Course report 2023

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 in conjunction with the published assessment documents and marking instructions.

The statistics in the report were compiled before any appeals were completed.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2022: 2,734

Number of resulted entries in 2023: 2,852

Statistical information: performance of candidates

Distribution of course awards including minimum mark to achieve each grade

A	Number of candidates	777	Percentage	27.2	Cumulative percentage	27.2	Minimum mark required	77
B	Number of candidates	817	Percentage	28.6	Cumulative percentage	55.9	Minimum mark required	62
C	Number of candidates	650	Percentage	22.8	Cumulative percentage	78.7	Minimum mark required	48
D	Number of candidates	416	Percentage	14.6	Cumulative percentage	93.3	Minimum mark required	33
No award	Number of candidates	192	Percentage	6.7	Cumulative percentage	100	Minimum mark required	N/A

Please note that rounding has not been applied to these statistics.

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

In this report:

- ‘most’ means greater than 70%
- ‘many’ means 50% to 69%
- ‘some’ means 25% to 49%
- ‘a few’ means less than 25%

You can find more statistical reports on the statistics and information page of SQA’s website.

Section 1: comments on the assessment

Question paper

Overall, the question paper proved to be more demanding for candidates than intended. Section 1 (multiple-choice) performed as expected, with a good spread of correct responses. However, there were a number of individual questions in section 2 (extended-response) that candidates found particularly challenging, and the grade boundaries were lowered to take account of this.

Project

The requirement to complete the project was removed for session 2022–23.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper

Section 1 (multiple-choice)

Question 1	Most candidates could choose an electronic configuration showing the ground state arrangement in the 3d and 4s subshells of an atom.
Question 3	Most candidates could identify the p block of the periodic table.
Question 12	Most candidates could choose the direction of electron movement and colour absorbed for a chromophore that absorbs blue-green light.
Question 13	Most candidates could select the compound that does not exhibit hydrogen bonding between its molecules.
Question 17	Most candidates could select the compound that was not an isomer of methoxypropane.
Question 22	Most candidates could determine the formula for a compound from the percentage composition by mass of the elements present in it.

Section 2 (extended-response)

Question 1(a)(iii)(A)	Most candidates could work out the oxidation state of chlorine in ClO_4.
Question 1(a)(iii)(B)	Most candidates could determine the number of sigma bonds in an organic molecule.
Question 2(a)(i), (ii)	Most candidates could state the order of reaction with respect to reactants.
Question 5(c)(ii)	Most candidates could state the coordination number of nickel in a complex.
Question 8(a)(i)	Most candidates could suggest the name for a crown ether using the example given.
Question 8(a)(ii)	Many candidates could draw the structure of a crown ether.

Areas that candidates found demanding

Question paper

Section 1 (multiple-choice)

Question 5	Some candidates could select the correct combination of acid and alkali to create the titration curve given.
Question 8	Some candidates could calculate the correct value for the free energy for the conversion of nitrogen dioxide to one mole of dinitrogen tetroxide.
Question 18	Some candidates could select a compound that can exhibit geometric isomerism from shortened structural formulae.
Question 19	Some candidates could recognise that test compounds are destroyed in mass spectrometry.
Question 23	Some candidates could select sodium carbonate as a primary standard.
Question 25	Some candidates could determine the number of moles of iodine formed from one mole of Pb^{2+} ions by following through the stoichiometry for three reactions.

Section 2 (extended-response)

Question 1(a)(i)	Most candidates were awarded 1 mark for this question as they were able to state that excited electrons emit a photon when they drop down energy levels. However, few candidates were able to state that the energy of the light emitted corresponds to the energy gap between these energy levels.
Question 3(a)(ii)	Few candidates were awarded this mark. While many candidates stated that the isolated precipitate should be dried before it is weighed, they did not mention that it should be done to constant mass, as detailed in the Advanced Higher Chemistry Course Specification.
Question 4	There were many ways this open-ended question could have been answered, including descriptions of how techniques such as atomic absorption and/or emission spectroscopy, colorimetry, gravimetric analysis and complexometric titration could be used. Many of the candidates were awarded 0 marks, as the answers given were either incorrect or not at Advanced Higher level, including answers such as acid/base titration, distillation and simple flame tests.
Question 5(d)(i)	Few candidates were awarded 2 marks for this question. The two main reasons for this were mentioning HOMO-LUMO transitions and/or emission of light due to electrons dropping down energy levels.

Question 5(d)(ii)	Few candidates were awarded this mark. Candidates correctly explained the reason for their choice with reference to the spectra but did not state the name of the ligand. Instead, they stated the formula for the complex.
Question 6(a)(ii)	Few candidates were awarded 2 marks for this question. The main reason was the candidates could not correctly calculate either the concentration of H_2 or HI at equilibrium. It was common for candidates to simply use the concentration of H_2 at the start of the reaction.
Question 6(c)	Few candidates were able to draw a correct structure. Most of the incorrect product structures drawn were ring structures.
Question 7(a)	Candidates were very good at explaining the effect on the position of the equilibrium caused by an increase in temperature. However, they reached the wrong conclusion.
Question 7(d)(i)	Few candidates were awarded 2 marks for this question. Most candidates did not know how to perform a back titration and, consequently, were awarded 0 marks. Of the candidates who were awarded 1 mark out of the 2, the most likely reason for not being awarded the second mark was because they mentioned dissolving the seashells or made no mention of reacting the seashells with a known quantity of hydrochloric acid.
Question 7(d)(ii)	Some candidates were able to state that pure calcium carbonate could be used as a control substance. Many were not awarded this mark as they stated that a solution of pure calcium carbonate should be used.
Question 9	Few candidates were awarded 2 or 3 marks for this open-ended question. This was due to answers not being at Advanced Higher level.
Question 10(a)(iii)	Few candidates were able to follow the example given and draw the structure.
Question 10(b)(i)	Very few candidates were able to correctly explain why Cl_2 molecules become polarised.
Question 10(b)(ii)	Very few candidates could correctly draw the cyclic intermediate. The structures drawn were either carbocations (as with an S_N1 mechanism) or a cyclic intermediate with dotted bonds.
Question 10(b)(iii)(A)	Few candidates could explain how geometric isomers arise in a ring structure. It was common for candidates to mention restricted rotation caused by a double bond. Other candidates also mentioned restricted rotation without referring to which bonds were affected.

Question 10(c)(i)	Few candidates could position the curly arrows and draw the structure correctly.
Question 11(a)(i)	Some candidates were awarded this mark. The answer to this question is from the course specification, in the section on electrophiles.
Question 11(a)(ii)(A)	Some candidates were awarded this mark.
Question 11(a)(ii)(B)	Few candidates were able to draw this structure.
Question 11(b)	Some candidates were able to recognise this as a reduction reaction.
Question 11(c)	Few candidates were awarded this mark.
Question 11(d)	Many candidates were awarded 0 marks for this question. Candidates were confusing a variety of techniques including heating to constant mass.
Question 11(e)(i)(A)	Few candidates correctly identified the carbonyl bond. Most suggested the C=C bond, however, this bond is also in the starting material and so does not prove that paracetamol has been synthesised.
Question 11(e)(i)(B)	Few candidates could give a complete explanation.
Question 11(e)(iii)(A)	Few candidates could correctly explain their conclusion.

Section 3: preparing candidates for future assessment

Teachers and lecturers should refer to the Advanced Higher Chemistry Course Specification, which is available on SQA's website.

Question paper

Accurate statement questions

Candidates still find it demanding to make accurate statements which are from the course specification. Teachers and lecturers should encourage candidates to learn these definitions as there are approximately 15 marks available for this type of question.

Researching chemistry questions

There are approximately 24 marks that assess knowledge and skills relating to the researching chemistry section of the course. Questions relating to this section continue to be poorly answered. Candidates are expected to describe the correct procedures associated with the use of the listed apparatus and techniques. Practical experience of using these apparatus and techniques aids candidates' ability to answer these types of questions. The course specification provides extended detail of the procedure required for each technique.

Questions involving colour

Candidates are exhibiting a great deal of confusion over the reasons why some substances are coloured. HOMO-LUMO transitions are frequently stated when explaining colour in transition metal complexes, and far too many candidates are stating that the colour observed in organic and transition metal compounds is due to emission of light when electrons drop down energy levels. It would be helpful if teachers and lecturers could stress the difference between emission and absorption.

Stoichiometric calculations

Calculations using Advanced Higher relationships stated in the data booklet are generally well done by candidates. However, stoichiometric calculations using National 5 relationships are often poorly done by candidates, and this is commonly due to incorrectly rearranged expressions.

Reaction mechanisms

The structure of the intermediate formed during electrophilic addition of a halogen across a double bond should have full bonds to the halogen atom, and not dotted or dashed bonds as seen in some old past paper questions. Also, the positive charge should be on the halogen atom (see the 2023 detailed marking instructions). It would be helpful if centres did not use examples of this mechanism containing dotted or dashed bonds, from past papers pre-dating the 2016 Advanced Higher, in their assessment materials.

Project

This course will return to full assessment requirements from session 2023–24 onwards. Please refer to the course specification for more information on the course assessment structure.

In the 2019–20 session, the project criteria changed. Teachers and lecturers must ensure they are using the current version of the Advanced Higher Chemistry Project Assessment Task. The revised project structure and mark allocation are included in the coursework assessment task available on the Advanced Higher Chemistry subject page of SQA's website. Teachers and lecturers can also refer to the Advanced Higher Chemistry webinar and example candidate evidence, with accompanying commentaries, that are available on the Understanding Standards website.

Unless centres are presenting a large number of candidates (more than 10) for Advanced Higher Chemistry, there is no reason for two candidates from any one centre to be doing the same or similar projects.

If you already have experience of the project work for this course prior to 2019, there are some notable changes to be aware of when preparing candidates for this assessment. You should ensure that candidates are following the guidance given in the 'Instructions for candidates' section of the Coursework Assessment Task for Advanced Higher Chemistry on SQA's website.

The project is now 25 marks (scaled to 40).

Underlying chemistry can be awarded up to 3 marks. Marks will be awarded for underlying chemistry relevant to the work that is carried out by the candidate. Historical and biological content and chemistry not relevant to the chemistry of the project will not be awarded marks. Candidates should include details of the theory of the chemistry of the project. This may include details such as balanced equations, formulae, mechanisms and the role of chemicals in the reactions. The underlying chemistry of the techniques being used should also be included, although care is needed to ensure that this includes details of how the techniques work, rather than a description of the method.

Candidates should include all procedural details in the procedures section of the report. This includes details such as concentrations and volumes of solutions, masses of chemicals, temperatures, and colour changes, if these are necessary to follow the procedure.

Procedures should be written in enough detail to show that the apparatus used for each measurement was of an appropriate accuracy, and this may not be obvious by simply including an equipment list.

Appropriate levels of complexity and demand must be used to collect data. This may be from a second procedure, a modification in the light of experience, a control experiment, or the standardisation of any solution, if the accuracy of the concentration is crucial in the analysis.

Repeats of all experiments are required (there are exceptions, but these are rare). In the case where it is not appropriate to repeat an experiment, other aspects of the experimental work must be repeated to access this mark.

The marking of analysis of data has changed. This is now marked holistically, and so teachers and lecturers should advise candidates to choose projects that will lend themselves to an analysis of data at a level appropriate to Advanced Higher Chemistry. Chemical calculations should be included, and a list of what we consider to be chemical calculations is given in the coursework assessment task document.

The conclusion should be a judgement or decision made based on the results obtained, and not simply a restatement of the results obtained.

An increased emphasis has been placed on analysing the results. Experimentally obtained results should, where possible, be compared with internet/literature values. If no internet/literature values are available, then duplicate experimental data should be compared.

The evaluation section is now 4 marks. Marks can be awarded for a valid evaluative statement with justification, if appropriate. Uncertainty calculations could still be awarded 3 marks.

Appendix: general commentary on grade boundaries

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

For most National Courses, SQA aims 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, SQA holds 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 SQA's 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. SQA 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.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year on year. This is because the specific questions, and the mix of questions, are different and this has an impact on candidate performance.

This year, a package of support measures was developed to support learners and centres. This included modifications to course assessment, retained from the 2021–22 session. This support was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic while recognising a lessening of the impact of disruption to learning and teaching as a result of the pandemic. The revision support that was available for the 2021–22 session was not offered to learners in 2022–23.

In addition, SQA adopted a sensitive approach to grading for National 5, Higher and Advanced Higher courses, to help ensure fairness for candidates while maintaining

standards. This is in recognition of the fact that those preparing for and sitting exams continue to do so in different circumstances from those who sat exams in 2019 and 2022.

The key difference this year is that decisions about where the grade boundaries have been set have also been influenced, where necessary and where appropriate, by the unique circumstances in 2023 and the ongoing impact the disruption from the pandemic has had on learners. On a course-by-course basis, SQA has determined grade boundaries in a way that is fair to candidates, taking into account how the assessment (exams and coursework) has functioned and the impact of assessment modifications and the removal of revision support.

The grade boundaries used in 2023 relate to the specific experience of this year's cohort and should not be used by centres if these assessments are used in the future for exam preparation.

For full details of the approach please refer to the National Qualifications 2023 Awarding — Methodology Report.