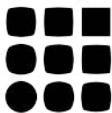
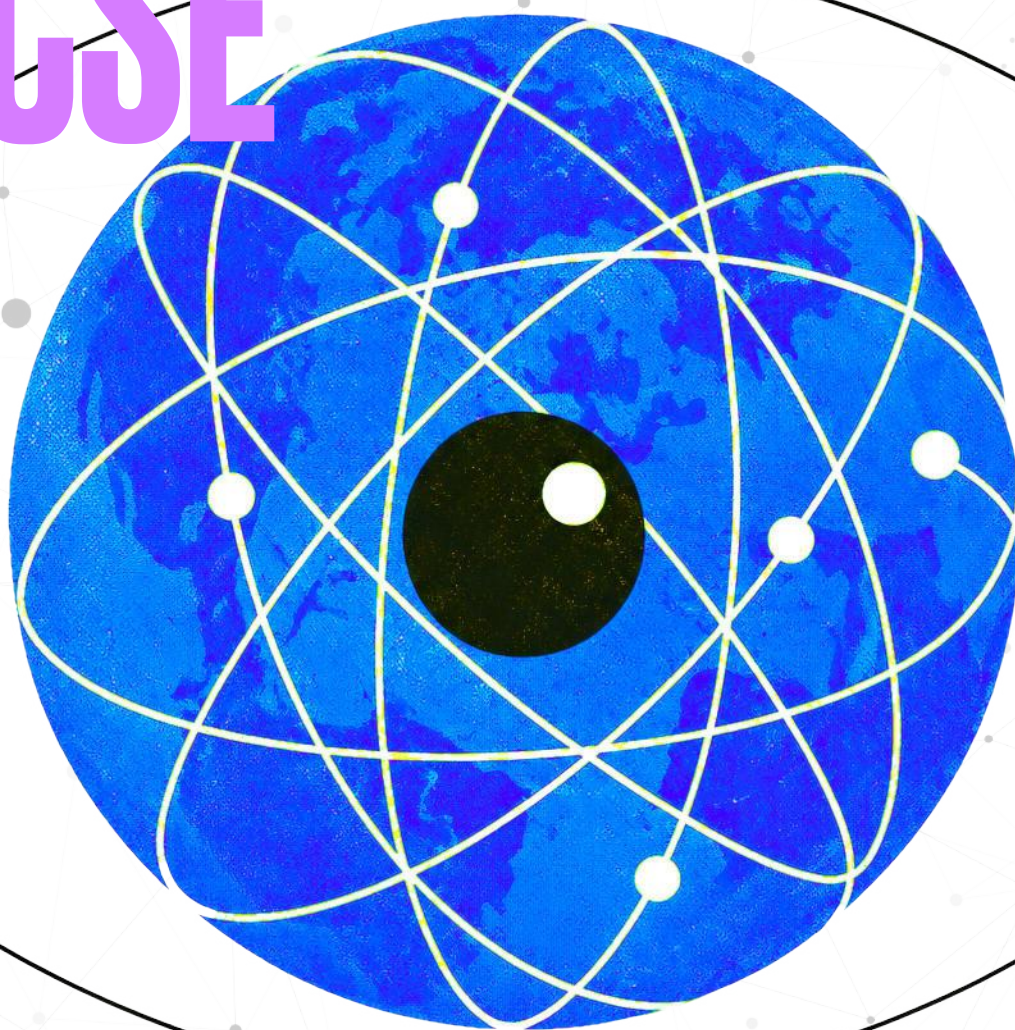


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CHEMISTRY

IGCSE



COMPLETE NOTES

LATEST SYLLABUS
MODULE & LINEAR



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How to Use This Book

1

Scan

Read the section headings and every **bold key term** first. This builds a mental map, so each new fact has somewhere to attach.

2

Read

Read each section in full and study every diagram beside the text it illustrates. Diagrams carry information that prose cannot.

3

Flashcards

Stop reading once the topic makes sense, then use the online flashcards. Recalling from memory is **active recall** — far stronger than re-reading.

4

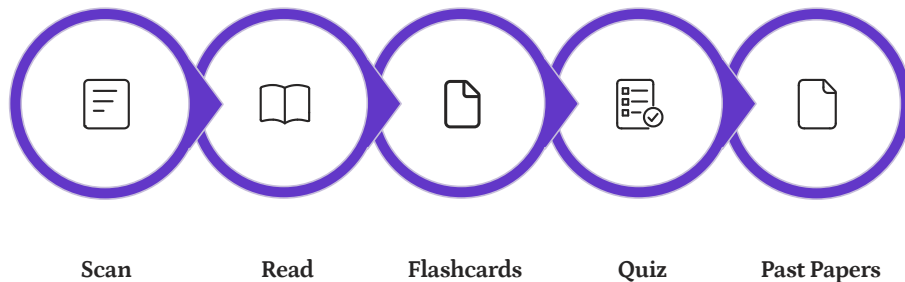
Quiz

Complete the online quiz for the topic. It tests whether you can **apply** the content, not just recognise it. Return to any section a wrong answer points to.

5

Past Papers

Finish by answering past-paper questions under **timed conditions**. Past papers train you to meet the exam command words.



Online Resources

- Flashcards
- Quizzes
- Summary pages
- Progress tracker

Before Any Quiz, Test or Exam

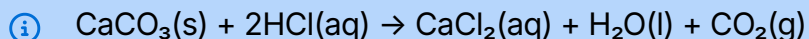
Revise with the online **summary page** for the topic to consolidate everything you have learned.

Finishing a Topic

Open the **progress tracker** on the website and tick it off. This is the top of the ladder — **topic complete**.

19.5 Practical: Surface Area and Concentration

This practical uses marble chips and dilute hydrochloric acid to investigate rate.



1

Method

- React the marble chips with dilute hydrochloric acid in a flask connected to a gas syringe.
- Measure the volume of carbon dioxide produced at regular time intervals.
- Plot a graph of volume of gas against time.
- The system must be airtight so that no gas escapes.

2

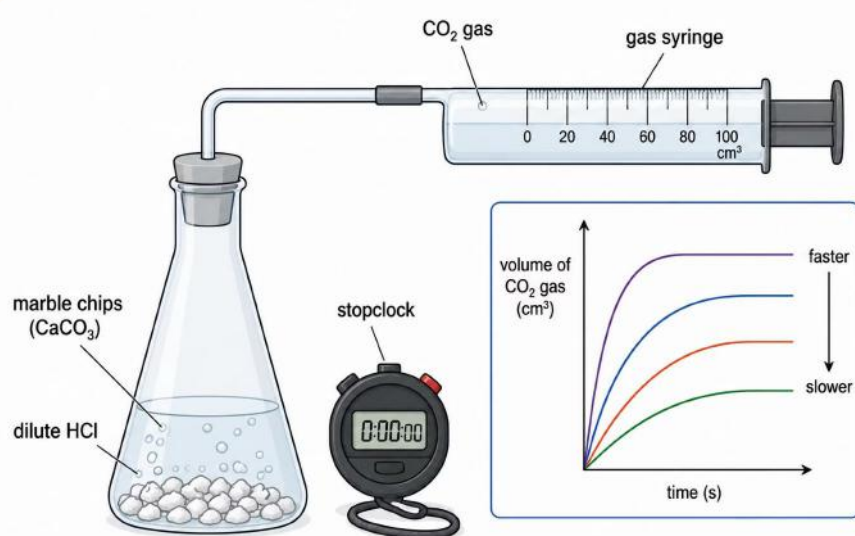
Investigating Surface Area

- Repeat with the same mass, volume and concentration, but with the marble more crunched up, then as powder.
- Finer particles have a larger surface area, giving a steeper graph that levels off sooner — a faster reaction.

3

Investigating Concentration

- Repeat with the same mass and surface area of marble chips, but different acid concentrations.
- A higher concentration gives a steeper graph that finishes sooner — a faster reaction.



The reaction can also be followed by measuring the loss of mass as carbon dioxide escapes.

Chapter Summary

Key Definitions

Exothermic

Gives out energy; temperature rises; ΔH negative.

Endothermic

Takes in energy; temperature falls; ΔH positive.

Enthalpy Change (ΔH)

The overall energy change, in kJ/mol.

Activation Energy (Paper 2)

The minimum energy needed for a reaction to occur.

Key Facts and Equations

- Calorimetry measures energy transfer from a temperature change.
- $Q = m \times c \times \Delta T$, where m is the mass of water and $c = 4.2 \text{ J/g}^\circ\text{C}$ for water.
- Molar enthalpy change: $\Delta H = \text{energy change} \div \text{moles of reactant}$.
- Energy level diagrams (Paper 2): products lower for exothermic, higher for endothermic.
- Bond breaking is endothermic; bond making is exothermic.
- Bond energies (Paper 2): $\Delta H = \text{energy to break bonds} - \text{energy released making bonds}$.

Exam Tips, Condensed

Use the mass of water, not fuel, in $Q = mc\Delta T$.

Exothermic ΔH is negative; endothermic ΔH is positive.

For bond energies, count every bond and take broken minus made.

— Hosni

18.2 Measuring Enthalpy Changes by Calorimetry

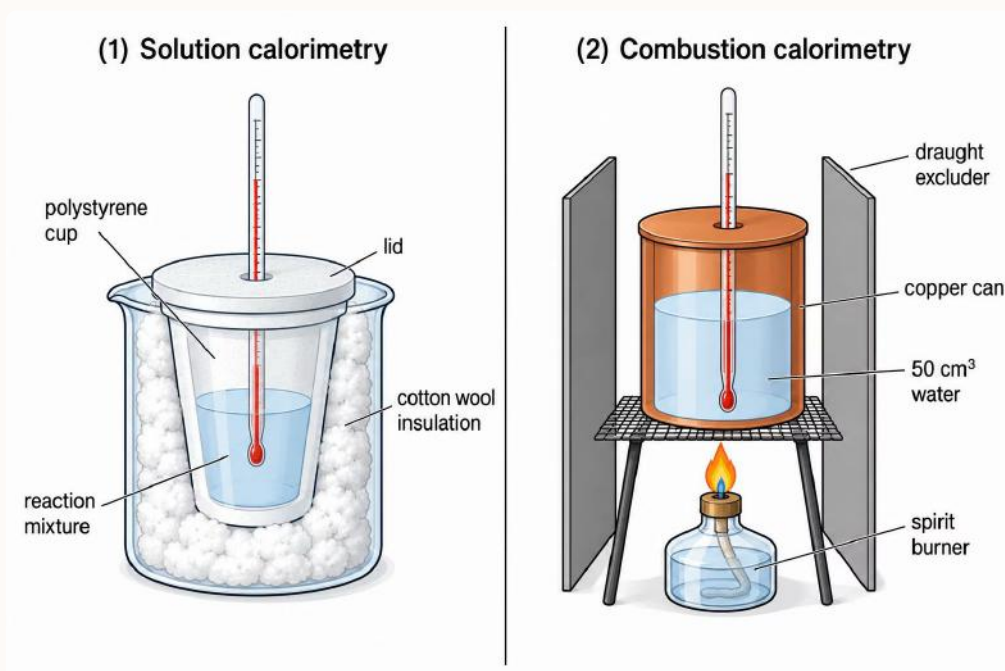
Calorimetry measures the energy transferred in a reaction from the temperature change it causes.

Method 1 — Dissolving, Displacement and Neutralisation

- Measure the starting temperature of the reactants, making sure they are the same.
- Mix the reactants in a polystyrene cup, which is insulated by a beaker of cotton wool and fitted with a lid.
- The cup, cotton wool and lid reduce the energy lost to the surroundings.
- Record the temperature of the mixture every 30 seconds and note the largest change.

Method 2 — Combustion of a Fuel

- Place a known mass of water, such as 50 g, in a copper can and record its temperature.
- Weigh the spirit burner of fuel and its lid.
- Burn the fuel beneath the can, stirring the water, until the temperature rises by a set amount.
- Use a draught excluder so that as much heat as possible goes into the water.
- Reweigh the burner to find the mass of fuel burned, and record the final water temperature.



The main source of error is energy lost to the surroundings, so good insulation improves the result.

Exam tip

The acid added before the test is not optional, and the choice matters. Use nitric acid for the silver nitrate test — never hydrochloric acid, because that would add chloride ions and give a false positive. The acid removes carbonate ions that would otherwise interfere.

— Hosni

17.5 Testing for Water and Water Purity

A test can show that water is present, and a separate physical test can show whether it is pure.

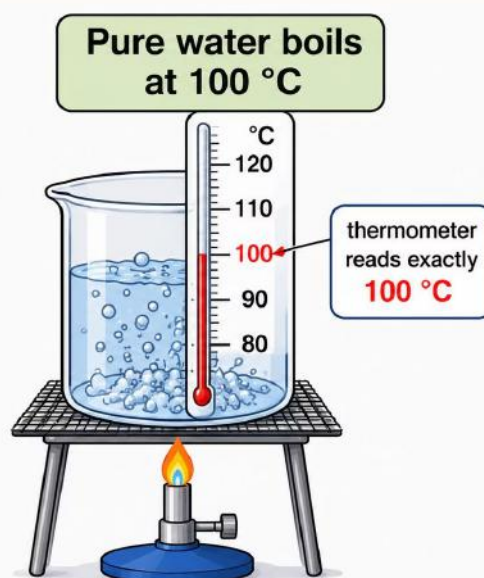
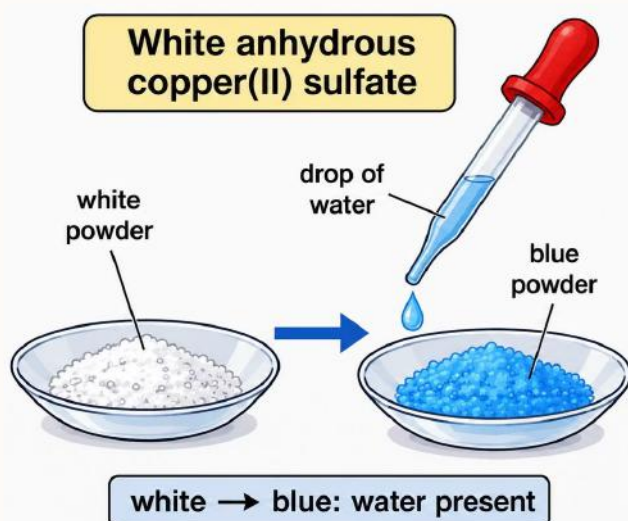
Testing for the presence of water (6.20)

- Anhydrous copper(II) sulfate is a white powder.
- Adding water turns it blue, as hydrated copper(II) sulfate forms.
- So a white-to-blue colour change shows that water is present.

☐ This test shows only that water is *present*, not that the water is *pure*.

Testing whether water is pure (6.21)

- A pure substance is made of only one substance, with fixed physical properties.
- Pure water boils at exactly 100 °C and freezes at exactly 0 °C.
- Measuring the boiling point or freezing point is a physical test for purity.
- If the boiling point is not 100 °C, or the freezing point is not 0 °C, the water is not pure.



17.2 Flame Tests for Metal Ions

A flame test identifies a metal ion from the colour it gives to a flame.

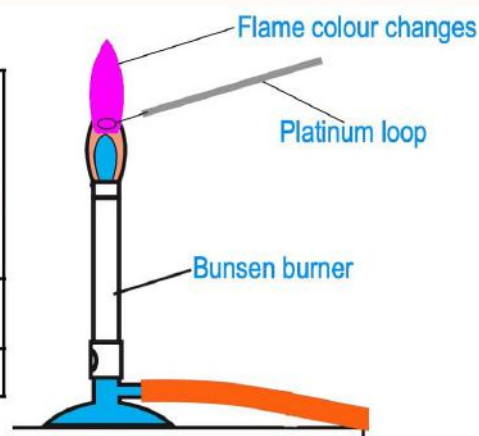
Method

1. Clean a platinum wire loop by dipping it in dilute hydrochloric acid.
2. Hold the loop in a Bunsen flame until it burns without adding any colour.
3. Dip the clean loop into the sample to be tested.
4. Hold the loop in the hot blue part of the Bunsen flame.
5. Observe and record the colour of the flame.

Flame Colours

Cation	Flame Colour
Lithium, Li^+	Red
Sodium, Na^+	Yellow
Potassium, K^+	Lilac
Calcium, Ca^{2+}	Orange-red
Copper(II), Cu^{2+}	Blue-green

Cation					
Symbol	Li⁺	Na⁺	K⁺	Ca²⁺	Ba²⁺
Flame	Red	Yellow	Lilac	Orange	Light green



Hosni Says

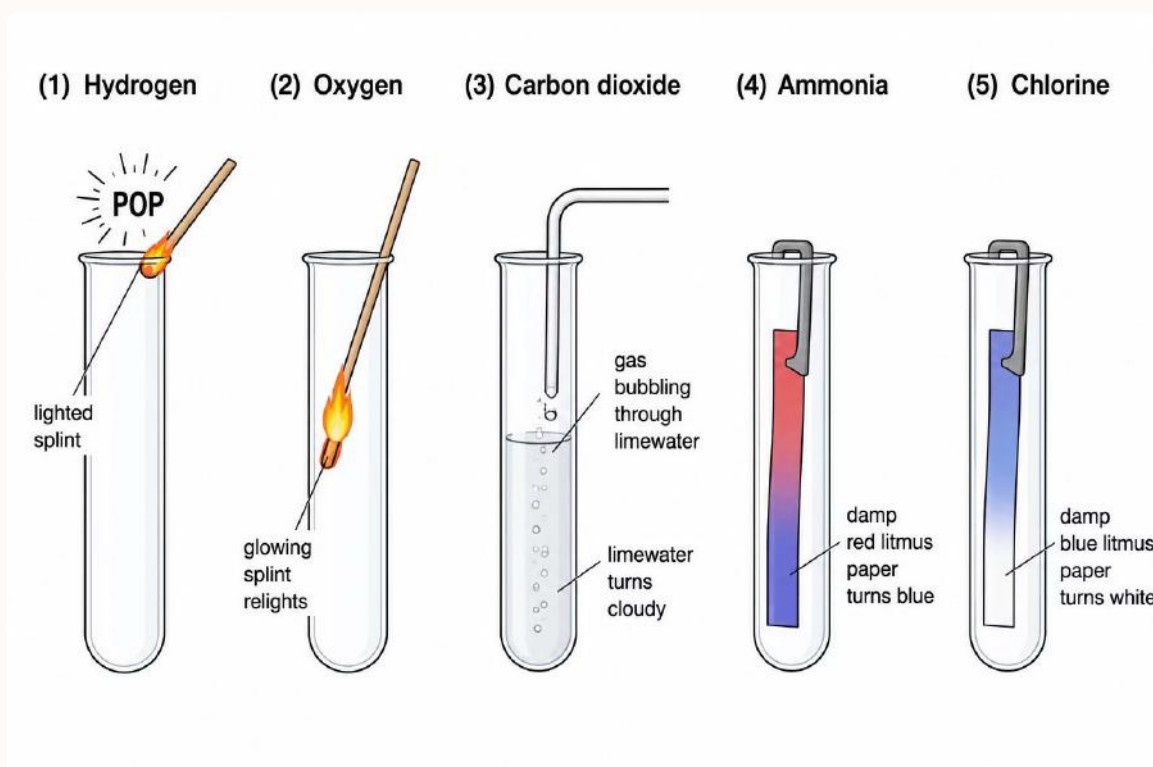
Fix the five flame colours in order: **L**ithium red, so **D**ium yellow (think daffodil), **K** for potassium lilac, **C**alcium orange-red, **Cu** copper blue-green.

17.1 Tests for Gases

Each common gas has a characteristic test and result.

Gas	Test	Positive Result
Hydrogen	Hold a lighted splint at the mouth of the tube	A squeaky pop
Oxygen	Insert a glowing splint	The splint relights
Carbon dioxide	Bubble the gas through limewater	The limewater turns cloudy
Ammonia	Hold damp red litmus paper in the gas	The paper turns blue
Chlorine	Hold damp blue litmus paper in the gas	The paper is bleached white

- Chlorine may briefly turn the litmus paper red first, because a solution of chlorine is acidic.
- Ammonia also has a strong, sharp smell.



20.1 Reversible Reactions

In a reversible reaction the products can react to re-form the original reactants.

Reversible reaction

A reaction in which the products can react together to convert back into the reactants, so it can go both ways.

The $\rightleftharpoons$ symbol

Used in the equation to show that a reaction is reversible.

Forward & Backward

The left-to-right change is the **forward reaction**; the right-to-left change is the **backward reaction**.

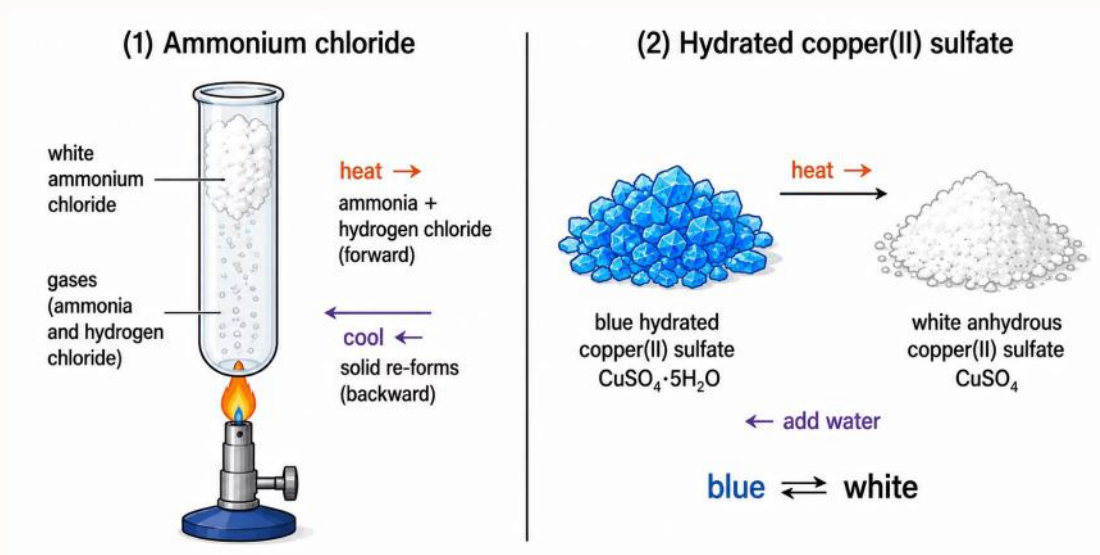
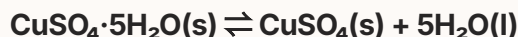
The effect of heat on ammonium chloride

- Ammonium chloride is a white solid.
- When heated, it decomposes into ammonia and hydrogen chloride gases — the forward reaction.
- When the gases cool, they react to re-form the solid — the backward reaction.



The dehydration of hydrated copper(II) sulfate

- Hydrated copper(II) sulfate is made of blue crystals.
- When heated, it loses its water to form white anhydrous copper(II) sulfate — the forward reaction.
- When water is added back, the blue crystals re-form — the backward reaction.



Exam tip

The $\rightleftharpoons$ symbol is the giveaway that a reaction is reversible — never write a single arrow for these. Be ready to name the forward and backward directions and to say what is observed, such as the colour change blue to white for copper(II) sulfate.

— Hosni

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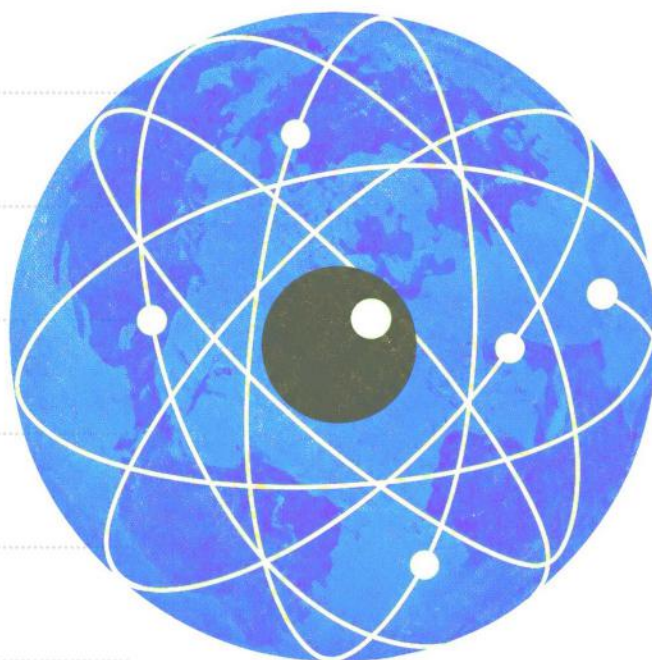
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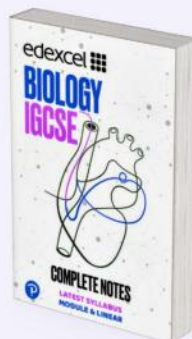


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