Course Report 2016

Subject	Chemistry
Level	Higher

The statistics used in this report have been compiled before the completion of any Post Results Services.

This report provides information on the performance of candidates which it is hoped will be useful to teachers, lecturers and assessors in their preparation of candidates for future assessment. It 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.

Section 1: Comments on the Assessment

Component 1: Question paper

The question paper had two sections:

- Section 1 contained 20 fixed-response (multiple-choice) items each worth 1 mark.
- Section 2 consisted of questions worth 80 marks of the 100-mark question paper total.

This section contained questions that required single-word answers worth 1 mark, as well as extended written answers with a weighting of 2 or 3 marks, and calculations worth 1 to 3 marks. Calculations covered general numeracy calculations, in a chemistry context, as well as specific chemistry calculations taught as part of the Higher Chemistry course.

The question paper performed as anticipated. In view of the Grade Boundaries and National Rating for the 2015 New Higher Chemistry paper, the proposed 2016 paper was reviewed to ensure that questions would be accessible to candidates. The paper functioned well.

Statistical evidence shows that there was a good range of questions in terms of difficulty, and that questions showed good discrimination.

Component 2: Assignment

The assignment for Chemistry has a weighting of 20 marks from the total of 120 marks for course assessment. The weighting for each of the criteria assessed as part of the assignment is given in the table below.

Criteria	**Mark allocation**
Aim(s)	1
Applying knowledge and understanding of chemistry	4
Selecting information	2
Risk assessment	1
Processing and presenting data/information	4
Analysing data/information	2
Conclusion(s)	1
Evaluation	3
Presentation	2

This component performed as anticipated. The average mark for this component has risen. A good number of candidates managed to achieve full marks with few candidates scoring very low marks.

Section 2: Comments on candidate performance

Component 1: Question paper

A number of candidates achieved 20 marks for Section 1 of the paper. No candidate achieved all 80 marks in Section 2 of the paper, but a number achieved 79.

Candidate performance was notable in questions that examined calculations taught as part of the Higher Chemistry course

Candidates performed less well in questions that related to practical aspects taught as part of the Researching Chemistry Unit of the course.

Component 2: Assignment

Candidates' performance was generally good. However, analysis of data tends not to be done sufficiently well to gain all of the marks for this criterion.

Areas in which candidates performed well

Component 1: Question paper

Candidates performed well in the following questions.

Section 1

Question 2	Understanding the dipole notation and relative position of bonding electrons in a polar covalent bond.
Question 3	Recognising the compound with the greatest ionic character.
Question 4	Calculating an enthalpy change from an energy profile diagram.
Question 5	Stating that there are two isoprene units in limonene.
Question 9	Knowing that soap is a salt of a long chain fatty acid.
Question 12	Naming a branched carbonyl compound.

Section 2

Question 1(b)(i)	Completing a diagram to show how gas can be collected and its volume measured.
Question 1(b)(ii)	The calculation of volume strength (numeracy).
Question 5(a)	Identifying that glycerol is produced by the hydrolysis of fats and oils.
Question 6(a)	Naming the type of peptide.
Question 6(c)	Stating that the term used to describe amino acids that can't be made by the body is 'Essential'.
Question 7(a)	Understanding dangers associated with the use of UV radiation.
Question 7(b)(ii)	Stating that Initiation is the first step of a free-radical chain reaction.

Question 7(b)(iii)	Naming the carboxyl functional group.
Question 7(c)(iii)	Calculating percentage yield.
Question 7(c)(iv)	Identifying esterification/condensation.
Question 9(a)(ii)	Evaluating a procedural detail.
Question 11(a)(v)	Calculating the sugar content of a drink (numeracy).
Question 12(a)	Stating hydrogen bonding as the intermolecular force responsible for the high boiling points of carboxylic acids.

Component 2: Assignment

Comment on candidates' overall performance in the assignment is made under each assignment criterion.

Aim: 1 mark

Nearly all candidates stated an aim that could be investigated. There was evidence that centres had taken the advice given in the 2015 Course Report, and at Understanding Standards events, to ensure that aims were clear and that all aspects of candidates' aims could be investigated.

Knowledge and Understanding of Underlying Chemistry: 4 marks

Most candidates provided chemistry that was relevant to the topic. However certain topics are better than others at allowing candidates to describe underlying chemistry 'at a depth appropriate to Higher Chemistry'.

Selecting Information: 2 marks

Candidates are required to select at least two data sources that are relevant to the aim and which, when processed and analysed, should allow the candidate to draw a conclusion related to the aim.

Many candidates were able to provide relevant information that would be sufficient to allow a conclusion relating to the aim to be drawn. However, this did not necessarily mean that the mark for conclusion would be able to be awarded if the two relevant sources were not sufficient to cover all aspects of the stated aim.

Risk Assessment: 1 mark

In the Higher Chemistry Assignment assessment task; Appendix 1: Instructions for Candidates, Section - Guidance on producing your report; sub-section - Experimental procedure, it states:

> *Here you must include a description of your experimental procedure. Safety measures should be included. This may include clearly labelled diagrams.*

It is acceptable to provide the experimental procedure as an appendix to the report.

For the risk assessment to be awarded, candidates needed to clearly link precautions taken to the nature of the hazard and the associated risk.

Processing and presenting data: 4 marks

This was generally done well, with candidates scoring highly. Candidates chose appropriate formats to present data.

Only one set of data needed to be processed. Most candidates chose to process data from an experiment they had carried out.

Some candidates took information from a bar chart, found in an internet source, with numerical values at the top of each bar and turned this information into a table. This was taken to be simply restating information rather than processing. Processing should involve calculating or skills such as plotting on a graph etc.

Many candidates failed to gain the mark for citing information. When experimental results were given as raw data, either: the title and aim of the experiment needed to be given with the results data within the body of the report; or the title and aim needed to be given in the reference section of the report. A full reference for the second data source needed to be given with the data, or the data clearly linked to a reference in the reference section of the report.

Analysing data/information: 2 marks

Many candidates were unable to be awarded both marks for this criterion mainly due to the limited nature of the data being processed. Most candidates only made simple comparisons of data sources or described data trends.

Conclusion(s): 1 mark

Most candidates gave conclusions that related to their aim. However, many candidates with multiple aspects to their aims failed to gain the conclusion mark either due to the conclusion not addressing all aspects of the aim, or failing to be supported by relevant information in the report.

Evaluation: 3 marks

A significant number of candidates evaluated their experimental procedure but failed to provide details of the experimental procedure. Marks can only be awarded for evaluating the experimental procedure if the candidate includes the experimental method in their report so that markers are able to judge whether an evaluative comment is valid.

When commenting on the validity / reliability / robustness of sources candidates need to justify their comment, eg if commenting on the robustness of data from a website, stating that the same information is given on other websites, and stating these websites.

Presentation: 2 marks

Most candidates structured their report appropriately with a title, then the body of the report, finishing with a reference section. The only information that is allowed to follow the reference section is any clearly-labelled appendices that the candidate wishes to include with their report.

The most frequent mistakes made in terms of the presentation of the report were:

- Attaching processed charts and graphs to the report after the reference section.
- Including material other than references in the reference sections eg evaluative comments which should have been stated separately.

Areas which candidates found demanding

Component 1: Question paper

Section 1

Question 10	How emulsifiers in food can be made. This is a question based on a specific statement given in the Course Support Notes.
Question 13	A demanding question based on calculations from an equation.
Question 19	A demanding question requiring understanding of how the electrochemical series can be used to predict reactions**.**

Section 2

Question 2(c)(i)	Predicting the lattice enthalpy for RbF. Many candidates simply looked at the trend for fluoride ions down group 1.
Question 4	An open-ended question relating to viscosity. It was evident some candidates did not understand what was meant by the term ‘viscosity’.
Question 5(c)(i)	Many candidates answered in terms of how quickly the oils would decolourise bromine solution rather than the volume of bromine solution required to saturate the oils.
Question 6(d)(ii)	Identifying the spot corresponding to methionine. It would appear candidates guessed rather than use the formula given and a ruler to work out the correct spot.
Question 8(b)(i)	Suggesting structure for compound X.
Question 10	An open-ended question relating to efficiency and environmental implications of industrial processes.
Question 11(a)(i)	Drawing a volumetric flask.
Question 11(a)(ii)	Describing a method to accurately measure the mass of 10 cm^3 of sugar solution. Many candidates described making a standard solution.
Question 11(b)(i)	Drawing the aldehyde functional group. Many candidates simply drew a carbon double bonded to an oxygen atom.
Question 11(b)(ii)	Writing the ion-electron equation for the oxidation reaction given the redox equation.

Question 12(a)(ii)	Most candidates were able to describe the effect of branching. However, few candidates were able to adequately describe the effect of the position of the ester linkage. Many incorrectly referred to the position of the 'carbonyl' group within the compounds.
Question 12(b)(ii)	Determining the number of peaks on the carbon-13 NMR spectrum

Section 3: Advice for the preparation of future candidates

Component 1: Question paper

Open questions

A significant proportion of candidates did not attempt the open questions; very often a candidate would not attempt both of the open questions. This did not appear to be ability-related — ie it was not always candidates who performed poorly in other questions who omitted the open questions.

Candidates need to be given more opportunities to answer this type of question than is afforded by a prelim exam alone.

Candidates need to be made aware that there are no definitive answers to open questions. Candidates can give broad answers covering a number of aspects of a question or focus on one particular aspect and give a detailed explanation.

These questions are marked holistically rather than on a number of points basis (eg 1 point 1 mark; 2 points 2 marks etc). Marks are assigned according to whether the candidate's answer displays no understanding (0 marks); limited understanding (1 mark); reasonable understanding (2 marks); or good understanding (3 marks). Candidates are not expected to give a perfect answer to gain the full mark allocation for the question.

Researching Chemistry questions

Approximately 10 marks are allocated to the assessment of knowledge and skills relating to the Researching Chemistry Unit. Apparatus and techniques that candidates should be familiar with are listed in the Course and Unit Support Notes.

Again this year, as was the case in 2015, candidates tended to perform poorly in these questions. This was particularly true of drawing a diagram of a volumetric flask (many candidates drew a conical flask and some even drew a beaker) and of measuring the mass of 10 cm^3 of sugar solution (many candidates made no mention of a balance or weighing in their answer).

The Researching Chemistry Unit has a half-unit weighting in the course. This is to allow time to develop practical skills associated with the Unit. It should not be assumed that candidates will gain understanding of the proper use of equipment and the techniques listed without these being specifically taught.

Questions requiring more detailed answers

Questions that require more detailed answers are signalled by the words ‘Explain fully’ or ‘Explain clearly’ and are worth a minimum of two marks.

Candidates need to be made aware that, to gain full marks for the question, a detailed explanation needs to be given.

When the weighting of the question is two marks, candidates would be expected to make at least two correct points within their answer. For example, in Q2(b)(ii), candidates stating that the 2nd ionisation energy for a Group 1 element required removal of an electron from an inner shell would have gained 1 mark. To gain the second mark, the candidate would have needed to go on and say that electrons in this shell are less shielded from the nuclear pull.

Calculations

The paper contains calculations that are taught as part of the course, and general numeracy calculations set in a chemical context. Calculations tend to be highly discriminating when candidates’ performance in calculations is compared to overall course performance.

Calculations that are taught as part of the course were well done, in particular performance in question 11(b)(iv), which was thought to be quite a difficult titration calculation, was notable.

Candidates should be encouraged to set working out clearly, as partial credit can often be given to those who fail to gain full credit for the questions. This is particularly true where a concept marking approach is adopted. In question 11(b)(iv) when looking to assign partial marks, markers looked for $n = c \times v$ being applied correctly and for the stoichiometry of the equation being applied correctly.

Component 2: Assignment

This was the first year when all presenting centres presented candidates for the new Higher Chemistry.

All candidates therefore had to undertake an assignment relating to a Key Area within the course. Whilst candidates can work collaboratively when undertaking the research phase of the assignment, ie when carrying out practical activities and carrying out literature/internet research, they must work independently during the communication phase, ie when producing their report that is submitted to SQA for assessment.

Candidates will therefore benefit from keeping a record of the work they carry out as part of the assignment. This can be in the form of a day book similar to that used in Advanced Higher Chemistry.

It is important for the integrity of the process that the guidance given in the ‘Chemistry Assignment General Assessment information’ is adhered to.

Many candidate reports indicated that candidates would have benefited from greater engagement with their teachers throughout the research phase of their assignment.

Some reports also showed that candidates had collaborated when processing raw data prior to writing their report. Evidence for this was the same processing mistake appearing in several candidates' reports. The report, including the processing of data within the report, should be a candidate's own work, and therefore should not be done collaboratively.

There was also evidence of re-drafting of reports in some centres. Centres are reminded that teachers/lecturers are not allowed to give feedback on reports and that candidates are not allowed a draft report.

The following advice covers specific criteria within the assignment. Please also see Section 2 of this report — Areas in which candidates performed well, Component 2: Assignment.

Title and aim of the assignment

A title can be broad in nature; an aim needs to be specific.

The aim must be stated separately from the title. 'Higher Chemistry Assignment' does not constitute a title. The title should give some indication of the Key Area that the assignment relates to.

A candidate who started his/her report with: 'Aim: the aim is …' would not be deemed to have given the report a title, and would therefore not gain a mark for report structure in presentation.

Candidates need to be clear about their aim. If their aim relates to socio-economic or medical information taken from literature sources, then this information needs to be given as raw data in the form of a photocopy or a print-out from the source. This can be appended to the report. It is not sufficient simply to give a reference to the literature source.

Raw data

Candidates must cite the raw data that they include in their report by giving a full reference with the raw data or giving a link to a reference in the reference section of their report.

Results from an experiment

One of the sources of information that candidates **must** use is data from an experiment in which they had taken part. Candidates must link their data to the title and aim of the experiment either by stating the title and aim of the experiment with the data, or by clearly indicating that the title and aim are given in the reference section of the report. Candidates should be using the experimental data generated for the Researching Chemistry Unit as the basis for the assignment.

Processing and presenting

Candidates must provide the raw daw data that they process. The presentation marks are associated with processed data and not with raw data.

Analysing data/information

These marks are given for stating data trends, making comparisons between data sets.

Very often the raw data that the candidate had used or the data that the candidate had processed was so limited that it was difficult for candidates to carry anything other than a very simple analysis.

Candidates need to be given the opportunity to engage in activities where they are asked to analyse data in advance of writing their reports in order that they develop the skills of analysing prior to writing their reports.

Evaluation

Candidates do not need to design the experimental procedure they use as part of their assignment. Candidates can follow a procedure that is given to them or that they have researched. They are therefore able to discuss the appropriateness of a procedure prior to carrying it out.

In order to access marks through evaluating experimental procedures, it is important that the candidate has included a description of the procedures in the report, so that the marker can judge the validity of the evaluative comment.

It is not acceptable for candidates to carry out experimental procedures badly in order to then state in an evaluation section how the procedure could be improved, eg carrying out titrations and then stating in the evaluation section that a white tile could be used to see the colour change more clearly.

Structure of the report

Although the structure of the report need not follow the assignment criteria, the report must have a title and a reference section at the end.

The only materials that should come after the reference section are any appendices that a candidate may wish to include. Appendices should not need to be marked. The only allowable exception to this is for the risk assessment mark where a candidate has indicated within the body of the report that their experimental procedure is given as an appendix. Appendices must be labelled clearly as such.

If candidates include materials such as graphs of processed data that need to be marked as part of the report after their reference section, then they are not able to be awarded a mark for the structure of the report.

Grade Boundary and Statistical information:

Statistical information: update on Courses

Number of resulted entries in 2015	4020

Number of resulted entries in 2016	10077

Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark -				
A	29.6%	29.6%	2981	86
B	25.2%	54.8%	2544	74
C	21.3%	76.1%	2145	62
D	8.8%	84.9%	886	56
No award	15.1%	-	1521	0

General commentary on grade boundaries

- While SQA aims to set examinations and create marking instructions which will allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and a well prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary), it is very challenging to get the standard on target every year, in every subject at every level.

- Each year, SQA therefore holds a grade boundary meeting for each subject at each level where it brings together all the information available (statistical and judgemental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the management team at SQA.

- The grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- Where standards are comparable to previous years, similar grade boundaries are maintained.

- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set in centres. If SQA has already altered a boundary in a particular year in, say, Higher Chemistry, this does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related, as they do not contain identical questions.

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