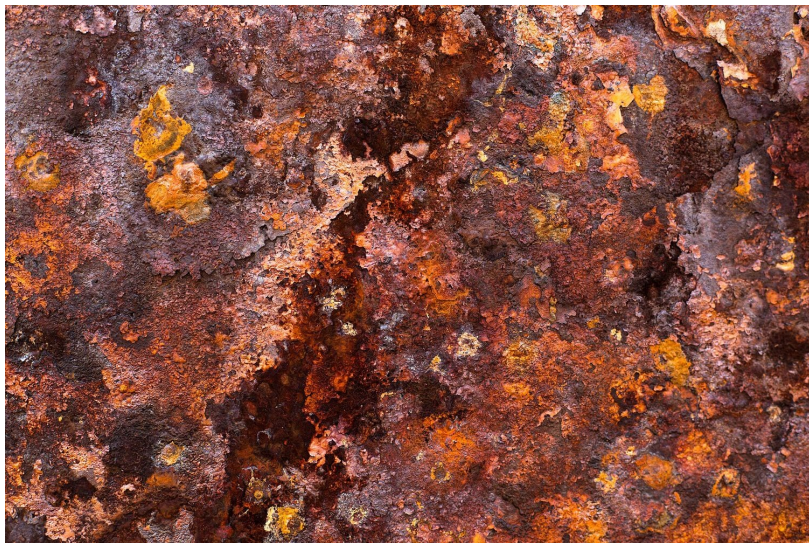
Exercise walk-through

6.2

Rate of reaction

IGCSE Chemistry

Physical vs chemical change



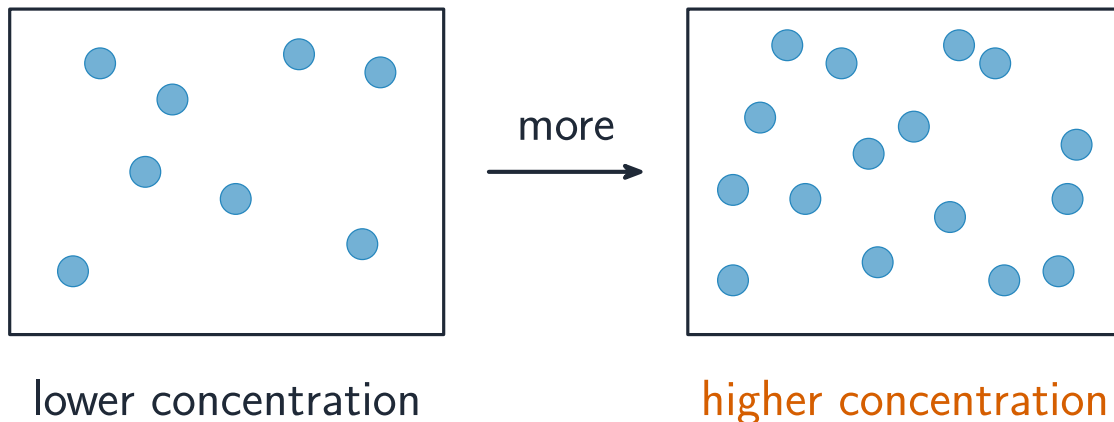
Iron rusting – a new substance forms

- A **physical change** makes **no new substance** – only the state or shape changes, and it usually reverses. Melting ice, dissolving sugar.
- A **chemical change** makes **one or more new substances** and is usually hard to reverse. Burning, rusting.
- Signs of a chemical change: a colour change, a gas given off, an energy change, or a **precipitate** forming.

Collision theory and rate

Collision theory : particles must collide with enough energy ($\geq E_a$). Faster when collisions are **more frequent** or **more energetic**:

- more **concentration** / pressure
- more **surface area**
- higher temperature



What a collision needs

Rate of reaction

The **rate of reaction** is how fast the **reactants** are used up, or the **products** formed.

Frequency

More collisions per second – higher concentration, higher pressure, larger surface area – means a faster rate.

Energy

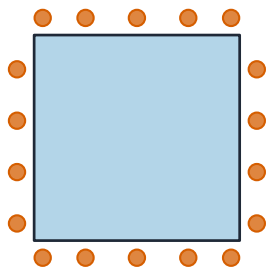
A collision only works if the particles have enough **kinetic energy** to react. Heating raises the average, so far more collisions succeed.

The other half

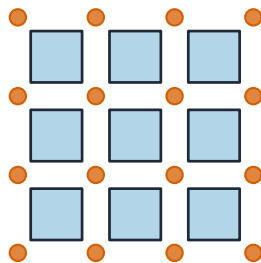
Temperature therefore acts twice, which is why it changes rate more sharply than concentration does.

Every rate factor is either *more collisions* or *more successful ones*. Say which, and the explanation is complete.

Surface area



one big lump
small surface
area $\rightarrow$ slower

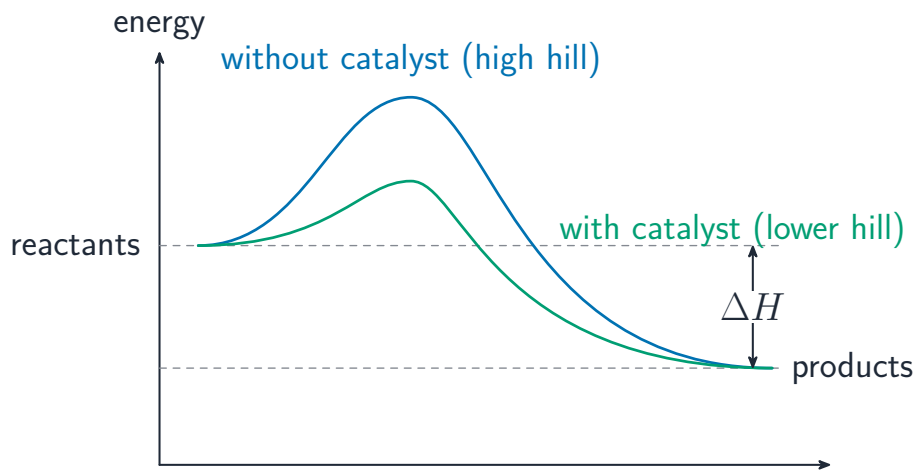


same mass
as powder
large surface
area $\rightarrow$ faster

A powder has far more surface than one lump, so acid touches **many more** particles.

More exposed particles $\Rightarrow$
more collisions $\Rightarrow$ a faster
rate.

Catalysts



a catalyst lowers the activation energy; ΔH is unchanged

A **catalyst** speeds a reaction but is **not used up**.

- it lowers the **activation energy**
- ΔH is unchanged
- **enzymes** are biological catalysts

Exercises 2.1·2.2

2.1 State two factors that increase the rate of a reaction.

[2]

2.2 State how a catalyst speeds up a reaction.

[1]

Exercises 2.1·2.2

2.1 State two factors that increase the rate of a reaction. [2]

2.1

- any **two** of: higher concentration / larger surface area / higher temperature / higher pressure (gases) / a catalyst
-

2.2 State how a catalyst speeds up a reaction. [1]

2.2

- a catalyst **lowers the activation energy**, so more collisions are successful

Exercise 3.1

3.1 Increasing the temperature speeds up a reaction mainly because the particles: [1]

☐

A become larger

B move faster and collide more often with enough energy

C become catalysts

D stop colliding

Exercise 3.1

3.1 Increasing the temperature speeds up a reaction mainly because the particles: [1]

☐

A become larger

B move faster and collide more often with enough energy

C become catalysts

D stop colliding

3.1 B

- hotter particles **move faster** and collide **more often with enough energy**
- A, C and D are not how temperature works

Exercise 3.2 (a)

3.2 Marble chips react with hydrochloric acid, giving off carbon dioxide.

(a) Explain, using collision theory, why powdered marble reacts faster than large chips. [2]

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3.2 Marble chips react with hydrochloric acid, giving off carbon dioxide.

(a) Explain, using collision theory, why powdered marble reacts faster than large chips. [2]

(a)

- a powder has a **larger surface area**
- more frequent collisions with the acid, so a **faster rate**

Exercise 3.2 (b)

3.2 Marble chips react with hydrochloric acid, giving off carbon dioxide.

(b) Describe one method to measure the rate of this reaction.

[2]

Exercise 3.2 (b)

3.2 Marble chips react with hydrochloric acid, giving off carbon dioxide.

(b) Describe one method to measure the rate of this reaction.

[2]

(b)

- collect the gas in a **gas syringe** and record volume against time
- or stand the flask on a **balance** and record the falling mass

Exercise 3.3

3.3 On a graph of gas volume against time, explain why the line becomes less steep and then flat. [2]

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3.3

- as reactants are used up there are **fewer collisions per second**, so the line is less steep
- when a reactant runs out the reaction **stops**, so the line is **flat**