The Mark-Scheme Gap

Ten places students lose marks they have already earned, and the exact wording that wins them back.

INSIDE

Ten full worked exam questions, mark by mark

INSIDE

The reasonable-but-wrong answer for each one

INSIDE

The exact phrasing that wins the mark back

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Why this guide exists

Most students who miss an A in AQA Chemistry did not miss it on content. They missed it on wording.

An examiner marking Paper 1 is not deciding whether your child understands equilibrium. They are holding a mark scheme, and checking whether specific ideas appear, in a specific order, in language the scheme recognises. A student can write something chemically true and score nothing, because the mark point was somewhere else in the sentence.

That gap is worth a grade. It is also the cheapest thing in A-Level Chemistry to fix, because closing it costs no new content: only a change in how knowledge the student already has gets written down.

These are the ten I see most often. Each one shows what students actually write, why it scores below their understanding, and what the scheme is waiting for.

01 Concentration and rate: "more particles" is not a mark point

THE QUESTION

> A + 2B → C + 2D
>
> Explain how increasing the concentration of **A** affects the rate of this reaction. **(3 marks)**

A REASONABLE BUT WRONG ANSWER

> *"There are more particles of A, so they collide more often with B and the reaction speeds up."*

WHY THIS SCORES LOW

This picks up at most 1 of the 3 marks. "More particles" on its own is not the mark point, concentration is particles per unit volume, so the answer never establishes why collisions become more frequent, only asserts that they do. It also stops after one idea. The scheme is built as a three-step chain (cause, mechanism, consequence for rate), and this answer supplies only the middle step, and even that without its reason.

THE STRUCTURE THE ANSWER NEEDS

1. State the cause: concentration of A increases means more particles of A per unit volume
2. State the mechanism: particles are closer together / frequency of collisions between A and B increases
3. State the consequence for rate, explicitly: more successful collisions per second, so rate increases

THE MODELLED FULL-MARKS ANSWER

> "Increasing the concentration of A means there are more particles of A per unit volume ✓ (mark point 1), so the frequency of collisions between particles of A and B increases ✓ (mark point 2). This means more collisions occur per second that exceed the activation energy, so the rate of reaction increases ✓ (mark point 3)."

THE IDEA UNDERNEATH

Concentration and pressure change how often particles collide. They do not change what fraction of collisions has enough energy. Only temperature and catalysts touch that fraction. Students who blur the two lose marks in every kinetics question they meet for the next two years.

02 Temperature and rate: "they move faster" is the weakest part of the answer

THE QUESTION

> Explain how increasing the temperature of a reaction mixture affects the rate of reaction. **(3 marks)**

A REASONABLE BUT WRONG ANSWER

> *"The particles have more energy and move around faster, so they collide more often and the reaction is faster."*

WHY THIS SCORES LOW

Everything here is true, and none of it is the main reason. Faster movement does raise collision frequency slightly, but that's a minor effect the scheme barely credits on its own, and this answer stops there, never reaching the dominant factor: what fraction of collisions actually has enough energy to react. An answer built entirely on collision frequency, with no mention of activation energy, typically scores 1 of 3.

THE STRUCTURE THE ANSWER NEEDS

1. State the cause: molecules have a greater average kinetic energy
2. State the consequence for the energy distribution: a greater proportion of molecules has energy ≥ the activation energy
3. State the consequence for rate, explicitly: a greater proportion of collisions is successful, so rate increases

THE MODELLED FULL-MARKS ANSWER

> "Increasing the temperature means the molecules have a greater average kinetic energy ✓ (mark point 1). A greater proportion of molecules therefore has energy greater than or equal to the activation energy ✓ (mark point 2). This means a greater proportion of collisions is successful, so the rate of reaction increases ✓ (mark point 3)."

WATCH FOR

"The particles gain activation energy" and "now all the particles have enough energy" are both wrong, and both common. Activation energy is a threshold to be met, not a quantity a particle acquires.

3.1.5 KINETICS

03 Catalysts: half the definition scores half the marks

THE QUESTION

> Explain how a catalyst affects the rate of a reaction. **(3 marks)**

A REASONABLE BUT WRONG ANSWER

> *"A catalyst lowers the activation energy of the reaction, so more particles have enough energy to react and the rate increases."*

WHY THIS SCORES LOW

This is fluent and sounds complete, which is exactly what makes it dangerous, it's built on a misstatement rather than a gap. A catalyst does not lower the activation energy of the original reaction; that pathway and its barrier are still there, untouched. What actually happens is that the catalyst offers a different pathway, and it's that alternative pathway which has the lower activation energy. Skip "alternative route/mechanism" and the answer is arguably chemically wrong rather than merely incomplete, and typically scores 1 of 3 at most, usually just the final consequence mark, since the reasoning that leads to it is unsound.

THE STRUCTURE THE ANSWER NEEDS

1. State the mechanism: the catalyst provides an alternative route or alternative reaction mechanism
2. State the property of that route: it has a lower activation energy (than the uncatalysed route)
3. State the consequence, explicitly: a greater proportion of molecules now has energy ≥ this (lower) activation energy, so more collisions are successful and the rate increases

THE MODELLED FULL-MARKS ANSWER

> "A catalyst provides an alternative reaction pathway / alternative mechanism ✓ (mark point 1), which has a lower activation energy ✓ (mark point 2). This means a greater proportion of molecules now has energy greater than or equal to this activation energy, so a greater proportion of collisions is successful and the rate of reaction increases ✓ (mark point 3)."

THE IDEA UNDERNEATH

Both halves, every time. "Alternative route" without "lower activation energy" is incomplete; "lower activation energy" on its own is arguably wrong. On a Maxwell-Boltzmann diagram this is exactly why the curve does not move and the activation energy line does.

3.1.6 CHEMICAL EQUILIBRIA AND LE CHATELIER'S PRINCIPLE

04 Le Chatelier: the direction is not the answer

THE QUESTION

> $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92\ kJ\ mol^{-1}$
>
> Explain the effect on the equilibrium yield of ammonia when the temperature of the equilibrium mixture is decreased from 290 K to 250 K. **(3 marks)**

A REASONABLE BUT WRONG ANSWER

> *"The temperature decreases, so the equilibrium shifts to the right to oppose the change, and the yield of ammonia increases."*

WHY THIS SCORES LOW

This gets the direction and the outcome right, which feels like a complete answer, but it restates Le Chatelier's principle instead of applying it. It never establishes why the equilibrium moves right for this specific reaction: nowhere does it say the forward reaction is exothermic. Swap this exact wording onto an endothermic forward reaction and it would sound equally plausible while being wrong, which is exactly why the scheme won't award the shift mark without the reasoning that justifies it. Typically scores 1 of 3.

THE STRUCTURE THE ANSWER NEEDS

1. Identify the reaction type from the ΔH sign: the forward reaction is exothermic
2. Apply the direction rule: decreasing temperature favours the exothermic direction, so equilibrium shifts to the right / toward the forward reaction
3. State the consequence for yield, explicitly: the yield of ammonia increases

THE MODELLED FULL-MARKS ANSWER

> "The forward reaction is exothermic (ΔH is negative) ✓ (mark point 1). Decreasing the temperature favours the exothermic reaction, so the equilibrium position shifts to the right / in the forward direction ✓ (mark point 2). This means more N_2 and H_2 are converted to NH_3, so the yield of ammonia increases ✓ (mark point 3)."

THE COMPROMISE-CONDITIONS TRAP

When a question asks why industry does not use the conditions that maximise yield, it wants both halves. High pressure raises yield but costs more and carries safety risk; low temperature raises the yield of an exothermic reaction but slows the rate below what is economic. An answer that discusses only yield cannot reach full marks.

05 Boiling points: never write “break the bonds”

THE QUESTION

> Explain why sulfur, S_8, has a higher boiling point than phosphorus, P_4. **(3 marks)**

A REASONABLE BUT WRONG ANSWER

> *“Sulfur has stronger covalent bonds than phosphorus, so more energy is needed to break them and it has a higher boiling point.”*

WHY THIS SCORES LOW

Both are simple molecular substances, boiling S_8 or P_4 breaks no covalent bonds at all; the molecules themselves stay intact and simply separate from each other. This answer doesn't just miss the mark points, it names the wrong force entirely, which examiners read as a genuine misconception rather than loose wording. It can cost every mark on the question, not just one.

THE STRUCTURE THE ANSWER NEEDS

1. Name the correct force: van der Waals' forces (between molecules, not atoms)
2. Give the reason it's stronger in S_8: more electrons per molecule / greater molecular size / larger surface area of contact than P_4
3. Finish the sentence properly: more energy is required to overcome the forces between the molecules

THE MODELLED FULL-MARKS ANSWER

> “Both S_8 and P_4 are simple molecular substances held together by van der Waals' forces between molecules ✓ (mark point 1). S_8 has more electrons per molecule than P_4, so the van der Waals' forces between S_8 molecules are stronger ✓ (mark point 2). More energy is therefore required to overcome the forces between S_8 molecules, giving it a higher boiling point ✓ (mark point 3).”

TWO WORDS TO DELETE

“Break” and “bonds”, whenever the substance is molecular. Replace with “overcome” and “intermolecular forces”. AQA's own specimen comparison of P_4 and S_8 runs exactly this way: the sulfur molecules are bigger, therefore the London forces between molecules are stronger.

06 Ionisation energy: the chain has four links, not one

THE QUESTION

> Explain why the first ionisation energy of potassium is lower than the first ionisation energy of sodium. **(4 marks)**

A REASONABLE BUT WRONG ANSWER

> *"Potassium's outer electron is further from the nucleus, so it's easier to remove and the first ionisation energy is lower."*

WHY THIS SCORES LOW

This names one link of a four-link chain and skips the two that actually explain why the outer electron ends up further away with weaker attraction. Down a group, nuclear charge is bigger, not smaller, an answer that ignores this looks like it's dodging an inconvenient fact rather than reasoning through it. Examiners want all three factors weighed, and the conclusion drawn from that comparison, not just the radius asserted on its own. Typically scores 1 of 4.

THE STRUCTURE THE ANSWER NEEDS

1. Nuclear charge: potassium has more protons than sodium
2. Shielding: potassium has an extra complete inner shell, so shielding increases
3. Atomic radius: potassium's outer electron is further from the nucleus
4. Therefore: increased shielding and radius outweigh the increased nuclear charge, so the attraction on the outer electron is weaker, and first ionisation energy decreases

THE MODELLED FULL-MARKS ANSWER

> "Potassium has a greater nuclear charge than sodium ✓ (mark point 1), but potassium has an extra complete inner shell, so there is more shielding ✓ (mark point 2), and its outer electron is further from the nucleus ✓ (mark point 3). The increased shielding and greater distance outweigh the increased nuclear charge, so the attraction between the nucleus and the outer electron is weaker, and the first ionisation energy of potassium is lower than that of sodium ✓ (mark point 4)."

DOWN A GROUP, AND THE DEFINITION TRAP

Shielding and radius both increase, and together they outweigh the increased nuclear charge, so attraction falls and ionisation energy falls. And first ionisation energy is defined per mole of gaseous atoms, forming one mole of gaseous 1+ ions. "Gaseous" is itself a marking point, and it is the word students most often drop.

3.1.4 ENERGETICS · 3.1.8 THERMODYNAMICS

07 Calculations: where correct chemistry becomes a wrong answer

THE QUESTION

> For a reaction, $\Delta H = -126$ kJ mol^{-1} and $\Delta S = -92$ J K^{-1} mol^{-1}. Calculate ΔG for this reaction at 300 K, and state whether the reaction is feasible at this temperature. **(3 marks)**

A REASONABLE BUT WRONG ANSWER

> $\Delta G = \Delta H - T\Delta S = -126 - (300 \times -92) = -126 + 27600 = 27474$ kJ mol^{-1}
> *"This is positive, so the reaction is not feasible."*

WHY THIS SCORES LOW

The method is right and the final conclusion-logic is right, but the units were never converted, so the number itself is wrong by a factor of 1000. ΔH is in kJ mol^{-1} while ΔS is in J K^{-1} mol^{-1}; without converting ΔS to kJ K^{-1} mol^{-1} (or ΔH to J mol^{-1}) before subtracting, the two terms aren't comparable. This typically keeps the method mark but loses the accuracy mark and, because the numbers are now wildly implausible, often the conclusion mark too if it isn't sanity-checked.

THE STRUCTURE THE ANSWER NEEDS

1. Convert units so ΔH and ΔS are in the same energy unit: ΔS to kJ K^{-1} mol^{-1} (÷1000) is usually easier than converting ΔH
2. Substitute into $\Delta G = \Delta H - T\Delta S$ with T in kelvin, and show the working
3. State the conclusion explicitly, linked to the sign of ΔG: negative means feasible, positive means not feasible at that temperature

THE MODELLED FULL-MARKS ANSWER

> $\Delta S = -92$ J K^{-1} mol^{-1} $= -0.092$ kJ K^{-1} mol^{-1} ✓ (mark point 1, unit conversion shown)
> $\Delta G = \Delta H - T\Delta S = -126 - (300 \times -0.092) = -126 + 27.6 = -98.4$ kJ mol^{-1} ✓ (mark point 2, correct substitution and working shown)
> ΔG is negative, so the reaction is feasible at 300 K ✓ (mark point 3).

WORTH SAYING PLAINLY

The Gibbs units trap probably costs more marks nationally than any other single calculation error at A-Level. It is also entirely mechanical, which means it is entirely fixable.

08 Observations: describe what you would see, not what it proves

THE QUESTION

> Aqueous silver nitrate is added to a solution containing chloride ions, followed by dilute ammonia solution. State what would be observed. **(2 marks)**

A REASONABLE BUT WRONG ANSWER

> *"It shows that chloride ions are present, and that they react with silver nitrate."*

WHY THIS SCORES LOW

This is a conclusion about what the test proves, not a description of what happened. The question asked what would be observed, the scheme wants the physical appearance at each stage, not the chemistry it implies. An observation answer with no colour, no precipitate, and no description of a change scores zero regardless of how correct the underlying chemistry knowledge is.

THE STRUCTURE THE ANSWER NEEDS

1. Describe what forms when the first reagent is added: colour and physical appearance (precipitate/solution/gas), stated as an observation
2. Describe what happens at the next stage: whether it dissolves, changes colour, or stays the same, again as something visible

THE MODELLED FULL-MARKS ANSWER

> "A white precipitate forms ✓ (mark point 1), which dissolves in dilute ammonia solution ✓ (mark point 2)."

ALSO ACCEPTABLE, PER THE SOURCE DOC'S RULES

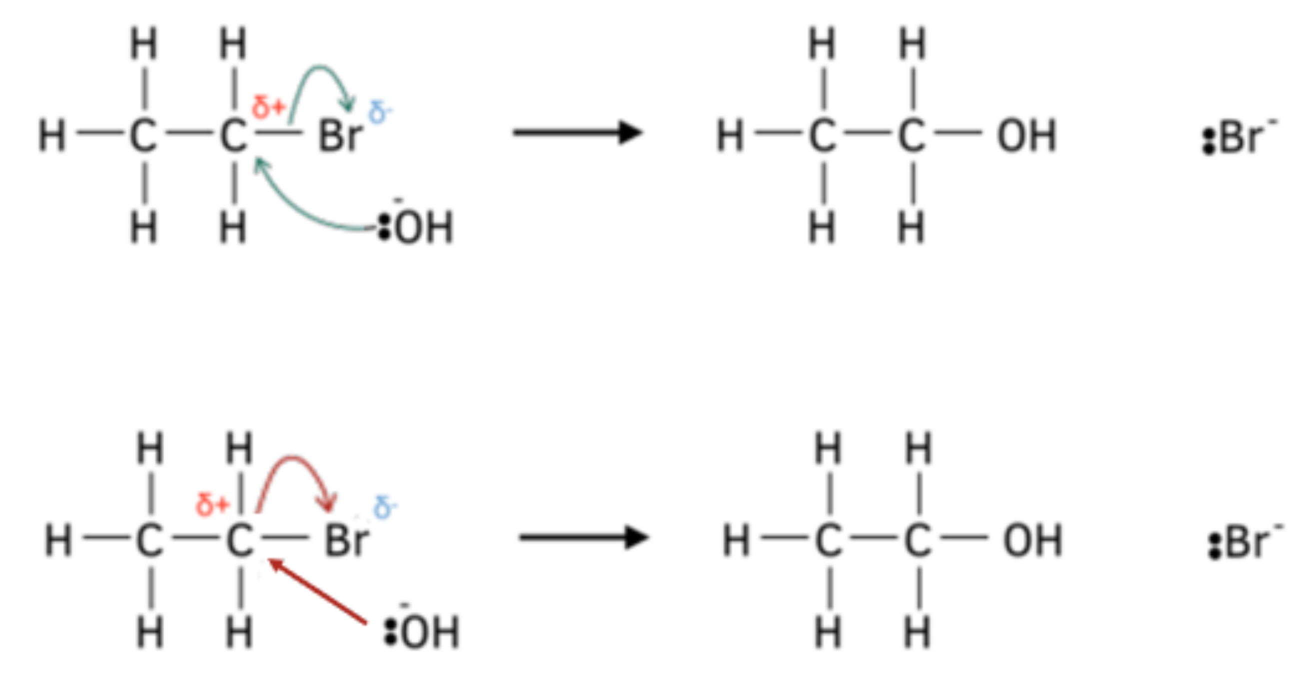
"Colourless" and "clear" are not synonyms, a solution can be perfectly clear and deep purple. "It changes colour" scores nothing without both colours stated, from one to the other. If the question names a reagent, name the reagent and the observation.

09 Mechanisms: arrow marks are geometric, so learn them mechanically

THE QUESTION

> Bromoethane reacts with hydroxide ions in a nucleophilic substitution reaction. Show the mechanism for this reaction, including all relevant curly arrows, charges and dipoles. **(3 marks)**

Curly arrows are marked geometrically, on exactly where they start and end, not on whether the student understands the reaction is happening. The two mechanisms below show the same reaction: the version at the bottom is a reasonable attempt that loses marks on arrow mechanics alone; the version at the top is what the scheme is looking for.



Green arrows: both curly arrows start correctly, on the carbon-bromine bond and on the lone pair. Red arrows: the same two mechanism steps, drawn from the wrong starting point.

THE RULES, EXACTLY

An arrow starts from a bond or a lone pair, never from an atom or a nearby negative sign. An arrow ends at an atom, or at the point where the new bond forms. If the arrow starts from a lone pair, the lone pair must be drawn. Charges must be shown on the species carrying them, the intermediate included.

THE DEFINITION TRAP

A nucleophile is an electron pair donor. “Something attracted to a positive charge” is not the definition, and does not score.

ALL PAPERS

10 Extended response: structure is worth a mark on its own

THE QUESTION

> Compare the bonding and structure of diamond and graphite, and explain how these differences account for their different electrical conductivity and use as lubricants. **(6 marks)**

A REASONABLE BUT WRONG ANSWER

> *"Diamond has covalent bonds and is very hard. Graphite has layers. Diamond doesn't conduct electricity. Graphite conducts electricity because it has delocalised electrons. Graphite is used as a lubricant. Diamond is used in cutting tools because it's hard."*

WHY THIS SCORES LOW

Every individual statement here is true, this isn't a content problem. It's marked against levels, and AQA's guidance caps an answer like this because it reads as a list of disconnected facts rather than "a sustained line of reasoning which is coherent, relevant, substantiated and logically structured." Nothing is explicitly linked to anything else: it never says why graphite conducts (which electron is delocalised, and why), or why that structure makes it slippery. A student who knows genuinely less chemistry but connects each point to the next with reasoning will outscore this.

THE STRUCTURE THE ANSWER NEEDS

1. Establish the structural difference first: diamond, each carbon forms four covalent bonds in a rigid 3D lattice; graphite, each carbon forms three covalent bonds in flat, hexagonal layers
2. Trace conductivity to a specific cause: in diamond, all four outer electrons are used in bonding, so there are no delocalised electrons to carry charge; in graphite, each carbon's fourth outer electron is delocalised across the layers, so it can move and carry charge
3. Trace the lubricant property to a specific cause: graphite's layers are held together only by weak van der Waals' forces (not covalent bonds), so they can slide over each other
4. Use "because"/"therefore"/"so" as real logical joints between each of these, in the order the question asked (bonding → structure → property → use)

THE MODELLED FULL-MARKS ANSWER

> "In diamond, each carbon atom forms four covalent bonds to other carbon atoms in a rigid three-dimensional lattice. Because all four of each carbon's outer electrons are used in covalent bonding, there are no delocalised electrons free to move, so diamond does not conduct electricity ✓. This same rigid, strongly-bonded structure makes diamond very hard, so it is used in cutting tools ✓."

> “In graphite, each carbon atom forms only three covalent bonds, arranged in flat hexagonal layers. This leaves one outer electron per carbon atom delocalised across each layer, so graphite conducts electricity, because these delocalised electrons can move and carry charge ✓. The layers themselves are held together only by weak van der Waals' forces between them, so they can slide over each other easily, which is why graphite is used as a lubricant ✓.”
>
> ✓ **Level mark (structure/coherence):** each property is explicitly derived from the structural cause stated just before it, in the order the question asked, bonding and structure first, then conductivity, then lubrication, rather than listed as separate facts.

WHAT TO DO ABOUT IT

Plan the chain before writing: cause, then mechanism, then consequence. Use “because”, “therefore” and “so” as real joints in the argument rather than decoration. Answer the question that was asked, in the order it was asked.

How to use this

Don't read it once and file it. Take the next past paper your child sits and mark it against these ten alone, ignoring everything else.

Nearly every student finds three or four of them repeating across a single paper, the same phrasing habit costing one mark here, two there, eight or ten across the full paper. It is rarely one catastrophic gap. It is the same small leak, in the same places, every time.

That accumulated total is usually the entire distance between a B and an A.

Chemistry with Dr John
AQA A-Level Chemistry, taught in small groups capped at six students, for Year 12 and Year 13. Every student is taught to an A/A* standard, and no grade is ever promised, because no one can honestly promise one.

If you would like to talk about where your child is now and what a realistic path forward looks like, the first conversation is free and takes fifteen minutes.

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WHY THIS MATTERS NOW

Your Year 12 foundation dictates your Year 13 grade

This guide covers one calculation. There are a dozen more like it, and Year 13 assumes every one of them is already secure.

Small errors, big consequences

Multi-step calculation traps cost strong students enough marks to derail Medicine and Russell Group offers — not because the chemistry was misunderstood, but because a conversion or a rounding was missed.

Year 13 does not slow down

The pace assumes flawless Year 12 foundations. Miss these traps and the mocks expose them in thermodynamics, kinetics and buffers — the topics where marks are hardest to win back.

Mechanisms escalate too

Year 12 nucleophilic substitution becomes Year 13 nucleophilic addition–elimination. Without mastering basic curly arrows, complex multi-step mechanisms are not survivable.

The gap is rarely understanding. It is the distance between knowing the chemistry and proving it the way AQA awards marks.

ABOUT

Dr John Nwokocha

John Nwokocha holds a PhD in Organic Chemistry from Loughborough University and has fifteen years of teaching, research and examining experience, including eight years teaching A-Level Chemistry.

Chemistry with Dr John was born from a passion to support students to understand chemistry and achieve the grades they need to unlock their future aspirations.

Having marked the papers, he teaches from the other side of the mark scheme: what an examiner is trained to look for, in what order, and where the marks quietly disappear.

PhD	15 yrs	AQA	Max 6
ORGANIC CHEMISTRY LOUGHBOROUGH UNIVERSITY	TEACHING, RESEARCH & EXAMINING	ONLY — NO MIXED-BOARD GENERIC TEACHING	STUDENTS PER COHORT

My principles

Weekly live teaching	Live small-group teaching each week, capped at six students and recorded for review.
Regular Actionable Feedback	Weekly homework tasks with Personalised Video Feedback marked to Exam Standards with clear action plans.
Independent Study Guidance	Clear guidance with quality resources so independent study is effective, efficient and fulfilling.
Transparency	Monthly check-ins with parent and student so progress is celebrated and any issues are resolved quickly.

PRICING ON PAGE 15

The Y12 Chemistry Super Starter Programme

A head start for new Year 12 students who want to avoid the common problems students face, so the journey to an A/A* stays smooth.

This is for new Y12 students who are

01

Aiming for A/A* predicted grades in Chemistry

02

Aiming for Oxbridge, Medicine, Vet or Russell Group universities

Why it works

Targeted diagnostics	Rather than re-teaching GCSE, we isolate the exact stumbling blocks that pull Year 12 grades down in October — amount of substance, bonding, organic fundamentals.
Micro-step skill building	Stoichiometry and IUPAC nomenclature broken into bite-sized logical frameworks, so the "A-Level shock" never arrives.
Study habit reset	Passive learning is replaced with real independent study: reading mark schemes, tracking error patterns, taking notes that work.
Early sight of hard topics	Students preview the earliest and most difficult concepts, so they settle in confidently when teaching starts.

> Staying consistently good is your best chance at the A/A* predicted grades required for Medicine, Veterinary, Oxbridge and Russell Group universities.

PRICING ON PAGE 15

The Y13 Accelerator Programme

A small-group AQA programme that closes the gaps in Year 12 knowledge before they derail Year 13 results. Most UK medical schools require a grade A in Chemistry and increasingly the best demand A*.

Why it works

Targeted Diagnostics and Strategic Revision	We locate and fill gaps in knowledge quickly, before they deteriorate the grade any further.
Accelerated Topic Coverage	Most schools barely finish the curriculum by May, leaving no time for exam practice, and students underperform their predicted grade in the final mock. We cover every topic by March, freeing quality time for exam technique — and seeing topics early builds confidence for when class reaches them.
Mark Scheme Decryption and Exam Focus	Beyond mark schemes and examiner reports, we study keywords and question types — including the notorious 6–8 mark Level of Response and extended answer questions.
Synoptic Problem Solving	We explicitly teach the links between topics — organic synthesis, energetics, bonding — because exam questions combine them. This is where elite problem-solving is built.

> Staying consistently good is your best chance at the A/A* Final Exam grades required for Medicine, Veterinary, Oxbridge and Russell Group universities.