Course report 2025

Advanced Higher Chemistry

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative, and to promote better understanding. You should read the report with the published assessment documents and marking instructions.

We compiled the statistics in this report before we completed the 2025 appeals process.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2024: 2,746

Number of resulted entries in 2025: 2,767

Statistical information: performance of candidates

Distribution of course awards including minimum mark to achieve each grade

Course award	Number of candidates	Percentage	Cumulative percentage	Minimum mark required
A	829	30.0	30.0	108
B	692	25.0	55.0	92
C	615	22.2	77.2	76
D	383	13.8	91.0	60
No award	248	9.0	100%	Not applicable

We have not applied rounding to these statistics.

You can read the general commentary on grade boundaries in the appendix.

In this report:

- 'most' means greater than or equal to 70%
- 'many' means 50% to 69%
- 'some' means 25% to 49%
- 'a few' means less than 25%

You can find statistical reports on the statistics and information page of our website.

Section 1: comments on the assessment

Question paper

Section 1 (multiple-choice) performed as expected.

Section 2 (extended-response) was more demanding than anticipated. We adjusted the grade boundaries to account for this.

Project

The project performed as expected.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper

Section 1 (multiple-choice)

Overall candidate performance in this section was slightly higher than last year. Most candidates gave the correct response for the following questions.

Question 1	Stating the cause of a line in an emission spectrum.
Question 8	Stating the definition of a base.
Question 9	Calculating the pH of a buffer solution.
Question 11	Comparing the properties of a weak acid and a strong acid.
Question 12	Determining the order of a reaction from a mechanism.
Question 13	Identifying an equation for an enthalpy of formation.
Question 14	Identifying a reaction with a positive entropy change.
Question 16	Comparing the properties of an alcohol and an ether.
Question 18	Identifying the electrophile in a chemical reaction.
Question 19	Stating the meaning of the term ‘geometric isomer’.
Question 21	Stating the type of radiation used to produce an NMR spectrum.
Question 23	Stating the effect on the melting point of purifying a substance.

Section 2 (extended-response)

Although the extended-response section proved more demanding than intended, there were still some very good areas of performance. Most candidates gave a correct response to the following questions.

Question 1(d)	Stating that equal concentrations of two enantiomers is called a racemic mixture.
Question 2(b)(ii)	Calculating a hydronium ion concentration from a given concentration of weak acid.
Question 3(b)	Suggesting what should be done to ensure a precipitation reaction was complete.
Question 4(a)(i)(C)	Calculating a temperature above which a reaction is no longer feasible.
Question 5(a)(i)	Writing a molecular formula from a skeletal formula.
Question 5(b)(i)	Identifying a bond in an infrared spectrum using the data booklet.
Question 6(a)(ii)	Calculating the mass of iron in a tablet, from titration data.
Question 8(a)	Calculating the energy associated with a wavelength of light.
Question 11(b)(i)(A)	Circling an alpha hydrogen atom on a structure.
Question 12(a)(i)	Determining the order of a reaction with respect to a reactant, using experimental data.
Question 12(a)(iv)	Calculating a rate constant from experimental data.
Question 12(b)	Extracting information from an unfamiliar phase diagram to answer a series of questions.

Project

Overall candidate performance in the project was higher than last year. There were a number of areas of good performance in the project.

- Most candidates wrote an abstract containing their aim and findings.
- Most candidates chose projects with an appropriate level of complexity and duplicated their procedures.
- Most candidates expressed their final results to an acceptable number of significant figures and compared them to literature values.

Areas that candidates found demanding

Question paper

Section 1 (multiple-choice)

Only some candidates gave the correct response to the following questions.

Question 5	Explaining the difference in colour between two transition metal complexes.
Question 6	Applying knowledge to determine the splitting of d orbitals in a tetrahedral transition metal complex.
Question 7	Determining the oxidation number of sulfur in two different substances.
Question 10	Determining which salt solution would have the lowest pH value.
Question 17	Identifying structural formulae that could be described as tertiary.
Question 20	Determining which solution contains the greatest number of negative ions.

Question 24 Selecting an appropriate filter and solvent for a colorimetric analysis.

Section 2 (extended-response)

Question 1(c) Few candidates compared the effect optical isomers have on plane-polarised light. Few candidates gave a complete answer. Generally, candidates stated that the optical isomers rotated light in opposite directions but did not state that they rotated light by an equal amount.

Question 2(c)(i) Some candidates explained the change in colour of an indicator, in terms of the conjugation, when the pH is altered. Many candidates attempted to explain the origin of the colour (in one form or the other) of the indicator and not what brings about the colour change. A few candidates attempted to answer the question in terms of the shifting equilibrium only.

Question 3(c) Some candidates calculated the concentration of chloride ions, in $g\ l^{-1}$, from gravimetric data. Few candidates gained 2 marks, but some candidates gained 1 mark for calculating the moles of chloride ions in the precipitate. Few candidates did not write the correct chemical formula for silver(I) chloride, which was needed for the calculation.

Question 4(b)(ii) Few candidates gained 3 marks for discussing how mixtures of isomers could be formed during addition reactions and how these isomers could be separated. Many candidates simply listed types of addition reactions without showing how they could lead to the formation of isomers, or they gave definitions of isomer types only. Some candidates gave examples of how the isomers could be identified rather than how they could be separated, such as NMR and IR.

Question 5(a)(ii)	Some candidates identified and wrote the formula for an ion fraction corresponding to an m/z value. Common errors included omitting the positive charge on the formula or writing a formula that did not correspond to a part of the molecule's structure.
Question 5(d)(i)	Few candidates outlined all the steps for solvent extraction listed in the course specification, but some candidates gained 1 mark by stating one or two of the steps. Many candidates did not achieve any marks because they described the wrong practical technique.
Question 6(a)(iii)	Few candidates suggested a reason why chlorine gas is produced. Few candidates identified that this was an oxidation reaction or that the potassium permanganate was acting as an oxidising agent.
Question 6(b)(ii)	Few candidates explained, with reference to the equation, why water can be described as amphoteric. Few candidates identified the two forms of water in the equation and described how these were acting in the reaction. Many candidates gave a definition of the term amphoteric without relating it to the equation.
Question 7(a)	Some candidates correctly identified compound **X** by working out which atoms were missing from the balanced equation.
Question 7(b)(ii)(B)	Some candidates determined the number of hydrogen bond acceptors. Many candidates did not identify all the atoms in the structure that have a lone pair of electrons and are capable of forming a hydrogen bond.
Question 8(b)(ii)	Some candidates gave a reason for why homolytic fission is not commonly used in organic synthesis. Many candidates did not state the reasons provided in the course specification.

Question 10(a)(i)	Some candidates calculated a volume required in a reaction from a percentage concentration and a mass. Many candidates did not correctly calculate a mass of NaCN and apply the percentage to obtain the final value. Some candidates gained 1 mark for calculating the number of moles of gold and applying the correct mole ratio to calculate the number of moles of NaCN.
Question 10(b)(i)	Few candidates identified the type of reaction taking place. Many candidates did not identify that gold was being reduced in the reaction. Many candidates gave the answer 'precipitation', which was given in the question.
Question 10(b)(ii)	Some candidates outlined the steps required to obtain a dry sample of gold from the reaction mixture. Few candidates outlined all the steps required but some candidates gained 1 mark by stating one or two of the steps. Many candidates did not gain any marks because they described the wrong practical technique.
Question 11(a)(iii)	Some candidates drew a structural formula of the product of the reaction. Many candidates did not draw the correct ester structure. Drawing the full structural formulae for the reactants would have helped candidates to see that the product is a branched ester.
Question 11(b)(ii)(A)	Few candidates drew the structural formula of the product of an aldol reaction. Few candidates drew a structural formula for the product by applying the example given in the question to the reactants.

Question 11(b)(ii)(B)(I) Few candidates suggested a reason why two isomers are formed when butanone takes part in an aldol reaction. Most candidates did not identify that butanone has two different alpha hydrogen atoms. Most candidates incorrectly answered that the carbonyl group can be on different carbon atoms.

Project

Only some candidates produced an acceptable risk assessment for their experimental work. Many candidates missed out on this mark for various reasons, including:

- not recording the flammability of indicators
- exaggerating the hazards associated with dilute solutions
- not distinguishing between solids and solutions when they used both

Section 3: preparing candidates for future assessment

Question paper

Questions linked to statements in the course specification

Teachers and lecturers should encourage candidates to practise accurately describing and explaining terminology from the Advanced Higher Chemistry Course Specification, which is available on our website. Teachers and lecturers should make sure that candidates know that they can gain approximately 15 marks in the question paper just for making statements straight from the course specification.

Researching chemistry questions

Teachers and lecturers should make sure that candidates know that the question paper features approximately 24 marks that assess knowledge and skills relating to the 'researching chemistry' section of the course.

Candidates tend to answer researching chemistry questions poorly. Gaining practical experience of using apparatus and techniques helps candidates to answer these questions. Teachers and lecturers should ensure that candidates can describe the correct procedures associated with the use of the apparatus and techniques listed in the course specification.

Project

Teachers and lecturers should refer to the most up-to-date Advanced Higher Chemistry Project Assessment Task on our website. Teachers and lecturers must provide candidates with a copy of the 'Instructions for candidates' section.

Choosing a topic to research

Teachers and lecturers should pay particular attention to the instructions in the 'Choosing the topic' section on page 5 of the Advanced Higher Chemistry Project Assessment Task.

Teachers and lecturers must ensure that each candidate has chosen a different chemistry topic to research, avoiding similar underlying chemistry. For example, determining the percentage mass of calcium carbonate in seashells and determining the percentage mass of calcium carbonate in antacids are the same chemistry topic (determination of percentage mass of calcium carbonate by back titration). The underlying chemistry is similar. It would only be acceptable for candidates in the same centre to complete these two projects if the centre presented more than 10 candidates. A centre can only repeat a topic once in every 10 projects.

Abstract

Teachers and lecturers should advise candidates to avoid including the word 'purity' in their aims. The aim 'Calculate the percentage purity of calcium carbonate in eggshells' would not gain a mark.

Aims about determining the purity of a synthesised or extracted product require a numerical value for purity in the conclusion. Performing melting point analyses and/or thin-layer chromatography alone would not be sufficient for this aim.

Teachers and lecturers should encourage candidates to copy and paste their conclusion into their abstract instead of typing a new version. This can help avoid inconsistencies.

Underlying chemistry

Teachers and lecturers should remind candidates that they should not include irrelevant, historical or biological information in their underlying chemistry. Although including unnecessary information does not affect the mark candidates achieve for this section, it can give candidates the impression that they have provided enough information about the underlying chemistry relevant to their project. Candidates must focus only on the reactions and techniques used in their project and the chemistry behind these and relate these to the reactions and experimental techniques they have used.

Candidates should not include generalised theory of techniques, reactions and/or substances used without relating these to their project work. For example, theory relating to choosing an indicator without relating this to the indicator used in the experimental work or the reactions being performed.

Data collection and handling

Teachers and lecturers should make sure that candidates know that they must provide concentrations and/or states when giving the hazards associated with chemicals. Candidates should give the hazards appropriate for these concentrations and/or states. For example, ‘harmful by inhalation’ is not appropriate to describe solutions that do not give off gas.

Candidates should know to include appropriate control measures for all identified hazards. For example, a substance identified as being flammable must have a control measure that states it will be kept away from naked flames. An online search will give candidates an appropriate risk assessment and appropriate control measures for the concentrations or states they are using.

Candidates should know how to clearly label raw data, such as spectra or graphs from data-loggers. This may require candidates to amend labels by hand. For chromatography, candidates must include unscaled photographs (or place a ruler for scale next to the chromatogram) or the original chromatograms. Diagrams are not acceptable.

Teachers and lecturers should encourage candidates to use SQA past papers to familiarise themselves with the format of data tables. Past papers (available on the past papers and marking instructions page of our website) are a good source of correctly formatted tables with appropriate headings and units.

Teachers and lecturers should remind candidates to follow the guidance on citation and referencing in the ‘Instructions for candidates’ section of the Advanced Higher Chemistry Project Assessment Task. Candidates must use this number system and must ensure that citations and references are in numerical order.

Data analysis

Generally, candidates duplicate their procedures; however, some candidates average their duplicate raw results before processing. If candidates average their duplicate raw results before processing, they cannot access the full range of marks for data analysis. Candidates must carry out calculations on duplicate raw results separately to produce two final values.

Candidates should not try to achieve concordancy or to average results for analyses they perform on separate samples. For example, if a candidate takes separate fresh samples of orange juice from a carton for a titration, they should not expect concordant results or to average the titre values obtained (unless they first diluted the sample of orange juice in a standard flask and used samples from the standard flask).

Teachers and lecturers should discourage candidates from producing bar charts. It is highly unlikely that a bar chart is appropriate in any Advanced Higher project report. Candidates should only produce line graphs if necessary, such as for calibration graphs or rate graphs. There is no requirement for candidates to include graphs in their project. If candidates include a graph, they must label it appropriately (with correctly formatted units) and use sufficient gridlines that allow markers to check the accuracy of their plotting. Candidates can amend labels and/or units by hand in electronically produced graphs.

When candidates make a comparison of experimental results with an internet or literature source, they should state whether their results are higher or lower than the source. Candidates may need to convert their results to compare them. For example, the concentration of a substance may be given by the manufacturer as a percentage, but a candidate has calculated the concentration in mol l^{-1}. The candidate would need to convert one unit into the other before making a comparison.

Evaluation

When making evaluative statements about the procedures used, candidates must state the precise effect this will have on the final results. For example, a candidate who identifies transfer losses during a synthesis should go on to say that this would result in a lower percentage yield value. Stating that the final result would be inaccurate is not sufficient.

Candidates should only calculate uncertainties for measurements where they use the measurement in a calculation leading to the final result. For example, candidates should not include uncertainties associated with measuring cylinders used to add substances in excess. When calculating uncertainties associated with burettes, candidates should use the titre volume in the calculation, and not the total volume of the burette. Candidates should only carry out uncertainty calculations for analysis experiments. Calculating an absolute uncertainty of a percentage yield is irrelevant because a percentage yield is already a comparison with an expected value.

Structure

Teachers and lecturers should encourage candidates to check their project report after they print it to make sure the headings for sections and tables do not split over multiple pages. They should also make sure the contents page only includes the main sections of the report.

Teachers, lecturers and candidates should use all the materials on our Understanding Standards website.

Appendix: general commentary on grade boundaries

Our main aim when setting grade boundaries is to be fair to candidates across all subjects and levels and to maintain comparable standards across the years, even as arrangements evolve and change.

For most National Courses, we aim to set examinations and other external assessments and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional grade C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional grade A boundary)

It is very challenging to get the standard on target every year, in every subject, at every level. Therefore, we hold a grade boundary meeting for each course to bring together all the information available (statistical and qualitative) and to make final decisions on grade boundaries based on this information. Members of our Executive Management Team normally chair these meetings.

Principal assessors utilise their subject expertise to evaluate the performance of the assessment and propose suitable grade boundaries based on the full range of evidence. We can adjust the grade boundaries as a result of the discussion at these meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper or other assessment has been more, or less, difficult than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper or other assessment has been more difficult than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the question paper or other assessment has been less difficult than usual.
- Where levels of difficulty are comparable to previous years, similar grade boundaries are maintained.

Every year, we evaluate the performance of our assessments in a fair way, while ensuring standards are maintained so that our qualifications remain credible. To do this, we measure evidence of candidates' knowledge and skills against the national standard.

For full details of the approach, please refer to the Awarding and Grading for National Courses Policy.

