Course report 2022

Subject	Chemistry
Level	Advanced Higher

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. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any appeals.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2022	2735

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

A	Percentage	32.6	Cumulative percentage	32.6	Number of candidates	890	Minimum mark required	77
B	Percentage	28.7	Cumulative percentage	61.3	Number of candidates	785	Minimum mark required	62
C	Percentage	20.7	Cumulative percentage	82.0	Number of candidates	565	Minimum mark required	48
D	Percentage	12.7	Cumulative percentage	94.7	Number of candidates	350	Minimum mark required	33
No award	Percentage	5.3	Cumulative percentage	N/A	Number of candidates	145	Minimum mark required	N/A

You can read the general commentary on grade boundaries in appendix 1 of this report.

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 page of SQA’s website.

Section 1: comments on the assessment

Question paper

Section 1 (multiple-choice)

The multiple-choice section of the question paper was slightly more demanding than anticipated. In particular, question 24 proved more challenging for candidates than expected. This was taken into account when setting grade boundaries.

Section 2 (extended-response)

The extended-response section of the question paper was more demanding than expected. In particular, questions 4(c)(i), 4(c)(iii), 4(d), 5(a), 5(b)(ii)(B), 6(a)(i), 8(a), 8(b)(i), 8(b)(iv), 8(c)(ii), 10(a), 11(b)(i)(B) and 11(b)(ii) proved more challenging than intended. Candidate performance in these questions was taken into consideration when setting grade boundaries.

In general, markers found an increase in the number of candidates who did not attempt certain questions. This also points towards a more challenging question paper for candidates.

Project

The requirement to complete the project was removed for session 2021–22.

Section 2: comments on candidate performance

Question paper

Although markers found an increase in the number of candidates who did not attempt certain questions, most candidates did attempt each question. The evidence suggests that candidates had sufficient time to complete the 3-hour question paper.

Section 1 (multiple-choice)

Question 4	Most candidates could choose an incorrect statement about heterogenous catalysts.
Question 5	This was a skills-based question, where candidates were given a definition of disproportionation and asked to identify an example of this type of reaction from an equation. This was expected to be a challenging question.
Question 10	Most candidates could choose a statement about order of a reaction.
Question 13	Most candidates could choose a molecule that only contains sigma bonds.
Question 16	Most candidates could identify the product from a reaction of a secondary haloalkane with cyanide followed by hydrolysis.
Question 19	Most candidates could identify a compound with a non-superimposable mirror image.
Question 20	Most candidates could determine the empirical and molecular formula from an elemental analysis.
Question 21	Most candidates could identify a compound from peaks in a mass spectrum.
Question 24	Candidates were required to pick a technique that could be used to both purify and identify a compound. Many candidates picked a technique that would do one, but not the other, such as recrystallisation or melting point determination.
Question 25	This was a practical skills question involving analysis of a chromatogram. Candidates usually find questions based on practical elements of the course demanding. Many candidates either thought that the reaction mixture did not contain impurities or that the reaction was complete.

Section 2 (extended-response)

Question 1(a)(i)	Most candidates could draw a p orbital.
Question 1(a)(ii)	Most candidates could write the quantum numbers for a 2p electron in oxygen.
Question 2(a)	Most candidates could determine, by calculation, whether a reaction is feasible.
Question 2(c)	Most candidates could determine the oxidation number of nitrogen in NO_2 and N_2O_3.
Question 3(b)(i)	Most candidates could calculate the pH of a weak acid from its concentration.
Question 3(b)(ii)	This question involved calculating a percentage by mass of a solution of hydrofluoric acid, from a concentration, in mol l^{-1}. This type of question has not previously appeared in a question paper. The question was intended to be challenging for candidates.
Question 3(b)(iii)	Most candidates could state the shape of SiF_4 molecules.
Question 4(a)(i)(A)	Most candidates could name the technique used from a reflux diagram.

Question 4(a)(ii)	This is a practical-based question, and some candidates may have had the opportunity to perform a version of this step if they had synthesised benzoic acid from ethyl benzoate in their centre. Teachers and lecturers may also have explained the theory behind this step in the synthesis. However, the knowledge is not beyond the expected level for an Advanced Higher candidate. Only a few candidates managed to achieve this mark.
Question 4(a)(iii)(B)	Most candidates could state why recrystallisation was used.
Question 4(b)(ii)	Most candidates could state the wavenumber of the N-H bond from an infrared spectrum.
Question 4(c)(i)	Candidates were expected to determine the number of ^{1}H environments from the structure of hippuric acid. Most candidates answered with the number four, having incorrectly counted all of the hydrogen atoms in the phenyl group as being equivalent and one environment.
Question 4(c)(iii)	The explanation of how peaks are produced in a ^{1}H NMR spectrum should have come straight from the course specification. It was clear from the evidence that candidates were not familiar with this. However, this was the first time an explanation of this has been required in a question paper. Many explanations given by candidates incorrectly involved electron transitions or ionisation of the sample.
Question 4(d)	This open-ended question, concerning the pH of urine, was poorly answered by most candidates. The answers given by many were at National 5 level and included statements about the relative concentrations of H^{+} and OH^{-} ions and the effect of dilution on the pH of solutions. Few candidates were awarded full marks for this question.
Question 5(a)	Most candidates did not state that it is the repulsion from the electron pair on the ligand that splits the d orbitals. Instead, they simply stated that it is the binding of the ligand that splits the d orbitals. This is a restatement of the information given in the stem of the question and was not awarded a mark.
Question 5(b)(ii)(B)	This question proved more challenging than expected. Many candidates were unable to spell the fluorido part of the name correctly.
Question 5(b)(ii)(C)	This was a skills question and candidates were expected to use information from the table and follow the examples already given.
Question 6(a)(i)	This question was poorly done. An unusually high number of candidates did not attempt this question. There was no particular pattern to what the candidates were circling, however, a significant number of candidates did not include the carbonyl group in the chromophore. The course specification does not mention carbon or limit a conjugated system to carbon chains. It simply states, 'molecules with alternating double or single bonds...'.
Question 6(b)(i)	Most candidates managed to give restricted rotation as one reason for the existence of cis and trans isomers. However, only a few were able to adequately explain that there needs to be two different atoms or groups on each carbon of the double bond. Most candidates had drawn examples of cis and trans isomers instead.
Question 6(c)(ii)	Most candidates could calculate the energy from a wavelength.

Question 7(b)(i)	Most candidates could state a characteristic of a primary standard.
Question 7(b)(ii)	Most candidates could calculate the mass of iron in a sample from titration data.
Question 8(a)	This question was not intended to be challenging but it was. Candidates should have been able to work out the formula for X by subtraction.
Question 8(b)(i)	In many cases, the nature of a nucleophile was unclear from the given definitions. Many candidates did not state what a nucleophile actually was, only what it could do.
Question 8(b)(ii)	This question was a skills question, using knowledge of the mechanism of nucleophilic attack from the nucleophilic substitution area of the course. A large number of candidates were not awarded this mark because they had drawn more than one arrow on the diagram, and it was not clear which one they were showing to be the nucleophilic attack.
Question 8(b)(iv)	Many candidates either stated that the product of the reaction was hydrochloric acid, or they gave the formula HCl and wrote 'hydrochloric acid' next to it (a cancelling error).
Question 8(c)(i)	Most candidates could state the type of amine.
Question 8(c)(ii)	Many candidates seemed to think that compound Y was a ketone. This was the most popular incorrect answer.
Question 8(d)(ii)	Most candidates could calculate the percentage yield of a reaction.
Question 10(a)	There were two parts to the definition of an antagonist (as shown in the marking instructions) and many candidates only stated one part.
Question 10(b)(i)	Most candidates could calculate the volume required to make a diluted solution of eucalyptol.
Question 11(b)(i)(A)	It was expected that this question, based on the solvent extraction practical technique, would prove challenging for candidates. This was the first time a description of the steps involved had been asked. It was also possible that many candidates had limited experience of practical techniques. Only a few candidates were able to describe the steps in full. Some candidates, at least, knew that a separating funnel was involved, but the most commonly missed step was the shaking or mixing.
Question 11(b)(i)(B)	Calculating equilibrium constants is frequently challenging. Most candidates did not subtract the 23.5 mg of caffeine from the 32 mg of caffeine that was dissolved in the soft drink at the start of the extraction. Candidates also found it difficult to calculate a concentration of caffeine in the two layers. Only a few candidates were able to correctly calculate the equilibrium constant.
Question 11(b)(ii)	Some candidates had the idea of repeating the extraction but only a few candidates were able to describe repeating the extraction with smaller volumes of dichloromethane.
Question 11(c)	Most candidates could write the charges on a zwitterion by considering the curly arrows.

Section 3: preparing candidates for future assessment

Question paper

There are two types of question that candidates consistently find more demanding. These are:

(a)Questions linked to statements from the course specification

Candidates should practise accurately describing and explaining terminology outlined in the course specification.

(b)Questions linked to practical techniques

Ideally, candidates should have experience of all techniques in the Researching Chemistry section of the course, as detailed in the course specification. Candidates are expected to be able to describe the correct procedures associated with each technique and how the relevant pieces of apparatus involved are used.

Units, significant figures, and intermediate rounding

Although there are signs of improvement, incorrect units, significant figures, and intermediate rounding remain common reasons for not awarding full marks in calculations.

Units are not required in the final answer when they are stated in the stem of the question. Candidates should take care to write the correct units if they include them in the answer. A common error is to use the incorrect case for the letter k. It is worth pointing out to candidates that they should make a clear distinction between their upper-case and lower-case letters, such as k.

The acceptable range for final answers is one fewer to two more significant figures than the data provided. Candidates should ensure they understand the difference between significant figures and the number of decimal places, so they do not confuse them.

Some candidates round intermediate values to one significant figure, making the final answer significantly different to the acceptable answers. A candidate will not achieve full marks for a question if they round intermediate values to less than one significant figure fewer than the data provided. It is best practice to retain intermediate numbers in the calculator after each step.

Open-ended questions

Teachers and lecturers should remind candidates that when answering open-ended questions, they will only receive credit for answers at Advanced Higher level. They should consider the problem and how it relates to what they have been taught in the Advanced Higher course. Candidates can give a broad treatment of the problem or go into detail about one aspect.

Reading questions and following instructions

Candidates should read the questions carefully and only do what is asked of them. If a question asks for two reasons why something is the case, then candidates should give only two reasons. Extra reasons are considered a cancelling error if they are incorrect. Similarly, when lines or arrows are to be drawn onto diagrams, if one is requested then candidates should give only one. Extra lines or arrows are likely to be taken as cancelling errors.

Appendix 1: 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 including assessment modifications and revision support, was introduced to support candidates as they returned to formal national exams and other forms of external assessment. This was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic. In addition, SQA adopted a more generous approach to grading for National 5, Higher and Advanced Higher courses than it would do in a normal exam year, to help ensure fairness for candidates while maintaining standards. This is in recognition of the fact that those preparing for and sitting exams have done so in very different circumstances from those who sat exams in 2019.

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 2022. 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 revision support.

The grade boundaries used in 2022 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 2022 Awarding — Methodology Report.

