External Assessment Report 2014

Subject(s)	Chemistry
Level(s)	Higher (Revised)

The statistics used in this report are prior to the outcome of any Post Results Services requests

This report provides information on the performance of candidates which it is hoped will be useful to teachers/lecturers 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 question papers and marking instructions for the examination.

Comments on candidate performance

General comments

The 2014 Higher (Revised) paper closely followed the distribution of marks given in the Arrangements documents and used for the production of the Specimen, 2012 and 2013 papers.

The revised Chemistry paper places far greater emphasis on assessing a candidate's ability to explain the underlying chemistry, and consequently there are greater numbers of marks assigned for extended answers including open questions where no definitive answer is being specified.

The revised course places significant emphasis on the development of numeracy skills. In addition to the calculation types specified in the Arrangements document, a number of questions assessing general numeracy skills within chemical contexts were set.

Unlike the traditional Higher exam, marking instructions do not allow for the award of half marks in the exam. The weighting of certain calculations and the marking is adjusted to take account of this.

Some questions used in the examination of Higher and Higher (Revised) Chemistry are common to both papers. These benchmarked questions are used to compare candidate performance by the two cohorts and ensure parity in terms of the awards made to the separate cohorts.

As was the case in 2013, in questions common to both the traditional and revised papers, the revised cohort outperformed the traditional group, although this was not as marked as in 2013.

In general, candidates appeared well prepared for the examination.

The overall impression of the paper from feedback received from markers at central marking was that the paper was accessible to all candidates with few missing answers. The paper was deemed to be appropriate in terms of demand.

Areas in which candidates performed well

Candidates performed well in the following questions from Section A

Question 1	Identifying the group that an element is in from Ionisation energies
Question 2	Periodic properties of elements descending a group
Question 5	Identifying a non-polar molecule from shape
Question 9	Processing information relating to naming of an unfamiliar compound
Question 12	Identifying that an alcohol reacting to form an acid is oxidation

Question 16	Describing the cleansing action of soap
Question 18	Relating structure of a terpene to the number of isoprene units
Question 6	Definition of enthalpy of combustion

In Section B of the paper numeracy questions were, in general, very well done.

Question 1(a) & (b)	Most candidates showed good knowledge of the structure and bonding in elements. There was also good understanding of the reason for atom size decrease across the period.
Question 2(a)(i)	Nearly all candidates knew that enzymes would be denatured if the temperature was raised.
Question 2(a)(ii)	Most candidates understood that the reaction was an example of reduction.
Question 2(a)(iii)	This calculation was very well done.
Question 2(c)	This numeracy calculation in a chemical context that required processing of information was very well done.
Question 3(a)	Most candidates were able to use bond enthalpies to calculate the enthalpy change for the reaction.
Question 4(b)(ii)	The Hess's Law calculation was well done.
Question 5(b)	The numeracy calculation relating to recommended daily allowance was well done by most candidates.
Question 6	Nearly all candidates gave a suitable method for heating a flammable reaction mixture, understood that esterification is a condensation reaction and were able to draw the structure of the ester.
Question 7(a), (b), (c)(i) and (c)(ii)	Nearly all candidates could identify the peptide link and name the hydroxyl group. Most candidates knew that glycerol was produced when ben oil was hydrolysed and carried out the numeracy calculation well.
Question 8(a)(iii)	Most candidates answered propagation.

Areas which candidates found demanding

In Section A the following questions had low facility values.

Question 4	Candidates were asked to identify the element with the strongest London dispersion forces. More candidates chose argon than the correct answer chlorine, suggesting candidates only looked at electrons in the atoms and didn't consider whether the element was monoatomic or diatomic.
Question 17	Many candidates chose the long chain fatty acid perhaps assuming it was a soap molecule.
Question 23	Candidates recognised the energy profiles were for gases at different temperatures but were unable to relate molar quantities to

	the area beneath the curve. The item was discriminating.
Question 28	Retention time related to polarity of the molecule. Nearly as many candidates chose A as the correct answer D suggesting that the relationship between height of peak and concentration was not well understood.

In Section B of the paper, open questions, and questions assessing knowledge of practical skills that should be developed during the Researching Chemistry Unit, were not well answered. The following questions highlight specific areas that were found to be demanding by some candidates.

Question 1(c)(iii)	Candidates tended to be non-specific in their answers, eg magnesium would react with liquid air rather than stating a specific reaction such as magnesium would react with the oxygen
Question 1(c)(iv)	The quality of answers varied highly. Most candidates didn't engage with the information they had been given. Many simply concentrated on argon being a Noble gas and therefore unreactive. Those who did engage with the information and considered the differences in the nitrogen prepared by the two methods gave some excellent answers.
Question 4(a)	The key to the answer was that the ammonia had to pass through the calcium oxide. Many candidates drew a system where the gas passed over the calcium oxide. The quality of drawing of the diagrams was very poor.
Question 5(a)(i)	Extracting the oxidation half-equation from the redox equation proved highly discriminating.
Question 7(c)(iii)	Many candidates drew the hydrogen bond from a hydrogen atom attached to a carbon.
Question 7(d)	Answers tended to be very limited with many candidates concentrating on hydrolysing fats and hair without going into detail about their structures or chemicals that might be used.
Question 8(a)(i)	Many candidates lacked the knowledge that a free radical has an unpaired electron.
Question 11(a) & (b)(i)	Many candidates were unable to balance the ion-electron equation. Many answers regarding preparation of a stock solution were limited with many candidates failing to mention aspects such adding rinsings, using a volumetric (standard) flask or making up to the mark with water. Some very good answers included inverting the flask to ensure mixing.

Question 11(b)(ii)	Many candidates simply used a permanganate concentration of 30 mg l^{-1} instead of drawing a best fit straight line and using that to determine the permanganate concentration.
Question 12(b)	A processing information question that required candidates to systematically follow the rules given. Many candidates failed to process Rule 3 changing some of the carbon monoxide to carbon dioxide.

Advice to centres for preparation of future candidates

General

The last Higher (Revised) paper based on the Arrangements document published in October 2010 has been set for 2015.

The Chemistry Higher (Revised) course presents different challenges from the traditional course and centres might find the following advice helpful regarding aspects of assessment that are new for the Revised Higher course.

Open questions

To allow candidates the opportunity to demonstrate their understanding of underpinning chemical concepts, and their ability to apply these ideas creatively in unfamiliar contexts, the examination for the Revised Higher course contains open questions. These questions are signposted for candidates by use of the phrase, '**Using your knowledge of chemistry'** printed in bold text in the question stem.

The nature of these questions is such that there is not a single definitive correct answer.

There are three marks allocated to each open question. Markers will allocate a mark based on the level of understanding illustrated by the candidate's answer.

1 mark:	The candidate has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.
2 marks:	The candidate has demonstrated a reasonable understanding of the chemistry involved. The candidate makes some statement(s) which is/are relevant to the situation, showing that the problem is understood.
3 marks:	The maximum available mark would be awarded to a candidate who has demonstrated a good understanding of the chemistry involved. The candidate shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This

type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an ‘excellent’ answer or a ‘complete’ one.

As a general principle it is worth emphasising that, whilst a candidate could score 3 marks by writing an extended paragraph covering a large number of different relevant facts and ideas, it would also be possible for a candidate to score 3 marks for a relatively short answer that gave a perceptive answer to the question.

The 2014 paper contained two open questions.

In question 1(c)(iv) candidates were given information about the discovery and naming of Argon and were asked to use their knowledge of chemistry to comment on the discovery and naming of argon.

Candidates’ answers made reference to the methods used to prepare the samples of nitrogen explaining for Method 1, the chemistry of the method and noting that the sample would contain Noble gas impurities.

For Method 2, candidates explained that the nitrogen gas would be pure.

Some candidates deduced that if equal volumes of the gases were compared, the gas prepared by method 1 would be slightly heavier.

Some candidates noted that if the gas prepared by Method 1 reacted with magnesium, a small amount would remain and that, since this gas was less reactive than nitrogen, argon was an appropriate name. Some candidates noted that this gas itself would not be pure since it would contain other Noble gases.

Many candidates referred to the structure of the Noble gases and explained their lack of reactivity in terms of stable outer shall arrangements

In question 7(d) candidates were asked to use their knowledge of chemistry to comment on chemical methods that might be used to clear blocked drains.

Candidates tended to focus on the structures of fats and proteins and the composition of food waste. Candidates tended to discuss methods of breaking fats down to long chain fatty acids and glycerol and breaking proteins down to amino acids. Candidates regularly mentioned hydrolysis, using alkalis such as sodium hydroxide, breaking ester and peptide linkages, denaturing of proteins and using heat to improve effectiveness of methods.

Assessment of Skills developed in the Researching Chemistry Unit

Skills developed in the Researching Chemistry unit of the course assessed throughout the exam. During the course learners should be given every opportunity to engage in investigative and illustrative practical work. The arrangements document specifies the apparatus in addition to the practical and data analysis techniques with which Higher

candidates should be familiar. The following list provides examples of questions in the 2014 paper which assess these skills.

Practical Technique	Section A	Section B
Filling a pipette	29	
Accurately diluting a solution	30	
Separation techniques		1 (c) (i)
Preparation of glassware when carrying out a titration		5 (a) (ii)
Improving reliability		5 (a) (iii)
Preparing a stock solution		11 (b) (i)

Data Analysis technique	Section A	Section B
Use of line of best fit		11 (b) (ii)

Calculations

As well as examining calculations related to content statements detailed in the Arrangements document, the examination paper examines general numeracy skills in a chemical context.

Candidates performed well in most calculation in the 2014 paper, particularly general numeracy calculations.

Candidates benefit from following set methods for carrying out calculations based on content statements, such as percentage yield (question 2 (a)(iii)), enthalpy change (question 4 (b) (i)), Hess's Law (question 4(b)(ii), titration (question 5 (a) (iii)), atom economy (question 6 (b)). Candidates need to be reminded that clearly showing working may allow partial credit for calculations when a wrong final answer is given.

Candidates should be aware that a principle of positive marking is applied in respect of units. Normally the units for a calculation will be given, eg Calculate the volume in litres… However, for one calculation the units that the answer should be given in will not be specified, and a mark awarded if the correct units appropriate to the calculation are given.

Statistical information: update on Courses

Number of resulted	652

entries in 2013	

Number of resulted entries in 2014	702

Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark 100				
A	35.3%	35.3%	248	71
B	24.9%	60.3%	175	59
C	20.7%	80.9%	145	48
D	7.0%	87.9%	49	42
No award	12.1%	-	85	-

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.