Principal Assessor Report 2004

Assessment Panel:	**Chemistry**

Qualification area

Subject(s) and Level(s) Included in this report	**Chemistry Advanced Higher**

Statistical information: update

Number of entries in 2003	1772 (Pre Appeal)

Number of entries in 2004	1747 (Pre Appeal)

General comments re entry numbers

There has been a very small decrease in the number of presentations at Advanced Higher.

Statistical Information: Performance of candidates

Distribution of awards

Distribution of awards	%	Cum %	Number of candidates	Lowest mark
A	20.9	20.9	365	87
B	23.9	44.8	418	71
C	27.5	72.4	481	56
D	10.5	82.9	184	48
No award	17.1	100.0	299	40

Comments on any significant changes in percentages or distribution of awards

There are no major changes, to the distribution of awards. The pass rate of 72.4% is slightly lower than the pass rate in 2003 (74.5%). The percentage of A awards is very similar to that of 2003.

Performance in Section A multiple choice questions which were pre-tested and/or have been used in previous examinations suggested that the candidate population was very similar than in the previous year. However, there was evidence of poorer performance in unexpected areas eg questions based in a Higher context. Lack of precision in the use of chemical terminology resulted in marks being lost.

Grade boundaries for each subject area included in the report

Grade Boundaries	Lowest mark	Percentage of maximum marks
A	87	70
B	71	57
C	56	45
D	48	38
No award	0	0

General commentary on passmarks and grade boundaries

- While SQA aims to set examinations and create mark schemes which will allow a competent candidate to score a minimum 50% of the available marks (notional passmark) and a very well-prepared, very competent candidate to score at least 70%, it is almost impossible to get the standard absolutely on target every year, in every subject and level
- Each year we therefore hold a passmark meeting for each subject at each level where we bring together all the information available (statistical and judgmental). 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 senior management team at SQA
- We adjust the passmark downwards if there is evidence that we have set a slightly more demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- We adjust the passmark upwards if there is evidence that we have set a slightly less demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- Where the standard appears to be very similar to previous years, we maintain similar grade boundaries
- 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 are different. This is also the case for exams set in centres. And just because SQA has altered a boundary in a particular year in say Higher Chemistry 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
- Our main aim is to be fair to candidates across all subjects and all levels and maintain standards across the years, even as arrangements evolve and change.

Comments on grade boundaries for each subject area

The lowest mark required for each grade is slightly lower than previous years. This was due to

- changes in the marking scheme for the Investigation
- Section B of the written paper being more difficult than previous years.

The C grade boundary was reduced by 4 marks to take account of questions in Section B of the examination which proved to be more difficult than similar questions in previous years. The changes in the marking scheme for the Investigation resulted in marks being more accessible to C candidates.

The A grade boundary was also reduced by 4 marks to take account of 2 questions in Section B of the examination affecting A candidates and 2 marks in the Investigation being more demanding for candidates performing at this level.

Comments on candidate performance

General comments

General comments from markers:

- There was a significant number of candidates who failed to complete the paper in the allotted time
- There was a much greater range in marks this year
- The examination discriminated clearly between well prepared able candidates and those of average or less than average ability
- There were excellent responses from very few candidates.

There was a wide variation in the quality of Investigations.

Areas of external assessment in which candidates performed well

1(a) (i) Trend in ionisation energy across a period.
4(b) - hydrogen bonding
Calculations were generally well done except for 2(a)
10(a) - Recognising an unfamiliar substance as an ether
10(c) - S_N1 mechanism although not well done, there was a marked improvement compared to when a similar question was asked in a previous year
10(d) - Candidates seem to be fairly good at optical isomerism
12(a) - Using Data Booklet to identify bond responsible for infra-red absorption at a particular wavenumber.

Areas of external assessment in which candidates had difficulty

Examination Section B
Any questions based on the Higher syllabus except for 4(b) which was well done
2 (a) - Very large number of candidates thought that ethyne had a C=C rather than a carbon to carbon triple bond
2 (b) - Too many candidates answered in terms of heat losses etc during enthalpy of combustion experiment rather than state that bond enthalpy figures are mean values.
3(b) - Although many candidates managed to answer this correctly, a few candidates gave a negative temperature despite using the Kelvin scale. Maybe we need to spend some time teaching the Kelvin scale at AH.
3(d) - Despite this being from a PPA, few candidates came up with acceptable answers.
4(c) - As expected, only a few candidates were able to answer this correctly
5(a) - Despite this being a fairly typical question a surprisingly large number made mistakes here
5(b) - Markers were very strict about the spelling of hexaammine. Spelling it as hexaamine lost 1 mark
5(c) - As expected, very few candidates were able to appreciate that chlorine is acting as an oxidising agent
6(a) - Writing the redox equation was surprisingly very badly done.
7(a) - Candidates who put the wrong charges on the resonance structures lost the mark here
7(b)(i) - Very surprisingly, a large number of candidates were unable to do this correctly
7(c)(ii) - Calculation was done correctly by many candidates but few managed to work out the correct units
8(a) - Most candidates knew what a buffer solution was but it was decided at the markers' meeting that a correct answer had to include "on addition of small amounts of acid or alkali" or something similar.
9(a) - Many candidates did not seem familiar with the term "reagent". Reagent Y was hydrogen cyanide or HCN. CN^- is not a reagent.
10(b) and 10(c)(i) - More candidates were able to answer these correctly compared to similar questions in previous exam papers. However (c)(ii) was, as expected, only answered correctly by a small number of

candidates.

11(b) - Poorly answered by many candidates who, obviously understood what is meant by the term "pharmacaphore" but who didn't read the question or the passage carefully. The question asked for the pharmacaphore **acting on the adrenoreceptors** which meant that only the structures of noradrenaline and phenylephrine needed to be considered and that of amphetamine ignored.
12(b) - Only a small number of candidates managed to calculate the masses of carbon, hydrogen and oxygen correctly.
12(d) - A surprising number of candidates gave a name for X which was not that of an ester, despite correctly stating in part (i) that X is an ester.

Recommendations

Feedback to centres

Examination

General comments:

- Candidates need to be taught the Kelvin temperature scale and to understand that there are no negative temperature values on the Kelvin scale.
- Candidates should be reminded that approximately 6 out of the 60 marks in the Section B of the examination paper are based on PPA experiments and to revise the PPAs when studying for the AH examination.
- Candidates should also be reminded that work covered at Higher can also be assessed in the AH examination.
- Units and terminology are important. Candidates should be able to work out the units for the rate constant for different reactions with different orders of reaction. They should also know that relative molecular mass has no units and certainly not grams. Spelling can be important and it is important that "ammine" and "amine" are spelled correctly in names of appropriate compounds.
- Candidates need to be aware that time is an important factor in the AH Chemistry exam and some need to increase their pace of answering.
- It is important that candidates do not confuse the terms "subshell" and "orbital". Stating that the 2p orbital is half filled is not the same as stating that the 2p subshell is half filled
- Many candidates seem to be unfamiliar with the term "reagent".

Specific comments:
Q1 - Reasonably well done except that a number of candidates got mixed up between orbital and subshell when answering (a)(ii)
Q2 - Candidates did unexpectedly poorly in this question. Much more poorly than would have been expected when this was part of the Higher course. Maybe, as teachers, we rush through this as it used to be done at Higher. A large number of candidates did not appreciate that C_2H_2 has a triple carbon to carbon bond.
Q3 - Candidates do fairly well in these calculations. However a number ended up with negative temperature values in Kelvins. They should have realised that this was an error and gone back to find out where they had gone wrong. Perhaps they just did not have enough time at the end to go over their answers.
Q4 - Part (c) was poorly done, as expected, but it was encouraging to note that some candidates had no problems here.
Q5 - (a) A fair number getting this wrong, forgetting that the 4s electrons are lost before the 3d electrons. When the question states "in terms of s, p and d orbitals" we are looking for the full electronic configuration not [Ar] $3d^7$
(b) - Candidates need to be reminded that this is hexaamminecobalt(II) and that hexaminecobalt(II) is not acceptable.
(c) - As expected most candidates did not appreciate that chlorine is acting as an oxidising agent here.
The calculation in (e) was generally well done.
Q6 - A large number of candidates were unable to write the redox equation.

Q7(a) - Most candidates found drawing the resonance structures very difficult and some put wrong charges on the oxygen atoms.
(b) - An unexpectedly large number of candidates did not write the equation for the overall reaction correctly.
(c) - Generally speaking most candidates are good at calculating the order and the rate constant. However most still have difficulty with the units of the rate constant.
Q8 - A good number of candidates know and are able to use correctly the equation for calculating the pH of a buffer solution.
Q9 - As stated above, some candidates do not understand the word "reagent".
Q.10 (a) - This was well done and (b) was done much better than similar questions in previous papers. Many candidates had difficulties in (c) but some markers reported an improvement in outlining the reaction mechanism.
(d) - Candidates seem to cope well with this type of question on optical isomerism.
Q11(b) - Candidates understand what is meant by "pharmacaphore" but many did not read the question and passage carefully enough. Part (c) was very well done.
Q12. - Most candidates found (a) very easy but many had difficulties in (b)(i). Part (c) was done well but by the time a fair number of candidates had reached part (d), they seemed to have forgotten that X was an ester.

Chemical Investigation

The comments from 2002 and 2003 are still very relevant and are repeated below.

Comments from 2002 included:

(i) More teacher involvement at the planning/designing stage would be very beneficial to many candidates. Some candidates also need better advice on writing up the Investigation report. It would appear that not all been give copies of the very useful "Candidates' Guide"?

(ii) Many candidates did their investigation experiments without proper controls. Although time is a factor, ideally, experiments should be repeated completely. This is much more than doing a titration until 2 or 3 results are concordant. For example, if the investigation involves determining the fat content of different types of cheese, then each experiment should be carried out at least twice for each type of cheese.

(iii) Raw results should be given. For example, the results of a titration experiment should include initial and final burette readings, not just titre values.

(iv) If the investigation involves the determination of one or more compounds, then it is not really acceptable to take it to the nearest university and get IR, UV, nmr etc spectra carried out. It may seem old-fashioned but the analysis should be done **chemically** giving the results, observations and conclusions plus reasoning at each stage.

(v) Unless the centre is presenting a large number of candidates for AH Chemistry it is advisable that no two candidates from any one centre are doing the same or similar investigations.

(vi) Aims should be given and the conclusion(s) should relate to these aims.

(vii) During the evaluation the candidate should not only identify the main sources of error but also show how these affect the final result.

Comments from 2003 included:

(i) Candidates must ensure their aims and overall findings are given at the start of their report. Ideally these should be given under separate, distinct headings.

(ii) Some candidates produce very interesting Introductions showing that they have found out much background information. However very few are getting maximum marks in this category because of the lack of underlying **chemistry** Candidates should use this opportunity to show how much chemistry they have found out. Appropriate formulae, equations etc should be given here.

(iii) Procedures should be clearly described so that they could be repeated from the information given. Diagrams often help here. The method used should not be listed as a set of instructions but should be written in the past tense and impersonal voice. The procedure should take into account the need for controls and each experiment should be replicated to eliminate rogue results. Candidates should be aware that any modifications made to original design/method etc should be reported. This may simply be diluting the titrant to get higher titre values with lower percentage error.

(iv) When giving raw data students should ensure that they are recording values with the correct number of significant figures and/or decimal places. Tables should have appropriate headings and correct units

should be given. Graphs should also be set out correctly, taking care when using EXCEL and other software that the scales are the most appropriate and that lines/curves of best fit are produced.

(v) Any observations should be recorded, for example, colour changes, precipitates, shapes and colours of crystals etc.

(vi) The overall conclusions should relate to the aims and be valid for the results obtained. They should also be given under a separate heading.

(vii) Most candidates lose marks under "Evaluation". The Conclusion is worth 2 of the 7 marks and the Evaluation is subdivided into 2 parts and is worth 5 marks. The first part is evaluation of procedures. Each candidate should consider what they did in their Investigation, the sources of error, how they have improved the Investigation in terms of modifications etc. The second part is the evaluation of the results. Here the candidate should analyse his/her results. He/she should consider how the errors in the procedures employed affect the final result. Uncertainty calculations are helpful but not compulsory. The evaluation should be done in a critical and scientific manner and should show a reasonable depth of **chemical** knowledge and understanding. The evaluation should be given at the end of the report under a separate heading and sub headings.

Comments from 2004:

- Candidates should use the "Advanced Higher Chemistry Investigation Guidance" to help them write the report in the correct format. It is evident that some candidates have not used this document resulting in a fairly good Investigation ending up with a fairly low mark for the report.
- In the report the references must be in the standard form given in the guidance document, both in the way it is cited in the main body of the text and also in the way it is listed near the end of the report.
- Almost all candidates now include a contents page and number the pages throughout the report.
- A brief summary, under a separate heading, should immediately follow the contents page and this summary must state the main aims and overall findings. More candidates are doing this correctly now.
- The introduction should then follow the summary and should also include a clear statement of the aim(s) of the Investigation. The introduction should include an account of the underlying chemistry. In previous years this was done poorly with some interesting background information but very little chemistry. There was a definite improvement this year but still room for more improvement.
- Generally speaking, the procedures part is well done with most candidates writing in sufficient detail for the experiment to be repeated. However some miss out relevant details and thereby lose marks. Almost all candidates managed to write the procedures in the past tense and using the impersonal passive voice as required.
- As stated in previous years the results section must include raw results as well as any derived results. Although raw data may be presented in an appendix, it is much easier for the marker if it is placed with the relevant experiment. Most candidates now use Excel or other software for graphs but some would do better using a pencil and graph paper if they cannot use the software to draw graphs of suitable size, with suitable labels and with lines of best fit. On the other hand, it is good to see candidates using their Chemistry Investigation report to hone their word processing skills. Candidates should note their observations down in their day book as they carry out their Investigation and these observations should find their way into the final report. It is hard to believe that candidates can do an AH Chemistry Investigation without observing anything of relevance. Too many candidates mention colour changes of indicators in the Introduction but the colour change is not mentioned again in the Procedures section which would be the expected place for an observation.
- The evaluation part of the Discussion section is still the part where most candidates lose marks but there has been a slight improvement here and this is certainly the most discriminating part of the report.