**Principal Assessor Report 2003**

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| **Assessment Panel:** | Chemistry |

**Qualification area**

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

## Statistical information: update

| **Number of entries in 2002** | |
|---|---|
| **Pre appeal** | 1769 |
| **Post appeal** | 1769 |

| **Number of entries in 2003** | |
|---|---|
| **Pre appeal** | 1772 |

### General comments re entry numbers

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| Numbers seem very stable. |

## Grade boundaries at C, B and A for each subject area included in the report

**Maximum mark = 125**
**Grade boundaries expressed as a percentage mark in brackets**

| Year | Upper A | A | B | C |
|---|---|---|---|---|
| 2002 | 106 (84.8%) | 90 (72%) | 74 (59.2%) | 58 (46.4%) |
| 2003 | 106 (84.8%) | 91 (72.8%) | 75 (60%) | 60 (48%) |

## 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 syllabuses evolve and change

## Comments on grade boundaries for each subject area

No major change from 2002.
It was felt that the candidate population was very similar to that in 2002.
Markers reported that there were fewer very poor candidates and statistics backed this up.
In the examination, Section A had no grid questions this year and the multiple choice questions gave a slightly higher facility value than in 2002, as intended.
Also, as intended, the mean mark for Section B of the paper was higher than in 2002. This was to counter the fact that the mark for the Investigation would be lower than in 2002 due to a revised marking scheme and the removal of the interview and no marks being awarded by the centre.
This explains the slight changes in grade boundaries compared to 2002.

## Comments on candidate performance

### General comments

**Examination:**
The mean marks were:
Section A = 24.5/40
Section B = 32.9/60

General comments from markers:

- There were fewer very poor candidates this year.
- The written paper was accessible to the vast majority of candidates. However there were few outstanding candidates with markers reporting that only a small number of candidates scored marks>50/60.
- Although it was a fairly demanding paper most candidates seemed to be able to complete it so time was not a factor this year.
- Many candidates had a good knowledge of the content and generally presented their answers in a manner which was easy to follow.
- Most candidates did well in the problem solving questions.
- In a few cases the standard of written English was very poor.
- A few candidates did poorly in the calculations due to poor arithmetic skills but generally speaking the calculations were well done.
- PPA questions were not particularly well done.

**Chemical Investigation:**
Once again, there was a wide variation in the quality of the Investigations. Many of the reports were presented extremely professionally and it is evident that many candidates are highly skilled in all aspects of word processing. The marking scheme used for the Investigation was different from the previous 2 years. The presenting centre did not award marks and there was no interview and, therefore, no opportunity for candidates to gain marks by explaining orally parts of the report which were unclear. The marking scheme was meant to be more discriminating with more marks awarded for chemical content. As expected the mean mark dropped from 18.1 in 2002 to 16.1 this year. Also it very noticeable that much fewer candidates scored marks over 20/25. There were also fewer very poor Investigations this year.

### Areas of external assessment in which candidates performed well

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| 1 | 1(b) and (c) |
| 3 | (b) |
| 4 | (d) — if the gram formula masses were calculated properly |
| 5 | (except for part (e) (i)) |
| 6 | (c) |
| 7 | (a) — (d) |
| 8 | Some good answers here although some candidates had difficulty expressing their answers precisely enough to gain full marks |
| 9 | except for the units of the rate constant and some candidates persist in writing “K” instead of “k” for rate constant. |
| 10 | (a) and (b) were done well, except for those candidates who forget to convert $\Delta S^o$ into kJ, when calculating $\Delta G^o$. Part (c) was also surprisingly well done. |
| 11 | (a) |
| 12 | (a) was done well by the candidates who took into account that at pH 7 the $[H^+] = 1 \times 10^{-7}$ |

## Areas of external assessment in which candidates had difficulty

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|---|---|
| 1(a) | Should have been a fairly easy question at the start of Section B but candidates had to state that both electrons came from the same **atom** whereas too many stated from the same **molecule** or **substance**. |
| 2(b) (i) | An amazingly large number of candidates got this simple equation wrong. $H_2CO_3$ is not acceptable as a product. |
| 3(a) | Very few got the correct answer here despite this being covered at SG and Higher. |
| 3(c) | Too many candidates realised that the molecule is non-linear but drew the bond angle of $90^o$ or less. |
| 4(a)-(c) | Too many candidates confused co-ordination number with oxidation number. Many did not realise that $H_2O_2$ acts as an oxidising agent nor knew or were able to work out that the mole ratio was 1:1 in this PPA experiment. |
| 5(a)(i) | Many candidates gave $H_2$ as the answer. |
| 6(a) (ii) | Some candidates got mixed up between $S_N1$and $S_N2$ but were still able to get 1 mark out of 2. |
| 6(b) | Many candidates answered this in terms of why the reaction is more likely to proceed by an $S_N2$ rather than why it is unlikely to be $S_N1$. |
| 7(e) | Despite being based on a PPA, many candidates failed to realise the significance of taking the melting point of a derivative. |
| 8 | This question was difficult to answer for those candidates who have difficulty expressing themselves when writing. |
| 9(b) | Calculation of the units for rate constant. Too many still write K when rate constant must have the symbol k. |
| 11(b) | Most candidates realised that a buffer solution had been formed but were not able to explain how a buffer works. |
| 12(b) | Some candidates wrote red/purple etc when it seemed that there was only a choice from blue, yellow or green. |

# Recommendations

## Feedback to centres

**Examination – Section B**

Q.1 Parts (b) and (c) generally well done but many candidates seem to have forgotten basic chemistry such as confusing the words 'molecule' with 'atom' and this was important when answering part (a). A dative covalent bond is when both bonding electrons come form the same **atom.**

Q.2 In general, calculations were well done but a large number of candidates failed to get the mark for (b)(i) as they had forgotten that the reaction of an acid with a metal carbonate produces a salt plus water plus carbon dioxide. $H_2CO_3$ is not acceptable.

Q.3 Part (a) was very badly done. Too many candidates assume that because a substance has covalent bonding then covalent bonds must be broken when it melts. A point worth going over again despite having been taught at Standard Grade and at Higher. In part(c) it should be stressed to candidates that the bond angle should be drawn carefully. It should not be at $90^o$ and a large number of candidates drew the bond angle at closer to $45^o$. Not acceptable at this level.

Q.4 A lot of candidates are confusing co-ordination number with oxidation number. This question is based on a Unit 1 PPA. Candidates need to be reminded that approximately 6 marks from Section B will be from PPA experiments.

Q.5 Generally well done. Some candidates found (e)(i) difficult to answer. Also it might be worth emphasising that, although, when an aldehyde is reduced to a primary alcohol it has gained 2 hydrogen atoms, hydrogen itself is not a suitable reducing agent. Very few came up with the correct answer of $LiAlH_4$ or NaBH.

Q.6 In part (a) many candidates were unable to give the carbocation intermediate in the $S_N1$ mechanism. In part (b) very few candidates gave the correct answer that the carbocation formed would not be stable.

Q.7 Was generally well done. A few candidates had difficulty working out the whole number ratio of hydrogen atoms and ended up with ridiculous values. Part (e) caused most difficulties despite being based on a PPA experiment. Many candidates did not realise the significance of finding the melting point of the derivative.

Q.8 This question gave the candidates an opportunity to use their writing skills. Some are very articulate and expressed themselves well. Others were either not so good at expressing themselves on paper or did not know enough about medicines. The meaning of the term "receptor" created most difficulties.

Q.9 As in last year's paper the two areas where candidates lose marks in this type of question are writing "K" rather than "k" for rate constant and not being able to work out the units correctly.

Q.10 This question was generally well done. There were, of course, some candidates who forgot to change the units of $\Delta S^o$ into kJ $K^{-1}$ $mol^{-1}$ when calculating $\Delta G^o$.

Q.11 A fair number of candidates were able to apply the equation correctly to calculate the pH. This is obviously being very well taught in centres. In (b) most candidates realised that a buffer had been formed but a large number have major difficulties trying to explain how a buffer functions. They must state that the octanoate ions which mop up the $H^+$ ions are from the **salt produced** (not from the acid).

Q.12 Part(a) was intended to be difficult with the trick being that the $[H^+] = 10^{-7}$ (from pH 7). Many candidates missed this, as expected, but a fair number managed to get the correct answer. Some centres obviously teach a formula which can be rearranged to calculate the $K_{In}$. It would appear that some candidates prefer being given formulae / equations which they can learn up rather than work from first principles.

Part (b) was meant to be easier with the poorest candidates just guessing from blue, yellow or green. It was surprising the number of candidates who gave purple / red etc as an answer.

**Chemical Investigation**

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

(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 just 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 also be done **chemically** giving the results 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 include:

(i) Most candidates are now doing proper **chemistry** investigations rather than science projects.

(ii) Still problems with references/bibliography. This will be tightened up in 2004. Look for the new information guide for session 2003/04.

(iii) 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.

(iv) 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.

(v) 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.

(vi) When giving raw data candidates 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.

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

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

(ix) Most candidates lose marks under “Evaluation”. This is subdivided into two parts and is worth 5 marks in total. 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.