Course Report 2015

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 examinations. 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 and marking instructions for the examination.

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 as well as specific chemistry calculations taught as part of the Higher Chemistry course.

The question paper performed much as anticipated.

Component 2: Assignment

The assignment for Chemistry had 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 with a small number of candidates gaining full marks. The average mark for the component was 12·1 out of 20.

Section 2: Comments on candidate performance

Component 1: Question paper

A number of candidates achieved 20 marks for Section 1 of the paper, but the highest mark achieved in section 2 was 75. Candidates performed slightly less well in Section 2 of the paper when performance was scaled to that of candidates in the traditional Higher and the Higher (Revised) papers.

Candidates perform well in questions that require them to process information, eg Q4 (a); Q 8 (a); and Q11.

Candidates perform less well in questions that related to practical aspects of the Course, eg Q 3 (a) (i) and Q 12 (a) (i).

Component 2: Assignment

Candidates' performance was good in terms of processing and presenting data but they had more difficulty when analysing data.

Section 3: Areas in which candidates performed well

Component 1: Question paper

Candidates performed well in the following areas of the question paper.

Section 1

Candidates performed well in this section of the paper. The average mark for this section was 13·7. Candidates answered the following questions particularly well:

Q1	recognising that nitrogen, oxygen, fluorine and neon are gases at room temperature
Q2	recognising an equation representing first ionisation energy
Q4	identifying that a covalent bond is not an example of a van der Waals' force
Q5	identifying that ammonia has more than one type of van der Waals' force operating
Q13	identifying the correct structure for an isoprene unit

Section 2

In the extended-response section of the paper, candidates performed better in calculations Q 3 (b) (i) and 3 (b) (ii) A; limiting reactant and percentage yield Q 7 (b) (i) C enthalpy of

combustion; and Q 12 (a) (iii) titration calculation, than had been the case in the other Higher levels in previous years. Candidates performed very well in the following areas:

Q2 (a)	calculating time of reaction from the relative rate
Q4 (a)	processing information from chromatograms
Q4 (d)	stating that terpenes consist of joined isoprene units
Q7 (b) (i) (A)	identifying an incorrect aspect of an experimental set-up
Q7 (b) (ii)	calculating the density of an alcohol
Q8 (a)	completing a flow chart
Q11 (a)	naming the carboxyl functional group
Q11 (b)	identifying that the formation was an example of esterification (condensation)
Q11 (d)	stating a conclusion relating to the absorption and structure of parabens
12 (c) (iii)	recognising a propagation step from a free-radical chain reaction

Component 2: Assignment

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

Aim: 1 mark

Most candidates stated an aim that would have been capable of being investigated. However, many of the stated aims were overly complex, making it difficult to evidence other criteria of the assignment.

Knowledge and Understanding of Underlying Chemistry: 4 marks

Many candidates provided historical/medical/socio-economic details mixed in with the underlying chemistry. No marks are given for this information. The marks are for understanding chemistry, and this needs to be at a level equivalent to Higher or the chemistry covered in the Course.

Many candidates who carried out assignments related to antioxidants tried to describe the chemistry of the Briggs Rauscher reaction. The chemistry of this reaction is extremely complex and well above the level that would be expected to be understood by candidates. It would have been sufficient to give brief details of the reaction and how the time interval between colour changes relates to antioxidant levels.

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. Many candidates were able to provide relevant information but because of the way in which their aim was stated they were unable to meet the criterion of sufficiency. This was particularly true for candidates carrying out assignments related to antioxidants when the stated aim was related to antioxidants in the diet and health. It was often the case that these

candidates included health information, (normally associated with the underlying chemistry section) and may well have provided reference(s) in the reference section of their report, but did not include an article from which the information was taken as raw data. These candidates therefore did not provide sufficient raw data with which to draw a conclusion relating to their aim.

Risk Assessment: 1 mark

The only aspect of experimental procedure that candidates were required to give information on was any safety precaution that was taken. The safety precaution needed to clearly link to the nature of the hazard and the associated risk. It should be noted, however, that including a description of the experimental procedure may well aid the candidate in scoring marks when it comes to the evaluation section of the report.

Some candidates included a risk assessment, sometimes with the experimental procedure, as an appendix to the report. When this is done, reference needs to be made to this within the body of the report.

Processing and presenting data: 4 marks

This was generally done well, with candidates scoring highly. However there were a number of candidates who used inappropriate formats, particularly pie-charts, to present data.

Only one set of data needed to be processed, and this was normally experimental data. Some candidates chose to process data that was in its most appropriate format, eg a table of data from the data booklet, into another form such as a graph, which was unnecessary and introduced errors.

Candidates most often did not gain the mark relating to 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.

Analysing data/information: 2 marks

Candidates found this criterion demanding. Some candidates were able to relate to or make comparisons of data sources, or process results further, but many candidates simply drew conclusions which they then restated.

Conclusion(s): 1 mark

Most candidates gave conclusions that related to their aim. However, many conclusions were not supported by information in their report.

Evaluation: 3 marks

Most candidates were able to gain marks for this criterion either by evaluating their experimental procedure or by commenting on the validity and reliability of sources. Where candidates are evaluating experimental procedures, it is important that they include the

experimental method in their report so that markers are able to judge whether the evaluative comment is valid.

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 allowable material after the reference section is any appendices that the candidate may wish to include with their report. Appendices must be clearly labelled as such.

Section 4: Areas which candidates found demanding

Component 1: Question paper

Section 1

Only questions 7, 8, 10, 12, 16 and 20 had facility value lower than 0·60. All six questions were very discriminating.

Q7	The majority of candidates thought this was esterification, answering C, and did not recognise that a neutralisation reaction would take place between the sodium hydroxide and the ethanoic acid.
Q8	Most candidates realised it was either B or C. Those who gave C as their answer did not recognise that the higher iodine number meant that linseed oil was more unsaturated and therefore would have the lower melting point.
Q10	A significant number gave D as the answer presumably because of water on the product side.
Q12	A significant number of candidates answered C indicating that they thought a ketone reacted with acidified potassium dichromate solution.
Q16	A significant number of candidates answered B. Surprisingly candidates found this question more difficult than Question 17.
Q20	Candidates needed to realise that they had to use the electrochemical series from the data booklet to be able to answer this question.

Section 2

In the extended-answer section of the paper, candidates did not perform well in the following areas:

Q1 (b)	Drawing a possible structure for P_4S_3 — any structure obeying normal valency rules was acceptable.
Q1 (b) (iii)	Explaining fully why the melting point of sulfur is much higher than that of phosphorus. It was thought that the wording of the question, ie the inclusion of the wording *in terms of the structures of sulfur and phosphorus molecules*

	and the intermolecular forces between molecules of each element would indicate to candidates what would be expected in a full answer. The majority of candidates simply stated that sulfur molecules were bigger and therefore had stronger intermolecular forces, rather than give details of the structures and naming the intermolecular forces.
Q3 (a)	Completing the apparatus diagram. The standard of drawing was extremely poor both in the technical sense (this is thought to impact on candidates' ability to attain the marks) and in terms of illustrating a suitable arrangement of apparatus to carry out the technique. Many candidates did not pass the steam 'through' the leaves and drew systems that were closed.
Q5	An Open-ended question – Many candidates did not use chemistry from Higher level ie aspects of periodicity covered in the Higher course, to illustrate their answers.
Q 7 (c) (i)	The question focused on an aspect of 'Enthalpy calculations used for Industrial Processes' that is given in the exemplification of the key area. *For industrial processes, it is essential that chemists can predict the quantity of heat energy taken in or given out. If reactions are endothermic, costs will be incurred in supplying heat energy in order to maintain the reaction rate. If reactions are exothermic, the heat produced may need to be removed to prevent the temperature rising.* An answer that focused on the reasons for controlling rate in terms of yield or speed of reaction was required.
Q8 (b)	Many candidates simply answered 'adding brine will push the equilibrium to the right' rather than give a full answer in terms of concentration of sodium ions and consequent rate of forward reaction.
Q10 (b) (iii)	Calculating the concentration of a diluted solution.
Q10 (c)	Using a best fit straight line from a graph.
Q12 (a) (i)	Setting up a burette. Few candidates mentioned aspects such as rinsing the burette with the solution to be used and checking for air bubbles in the jet of the burette when setting up the burette.
Q13 (b)	Many candidates drew a six-membered heterocyclic ring instead of a five-membered ring.

Component 2: Assignment

Please see section 3 for comment on each criterion of the assignment.

Section 5: Advice to centres for preparation of future candidates

Component 1: Question Paper

General

Centres should note that the Support Notes for Higher Chemistry were updated in May 2015 to clarify the mandatory content for the key areas.

Unfortunately, due to question lengths, a blank page was included in the extended answer sections of both the Higher (Revised) and the New Higher papers. The instruction *'Turn over for Question 10 on page …'* was given clearly on the blank page. A number of candidates in the Higher (Revised) paper obviously did not read this instruction and stopped answering after Question 9. It is very important that candidates check all pages of their exam script as it cannot be guaranteed that inclusion of a blank page, for question layout purposes, will not occur again in future papers.

Advice regarding particular types of questions

Researching Chemistry questions

Approximately 10 marks are allocated to the assessment of knowledge and skills relating to the Researching Chemistry Unit. These questions are in place of Prescribed Practical Activity questions which were included in the traditional Higher paper. Apparatus and techniques that candidates should be familiar with are listed in the Support Notes.

In this year's paper, candidates performed poorly in these questions, particularly the diagram completion and setting up a burette. It is important that centres spend time ensuring that candidates develop skills in using the listed apparatus and are given experiences that allow them to carry out the listed techniques.

Questions requiring more detailed answers

Questions that require more detailed answers are often signalled by the words '**Explain fully**' or '**Explain clearly**' and are worth a minimum of two marks. Candidates need to be 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 Q8 (b), an acceptable answer for two marks would have been*:*

'Adding concentrated sodium chloride solution increases the concentration of sodium ions. This increases the rate of the forward reaction pushing the equilibrium to the right and producing more sodium carbonate as a solid.'

When the weighting of the question is three marks, candidates may be given prompts within the questions to help them structure their answers. For example, Q 1 (b) (iii) Candidates were given the prompts *In terms of the structures of sulfur and phosphorus molecules and the intermolecular forces between molecules of each element.*

To gain the full three marks, candidates were expected to mention S_8 and P_4 molecules and London Dispersion Forces in their answers.

Open questions

The new Higher paper contains two open-ended questions. These are questions where there is no definitive answer. 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 by assessing 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.

Candidates need to be given greater experience of answering this type of question than is afforded by a prelim exam alone.

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 fairly well done, eg Q3 (b) (i) — showing that cinnamic acid was the limiting reactant; Q3 (b) (ii) A — Percentage yield; Q 7 (a) — Gas volume calculation; Q 7 (b) (i) C — and enthalpy of combustion.

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.

Component 2: Assignment

This was the first year of assignments being an assessable component of Higher Chemistry. Many candidates seemed well prepared for the task and produced well-structured reports.

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

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

The following advice covers specific criteria within the assignment.

Title and aim of the assignment

A title can be broad in nature, an aim needs to be specific. It is better to state the aim separately from the title. 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 would 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 to gain the mark for the sufficiency of data, this information needs to be given as raw data in the form of a photocopy of the literature. 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 the 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.

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.

Candidates need to be given the opportunity to engage in this type of activity in advance of writing their reports.

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 material that should come after the reference section is 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 candidates have indicated within the body of the report that their risk assessment was given as an appendix. Appendices must be labelled clearly as such.

Some candidates drew graphs of data which they attached to the back of the report. Candidates did not gain a mark for structure of the report since their reference section did not come at the end of the report. This had a lesser effect on marks than would have been the case if the graphs had been included as appendices and not marked.

Statistical information: update on Courses

Number of resulted entries in 2014	0

Number of resulted entries in 2015	4020

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	22.0%	22.0%	885	82
B	24.9%	46.9%	999	68
C	26.7%	73.6%	1075	54
D	10.5%	84.1%	421	47
No award	15.9%	-	640	-

For this course the intention was to set an assessment with grade boundaries of 50 for the C, 72 for the A and 83 for the upper A. A 2 mark adjustment was made at the 'C', 'A' and 'UA' boundaries for two questions in the multiple choice section - Q11 and Q22 - these questions did not function as intended. A 1 mark adjustment was made at the 'A' and 'UA' boundaries for both Q(3)(b)(ii) and Q(7)(d) as these questions did not function as intended. A 1 mark adjustment was made at the 'C', 'A' and 'UA' boundaries for Q(9)(a)(ii) as it didn't function as intended. A 1 mark adjustment was made at the 'C' boundary only for Q(10)(c) as it functioned as an 'A' question when it was intended for the 'C's. A 1 mark adjustment was made for the 'C', 'A' and 'UA' for Q10(b)(i) as it did not function as intended.

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.