RECOGNISING ACHIEVEMENT

GCE

Chemistry (Salters)

Advanced GCE **A2 7887**

Advanced Subsidiary GCE **AS 3887**

Report on the Units

June 2008

3887/7887/MS/R/08

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Advanced Subsidiary GCE Chemistry (Salters) (3887)

REPORTS ON THE UNITS

3887/7887 Chief Examiner's Report

Once again Examiners and Principal Examiners reported that many candidates showed enthusiasm and had been well prepared for the examination. This was particularly noticeable at A2 level. At AS, candidates coped well with the *Open Book* and *Chemistry for Life* (2850) but they found *Chemistry of Natural Resources* (2848) much more challenging. They had not always learned the key facts (e.g. reaction conditions) and they found it difficult to express themselves (e.g. about the depletion of ozone caused by CFCs).

Numbers continued their gradual rise and were close to 7000 at A2.

Candidates should be careful to follow the instructions on the front of the paper. If a mistake is made drawing chemical structures, it is best to cross it out and re-draw it.

In both the AS practical coursework and the Investigation, the statistics show that candidates have done better than in previous years, which is a tribute to the students themselves and their teachers.

Note that legacy AS units (2850, 2848, 2852) will be available for the last time in June 2009. This is the last re-sit opportunity for legacy AS candidates. For first time AS candidates there will be no more *Open Book* and the AS coursework will be much changed. There will be a distinct resemblance, however, between 2850 and F331 and also between 2848 and F332. Further details of the new specification and changes to assessment arrangements are available from the OCR web site:

www.ocr.org.uk/qualifications/asa_levelgceforfirstteachingin2008/chemistry_b_salters/index.html

There is no facility to mix and match units from the legacy (3887/7887) and new (H035/H435) specifications.

INSET events for new GCE Chemistry B (Salters), for first teaching from September 2008

OCR AS Level Chemistry B (Salters) (H035): *Get Started – towards successful delivery of the new specification*.

These **new full day** courses will give guidance and support to those planning to deliver the new AS/A level Chemistry B (Salters) (H035) specification.

Course dates and codes – Tuesday 23 September 2008 (London, OSCD301), Monday 29 September 2008 (Birmingham, OSCD302), Thursday 2 October 2008 (Durham, OSCD303), Wednesday 15 October 2008 (Plymouth, OSCD304), Wednesday 23 October 2008 (London, OSCD305).

Note: the second London event is targeted towards teachers, including NQTs, who are new to teaching AS/A Level Chemistry.

Fee – £160 including refreshments, lunch and course materials. £190 if you book within 7 days of the course date.

INSET cont'd.

OCR A2 Level Chemistry B (Salters) (H435): ***Get Started – towards successful delivery of the new specification*****.**

These **new full day** courses will give guidance and support to those planning to deliver the new A2 level Chemistry B (Salters) (H435) specification.

Course dates and codes – Tuesday 10 March 2009 (London, OSCD501), Wednesday 25 March 2009 (Birmingham, OSCD502).

Fee – £160 including refreshments, lunch and course materials. £190 if you book within 7 days of the course date.

Places may be booked on these courses using the booking form available on-line (http://www.ocr.org.uk/training/alevel_inset_training.html). Please quote the course code in any correspondence.

2848 Chemistry of Natural Resources

General Comments

Candidates' marks covered almost the full range, from single figures to the high 80s, although few marks above 75 were seen. There was no suggestion that candidates had problems with time, although there were a number of scripts that had blank answer spaces throughout the paper.

Good attempts were made with the calculation questions, with many answers being clearly set out, and showing what was being calculated at each stage. Again, candidates gained credit through the 'error carried forward' rules if they had made a mistake. There were also good responses to the question about reaction rates.

Marks were generally much lower on questions that required candidates to write a reaction equation or describe or explain the impact of intermolecular forces on materials' properties or the effect of radiation on matter. As with last year's paper, a limiting factor for many candidates was their poor literacy skills. Many candidates lost marks due to a weak grasp of the appropriate technical vocabulary or generally careless wording of written responses.

Comments on Individual Questions

Question 1

Scores on this question were low for many candidates. This was often caused by lack of clarity in wording of answers and candidates not reading or interpreting the question sufficiently carefully.

c) Most scored some marks for this part.

- i) Most scored a mark here.
- ii) Many candidates scored something here, although full marks was more rare. Some candidates were confused and gave the conditions for oxidation of the alcohol group.

d) Nearly all candidates scored one mark here, but few went on to score the second mark for a clearly worded explanation of why using ethanol to produce □thane was a better solution.

e) The majority of candidates gained this mark with a common error, from those who did not, being 'additional' polymerisation.

f) Good candidates scored at least four marks here, with the most common reason for not gaining the final mark being a double-headed arrow being used to mark the enthalpy change. Weaker candidates drew the products line below the reactants level and simply wrote E_a or E_c next to the curve, without drawing in the arrow to indicate the activation enthalpy. Some good candidates failed to score for the curve with a catalyst, because they gave a 'double-humped' curve for the catalysed route.

g) Credit gained for answers to this question was often determined by the candidates' literacy skills.

- i) Most scored one here, but few gained the second mark for comparing the extent of the chains' abilities to pack closely with the degree of chain branching.

ii) Good candidates gave clearly worded descriptions of crystallinity in the context of a polymer. Weaker candidates repeated their answer to the previous part of the question, or answered in terms of the orientation of ‘side chains’ on the polymer chains.

iii) Many gained a mark for a description of the difference in a property, with good candidates going on to explain this and gain full marks. Again many struggled with the wording of their answer, using terms like ‘greater intermolecular forces’ or ‘higher intermolecular forces’ rather than stronger.

Question 2

This question scored more highly than the first, with generally good marks for parts (d)–(f). Calculating values for oxidation states was generally less well done than in the past.

a) Most scored at least one here.

b) Most gained this mark.

c) Even some of the best candidates seemed to have problems here, with many not being able to work out either oxidation state.

d) The reaction equation caused some problems in this part.

i) In most cases, the top candidates were the only ones who wrote this equation correctly, although some scored one for correctly showing chloride ions being converted to chlorine molecules.

ii) Most candidates scored this mark, for describing oxidation in terms of electron transfer.

iii) Many candidates scored here, with a common incorrect answer being ‘swimming pools’.

e) i) A surprisingly low proportion of candidates gained this mark, with a range of answers being given, including some that involved elements not appearing at all on the reactants side of the equation.

ii) The majority of candidates gained this mark, with answers often being worded more clearly than in other parts of the paper where descriptive writing was required.

f) i) Good candidates gained both marks here. Some candidates gained one mark for appropriate state symbols, with an attempt at writing the full reaction equation, rather than an ionic one.

ii) Again good candidates scored here, with weaker candidates giving a wide range of different colours.

iii) Many scored here, but for some candidates a mark was lost for not reading the question carefully enough and giving an answer for sodium chloride.

iv) The same applied here, with most scoring the mark, but some failing to do so because they tried to draw a three dimensional structure instead of a layer.

g) Some good answers were given here, and many scored two marks. Nearly all candidates gained the mark for comparing surface areas. The mark for greater frequency of collisions was the one least often scored.

Question 3

Scores on this question were often better than on the first two, with parts requiring molecular structures and calculations being most well done.

a) Most gained this mark.
b) i) Many scored here.
   ii) Many candidates gained this mark. Some failed to score, even though they had given a correct structure in (i). For these candidates, the use of their Data Sheet would have helped.
   iii) Good candidates gave a prefect answer here. Many weaker candidates scored one for the inclusion of an appropriate acid in their answer.
   iv) Candidates who gained credit in (ii) often scored here too. The reverse also applied for many candidates.

c) For many candidates, even some very good ones, this proved to be the question on which they were least likely to score. Many wrote about instantaneous dipole-induced dipole forces as being the strongest type of intermolecular force between polymer chains. Others wrote about permanent dipole – permanent dipole forces. Some had misinterpreted the question and wrote about poly(ethene) instead of poly(ethenol). Answers that did explain the presence of hydrogen bonding often failed to give sufficiently clearly worded answers to gain more than one or two marks. Few answers included an explanation of how the presence of hydrogen bonding between polymer chains leads to the low solubility of the polymer.

Question 4

This question was answered well by the majority of candidates.

a) i) Many candidates scored two marks here for explanations.
   ii) Many candidates gained this mark for a reason that followed logically from their answer in (i).

b) i) A significant minority gave the answer d block, even though they went on to give the correct outer shell configuration in the next part of the question.
   ii) Both marks were scored here, although some candidates tried to work out the full electron configuration to get to the desired answer, which often lead to mistakes.
   iii) Good candidates scored both marks here. Weaker candidates sometimes gained one for +4 or -4, but could not give a reason for their answer.

c) i) Many candidates scored both marks here, with the most common error that lead to the loss of a mark being the failure to convert the volume from cm^3 to dm^3.
   ii) The majority gained this mark.
   iii) Good candidates scored all three here, with many candidate=s gaining some credit. Really clearly explained and logically set out answers were not often seen, but were produced by candidates likely to score and A grade.

Question 5

Marks on this question were very variable, with candidates finding difficulty wording answers sufficiently clearly to gain marks on the descriptive sections. Marks on the calculation were generally better.

a) Many gained this mark.
b) Most candidates scored here.
c) i) Many candidates included numbers in their answer. Some got the first part of the name correct, but wrote 'carbon' instead of 'methane' as the ending for the name.
   ii) Candidates did not always draw their arrows carefully enough to show the electron movement precisely and so did not score.

d) i) Marks were often scored for explanations of bond breaking processes that occur in the stratosphere, but candidates were less likely to gain credit for carefully worded explanations of why these processes do not happen in the troposphere. The mark for radicals catalysing the breakdown of ozone was the least often scored.

ii) Answers here were generally better than in the previous part, although many candidates did not give enough details in their answer and hence only scored two marks.

e) i) Many candidates gained credit for answers comparing the strength of the two types of bond, but did not as often go on to give a clear explanation as to why the C-F bond is the stronger one.

ii) Candidates often scored the two marks available here. A common mistake was to forget to convert the energy from kJ to J. Weaker candidates often failed to score because they had their quotient inverted.

iii) The majority of candidates who scored the two marks in (ii) went on to gain a further three marks here, with more candidates showing an understanding of the meaning of 3 sf this year than last.

f) Many candidates failed to score here because they were unclear about where in the atmosphere the CFCs were or because they thought the chlorine radical would exist for a significant time and so continue to have an effect. References to disused fridges or other specific pieces of equipment that contain CFCs were not often seen.

g) i) Many scored here.

ii) A significant minority of candidates failed to score here because they just wrote that making HFCs is more expensive, which they had been told, and did not give a clear reason as to why. Thos e who scored well generally gave the facts that hydrocarbons can be obtained directly from crude oil, but HFCs need to be manufactured, so the process has more steps.

2849 Chemistry of Materials

General Comments

All Assistant Examiners considered that the paper was set at an appropriate level and was a fair test of the candidates' knowledge and understanding. There was a good spread of marks which discriminated well between the most able and weaker candidates.

Pleasingly, there were fewer candidates whose marks were below 20 and who have little knowledge of chemistry at this level.

Candidates showed care in writing structural formulae, outlining experimental techniques, in using technical terms correctly and making effective use of the Data Sheet. However, it was noticeable that the understanding of n.m.r. spectroscopy and the use of electrode potential data remains largely centre dependent.

The overall quality of written communication and answer presentation remains a problem for the average candidate. It was often difficult to determine if marks for calculations had been earned, such was the paucity of their working and explanation.

One important area that many had difficulty with was the knowledge of expected chemical reactions, both organic and those specific to transition metal chemistry. Thus constructing chemical equations was rather hit and miss.

Comments on Individual Questions

1 (a) (b) The structures for butanoic acid and its methyl ester were largely correctly drawn, though a minority tried to skip detail by leaving out hydrogen atoms. A few confused the chain length, and gave the formula for ethanoic or pentanoic acid.

Some failed to recognise the need for concentrated sulphuric acid as the catalyst and used either hydrochloric or just dilute acid.

(c) Very few correct answers here; many new how carbonates react with acids to give carbon dioxide and water, but few could make any headway in giving the formula of the salt. Those that recognised the nature of the salt usually gave the formula of the calcium ion as Ca+.

Tip for students

Use the Periodic Table found on the data sheet to check which group a metal is in, hence identify the charge on its ion.

(d) Part (i) was fine and most drew clear structural formulae. However, part (ii) was very much centre dependent, with some students providing all the correct reasons to justify their choice of propan-2-ol, but many gave wrong answers by just using peak C and associating it with the R-CH_2-O group.

Tip for students

When considering the information given in a n.m.r. spectrum, remember to estimate the relative intensities of the peaks, as well as using the data sheet to identify the possible hydrogen containing groups giving rise to the peaks.

2 (a) Most candidates scored marks because they had learned the definitions of the three types of protein structure, though some got confused with primary, secondary and tertiary carbon atoms in a chain. The commonest error was to forget to mention in discussing the ‘primary structure’ the order or sequence of the amino acids. The conditions required for breaking down keratin were less well known; many satisfied with stating just 'by hydrolysis' or 'by heat'.

(b) Many students scored the first three marks by using a well labelled clear diagram. However there were two main areas of confusion. TLC plates, sheets or paper were often used and ninhydrin, despite its use being given in the question, was frequently spotted onto the base line with the aqueous mixture or used as the eluting solvent.

(c) The infrared data was used effectively by most, but even though candidates new either that the absorption of infrared energy is linked to the vibration of bonds or that molecules gained energy, few were able to connect these two ideas and score two marks.

Misconception

Infrared energy was thought by many to cause electrons to jump to higher energy levels in a similar way to visible and ultraviolet energies.

(d) The phenol test was very well known and the drawing of a suitable hydrogen bond was generally good, the usual error being the omission or incorrect placement of the lone pair.

(e) The order of reaction was often identified correctly at first, but some tried unsuccessfully to give an explanation by using the data given to estimate a rate of reaction. The use of the equation to calculate the rate constant was good, a big improvement on previous examples. The two commonest errors were to either calculate the 'initial' rate at a time other than 't = 0', or fail to rearrange the rate equation correctly. Determining the correct units for the rate constant was significantly better than on previous questions.

3 (a) The half-equations were well attempted though often the electrons were either omitted, left unbalanced or located on the wrong side of the equation.

Tip for students

With half- or ionic equations, check that both the mass and charge on each side of the equation balance.

The precipitate in (iii) was commonly identified as iron(III) oxide.

(b) It was common for candidates to discuss the reactivity of zinc and iron by stating that zinc was more 'electronegative' than iron, when of course it is more 'electropositive. This problem was usually centre dependent. Some also thought that the zinc oxide layer behaved as a protective barrier like chromium(III) oxide.

Misconception

The use of the term 'more negative electrode potential' is thought to be the same as 'more electronegative'. Students need to appreciate that the first term applies to redox systems whereas electronegativity is a property of an atom within a molecule.

Many candidates failed to gain the third mark by failing to mention that a polymer acts as a barrier to oxygen and water.

(c) Some well constructed answers, giving good explanation and showing clearly the steps used enabled many to score good marks. However, many were content to present a jumble of numbers and leave it up to the examiner to sort out. Some marks were undoubtedly lost through poor presentation. The main errors included: use of an incorrect A_r for iron (given in the question), incorrect significant figures, missing out the dilution factor of 10.

4 (a) The shape of the complex was often badly drawn since many candidates were not altogether clear how to show the 3D nature of such ions, many bonded the N atom to the iron despite the information given in the question.

(b) Most knew the type of reaction involved, the main error was to omit the word 'ligand'.

The use of square brackets was the main problem in writing the correct expression for the equilibrium constant, with the charge 4- appearing outside and the number 6 inside.

Three marks were rarely awarded in part (iv); Green and precipitate were seen, but not very often together, whilst a correct 'precipitate' rarely equated with correct state symbols. The recall of basic factual transition metal chemistry is generally very poor, it was only the high grade candidates who showed any knowledge in this area.

In part (v) there were some excellent answers showing clear understanding and using all the terminology correctly. It was very sad when candidates clearly understood the theory but misread the question and so argued the case for zinc as the best reducing agent. Candidates still write about 'higher' electrode potentials and many thought ‘chlorine more positive’. Some were totally confused about what was being oxidised and what reduced.

(c) Whilst many gained both marks, some still have electrons falling back and emitting blue light. Whilst others wrote about absorbing red and transmitting blue without mentioning light or frequency.

(d) The commonest answers were 'side effects' and 'formulation' though some were vague in the extreme and considered Prussian Blue to be a poison since it contained cyanide.

5 (a) The repeating unit was often correct, though some had difficulty in ascertaining the chain length of the monomer, G, or in having the correct number of oxygen atoms. Condensation was too often equated with the 'removal of water'; or contrasted,

incorrectly, with addition by having two different monomers involved instead of just one.

(b) Some excellent answers by all abilities, the commonest mistake was to identify the main intermolecular force in PET as hydrogen bonding.

Misconception

The presence of a carbonyl group does not mean that molecule can hydrogen bond.

(c) Candidates were better acquainted with how to explain the properties of polymers in terms of chains and energy, though some students, usually centre dependent, tried unsuccessfully to invoke amorphous and crystalline regions within the structure of the polymer.

(d) Many showed a good knowledge of how to name amines, though some gave an incorrect chain length, often with the correct numbering, and vice-versa.

(e) Part (ii) proved the most difficult question on the paper. Most said it was neutral because it was a zwitterion. Others thought it was acidic because the NH_3^+ group would lose protons. Very few noticed the extra amine group and hence gained both marks.

The positive charge was all too often missing from the formula of the ion in part (iii).

(f) Most were able to determine the correct number of electrons to add to give the configuration of the iron ions, but it was common to see the 4s orbital filled.

Most struggled to devise clear answers in part (ii). There were two main problems; Fe(II) ions were considered to show variable valency and also act as a heterogeneous catalyst. The terms oxidation and reduction were again confused and used incorrectly. Many gained a mark for 'lowering the activation enthalpy'.

2850 Chemistry for Life

1 General Comments

This paper proved very accessible to all candidates, giving the opportunity for more able candidates to score highly, yet providing weaker candidates with material that they could achieve success on.

Marks ranged from single figures to well into the 70s.

Examiners reported no problems with candidates failing to complete the paper.

Tip for candidates

The drafting out of an answer to a question, particularly those longer answer questions, is to be commended. However pencil marks must be very thoroughly rubbed out, or clearly crossed through.

There was encouraging evidence of candidates more logically setting out their answers and numerical questions were, in the main, well attempted.

2 Comments on Individual Questions

Question 1

Generated a mixed bag of answers. Parts a(i) and (ii) were an easy start to the paper for most candidates, however the correct naming of the alcohol in a(iii) proved more of a challenge. Part b(i) was not particularly well answered with the importance of the increased surface area being missed by many. Parts b(ii) and (iv) were generally well answered however b(iii) found a sizeable number of candidates not being able to clearly explain the idea of an empirical formula.

Numerical answer b(iv) 6200 (plus other values eg 6173 depending on rounding)

Question 2

Part a proved challenging for a minority of candidates and in part b(i) a significant number of answers unfortunately answered in terms of the intensity of the signals without interpreting that this translated into information on the relative abundance of the isotopes. Some candidates also gave same information for each isotope. eg isotope 88 is the most abundant with isotope 84 the least. Answers like this yield only one mark. The calculation in part b(ii) was certainly well answered and laid out by stronger candidates however less able candidates often did not score the significant figures mark. Also, this latter mark could only be scored if the numerical answer matched with candidates working.

Part c was encouragingly answered by the majority of candidates. There appears to be a continuing improvement in candidate's ability to logically set-out questions of this kind.

Part d(i) was reasonably well-answered. The common mistake was to offer only two correct answers when in fact there are three. It is accepted that the marks offered could have led candidates into believing that there were only two responses required.

Part d(ii) proved difficult for many candidates. Wrong answers included α decay or electron capture, as well as wrong mass and/or proton numbers. There were however opportunities for ecf marks.

Part d(iii) proved difficult for most candidates. The mark scheme required a comment that Ca and Sr have a similar chemistry/or are in the same group, and that therefore strontium can replace calcium in bones and teeth.

Part e was discriminating with only the best candidates able to work through and realise that two down arrows were required with the blue bigger than the red.

Part f was generally well answered.

Numerical answers: (a) 0.37; b(ii) 87.7

Question 3

Parts a and b(i) were generally well answered, however b(iii) found a sizeable minority of candidates balancing the equation using spurious species on either side of the equation.

The majority of candidates successfully negotiated part c, although the dot-cross diagram was not always accurate, electrons not shown in pairs being a common error.

Parts d, e and f(i) were high scoring for many candidates. In part f(ii) some candidates unfortunately tried to answer in terms of activation energy rather than the need to overcome the repulsion between positive nuclei.

Question 4

This was the most discriminating question on the paper. Part a was only well-answered by a minority of candidates with a common error being to talk in terms of energy needed for combustion!

Part b produced a variety of interesting names. The mark scheme did however allow the dropping of non-essential numbers. Part c(i) was answered correctly by many but a worrying minority could not draw the bonding in the ether often producing C-H-O.

Part c(iii) suffered, as in 3b(iii), with spurious atoms being produced to balance the equation.

Part d, both (i) and (ii) really showed up the most able candidates. A large number of answers to d(i) talked in terms of both bond breaking and bond forming producing energy. There was a real feel that many candidates simply had not understood the idea of bond making releasing energy and this error in understanding continued into d(ii).

Some candidates also misread the question and answered in terms of a comparison between isomer sets rather than within the sets. Few candidates commented that the bonds formed in products would be the same and some unfortunately talked in terms of different numbers of bonds formed compared to bonds broken.

Tip for teachers

Candidates need to be thoroughly coached in the ideas of energy changes when bonds are formed and broken, to avoid misconceptions.

2852/01 Open Book

General Comments

This year, the candidates were presented with two articles about nuclear reactions. The chemistry discussed in the reports linked directly to familiar concepts covered in the AS course, for example radioactive decay.

As in previous years, the standard and presentation of the reports continues to be impressively high. Few reports are handwritten. Most candidates cut and paste diagrams and structures electronically.

Candidates generally follow the Notes for Guidance on page 2 of the question paper. However, there continues to be a large number of candidates who lose marks by failing to follow this guidance. Specifically, this commonly applies to skills of referencing, text annotation and the inclusion of appropriate equations, formulae and diagrams to support their answers. Candidates who do not follow the guidance commonly lose both research and communication marks, which compose up to one third of the total marks for the papers.

Many candidates show very effective research skills, capturing relevant information and diagrams from texts and the internet. Best practice involves using information to support the chemical content of the report.

Candidates made some planning and word count errors this year. Typically, candidates often ran out of words before they had addressed the final bullet. Omission of this bullet lost not only evaluation marks, but also showed a lack of balance so that C1 also did not score.

Teacher's tip
Students should plan their word count for each bullet by dividing up the 1000 words roughly into how many words will be used per bullet, based on the marks available (1 mark 'uses up' about 35 words. Each section can then be tackled more manageably in terms of both time and space in the report. Students should be encouraged to tackle 'a bullet a night' during the available two weeks to allow time for proof reading, bibliographies etc.

A significant proportion of candidates continue to attempt to evade word count rules. Commonly, this happens by understating the word count or by some candidates over-annotating their diagrams with large amounts of text in text boxes. In both cases, examiners penalise words in excess of 1000 by taking off research and communication marks (R2 and C1) as well as drawing a line at 1000 words. No points made after that line score, leading to a significant reduction in the marks available for the candidates.

Teacher's tip
Words in equations and labels on diagrams do not count towards the word count. However, such labels should be limited to a single word or phrase. Use of text boxes in diagrams containing sentences or bullet points of additional information are against the spirit of the paper will be penalised by the examiner as additional wordcount. This could result in the last sections of the report being disqualified from scoring.

Comments on Individual Questions

Bullet point 1
This bullet was intended as an easy 'starter'. Candidates were asked about the chemistry of radioactive decay and to compare this with nuclear fission. Most candidates described α- and β-decay very well, and had clearly shown good research skills by including points looked up from Chemical Ideas. The comparison between natural radioactive decay and nuclear fission was less well done. This was a higher level skill, demanding some clear comparisons to be made. Many did not make clear comparisons between them.

Bullet point 2
Again, this bullet was well attempted. The reactions in stars were well described. Higher level marks were awarded for extra explanations and higher level understanding being shown, for example a description of the nuclear changes when lithium forms. Again, many candidates scored the 'straightforward' points and fewer gave the necessary analysis for the higher level answers.

Bullet point 3
A discussion of the differences between fusion and fission reactions was attempted with variable success. Most candidates described fission reactions very well and extracted the relevant information from the articles well. The chemistry of using the reactions to produce energy in a power station was less well described. Perhaps this was due to the fact that this area is unfamiliar, so candidates need to summarise and discuss unfamiliar material extracted from the articles. The lack of skill at managing the unfamiliar concepts led to poorer marks here, which often meant that the candidates did not score well across the evaluation section of the Mark Scheme.

Bullet point 4
The final bullet was a short three mark task asking candidates to outline the outstanding problems left facing scientists to develop fusion power stations. These marks were intended to be easy to gain, but many candidates ran out of words and failed to address this bullet.

This is a **five mark section that every candidate can gain**. Candidates' scores tend to be Centre dependent. Some Centres clearly train their candidates very well to follow the *Notes for Guidance* on page 2 of the paper. However, too many candidates lost marks by doing at least one of the following:

1 failing to provide a list of sources;
2 failing to include in the list the two articles in the paper. It is important to note that the articles should be referenced in full. 'The Open Book paper' does not score this mark;
3 failing to include page numbers or chapter/section titles for sources other than the Open Book paper articles, or statements of website titles or authors or content;
4 failing to annotate the text in their reports.

The requirement to apply some simple rules in this part of the assessment is stated quite clearly in the *Notes for Guidance* in the paper.

Summary
The four marks available are for making four clear chemical points, but were very rarely gained in full. It often appears that candidates write the summary in a very hurried manner, implying that they consider it to be of minor value to their main report. In fact, the reverse is true – these four marks are nearly 10% of their total score and, if earned, can tip them firmly into the next grade up. Candidates score more highly if they have re-drafted their summaries several times and have worked to tighten the chemical points they have made.

The two commonest errors in summaries this year were:

- including evaluation points, rather than chemical points e.g. about difficulties in developing power stations or descriptions of stars.
- Using vague sentences e.g. fusion involves fusing atoms together'

Summary tips for students

- Write **chemical** points in clear statements at **AS level standard.**
- Describe reactions using **chemical terminology**.
- Write points that cover the **chemical reactions** in your report
- **Re-draft** your summary in rough until you are sure you have made at least four clear points with definite **chemical content**. Don't 'rush' your summary at the last minute.

Communication (marking points C1 to C4)

This area gave a spread of marks across the candidates. Those who were careful to check their reports for spelling and technical accuracy, and who included formulae, equations and diagrams scored high marks. Examiners again commented that some reports had clearly been submitted without a spell check being carried out. Candidates need to allow enough time to thoroughly check their reports before submission. Again, the lack of care shown by some candidates implies that they consider this area less important than the main report. However, these 10 marks give almost a quarter of the total score of the paper. Common errors and omissions included.

1 Candidates who had spent too long on earlier bullets so that there was no word count left to tackle the last bullet.

2 For C2a, spelling and punctuation marks are deducted for two errors. Hence, mis-spelling or typos of two words leads to 1 mark being lost (4 errors = no marks!). Many candidates spell words that are given in the report wrongly, many of which would be identified if the candidate ran a spell check.

3 Technical errors in equations often lost both C2b marks. It was relatively common for formulae to have errors in the use of subscripts or equations to have balancing errors. Again, candidates need to check that they copy structures carefully.

4 A surprising number of candidates did not use enough diagrams to score the easy C4 marks.

2852/02 Experimental Skills

General Comments

The overall standard of candidates' work was similar to last year.

Most centres used assessment activities chosen from the OCR coursework guidance booklet. The most popular of these were '*Finding out how much acid is in a solution*', and '*Comparing the enthalpy of combustion of different alcohols*'.

For many candidates, work from a single activity was submitted for moderation.

Some centres continued to use an older set of marking descriptors rather than the new descriptors contained within the 2nd Edition of the OCR publication, '*Teacher Support: Coursework Guidance*' for teaching from September 2004. This invariably resulted in the award of higher marks than would have been the case if the correct descriptors had been used and is a key issue for a significant minority of centres.

A number of centres used check lists as a basis for the award of marks in **all** skill areas. Many achieved this by breaking down the coursework descriptors for specific assessment activities into small phrases and inserting these into a grid. The specific descriptors were then ticked when they had been met by a candidate or circled where they had not been met. This approach allows teachers to separate the fine detail of progression within a single are such as risk assessment or references at different levels of performance and avoids many of the issues of over generous and inappropriate mark allocation.

In some other cases, however, the annotation of candidates work was very brief, with few or no comments on cover sheets. This also increased the tendency for there to be a generous application of the coursework descriptors.

Comments on Individual Skill Areas

Planning

The detailed mark schemes supplied by OCR for exemplar activities include examples of the general details expected in the experimental plan expected to achieve level 8 and examples of the fine detail expected at level 11. These examples should provide a clear guide when allocating a mark in this skill area.

The descriptors provide a precise guidance about the quality of the risk assessment and the sources consulted in devising a plan at levels 5, 8 and 11. Centres need to carefully distinguish between the requirements at the different levels for these two features of the plan when awarding marks for this skill area.

Risk assessments should be relevant to the concentrations of the solutions actually used in the assessment activity. In the acid rain activity for example, both sulphuric acid and sodium carbonate must be described as irritant to meet the descriptors at level 8. It this is not done then the maximum mark available for this skill area is 7. In the enthalpy change of combustion experiment it is expected that candidates will indicate that all alcohols are highly flammable.

References to written documents should include detail such as page number and Hazcards should indicate the chemical they refer to. Where an internet source is used, brief details of the site should be included. At least two appropriate references, one of which includes detail, are required to meet the descriptors at level 8 and three references two of which include detail are required to meet the descriptors at level 11.

Common problems in planning included

Titrations

- Use of inappropriate equipment such as making up a standard solution in a beaker rather than a volumetric flask
- Choice of an inappropriate indicator
- No calculation of required amount of sodium carbonate
- No description of how to make up the sodium carbonate solution
- No equation for the reaction
- No distinction between of trial and accurate titrations
- No comments on why the procedure will be accurate
- Sources consulted not included or lacking sufficient detail such as page number
- Inappropriate risk assessment of dilute acid described as corrosive rather than irritant
- Insufficient explanation of the choice of concentration of sodium carbonate solution or dilution factor of acid

Enthalpy of combustion

- No indication of how the water volume is measured
- Poor choice of water volume e.g. below 20 cm^3 or above 500 cm^3
- Heating water for a fixed time rather than for a fixed temperature change
- Heating water to a high temperature
- No stirring of water
- No comments on why the procedure will be accurate
- Sources consulted not included or lacking sufficient detail
- Brief risk assessment covers only one alcohol
- Insufficient explanation of why a temperature rise of between 10 and 20 ^{o}C is chosen

Implementing

Some centres awarded marks which did not accurately match the descriptor requirements for the recording strand of this skill area, because they were solely based on the manipulation strand.

In the activity, '*Comparing the enthalpy change of combustion of different alcohols*', it is expected that candidates will record all temperature measurements and not simply the temperature change.

Recording data from titrations

In assessment activities that involve titrations, candidates should record all burette readings, not just titres, and should record their readings to two decimal places, where the second figure may be a 0 or 5, in order to access the higher mark levels. The marks awarded in this skill area should reflect any omissions in recording data from titrations. It is also expected that candidates will use units of cm^3 rather than 'mls'. Where no units are included the maximum mark available for this section is 4. It is expected that candidates will show zero as 0.00 cm^3. Where this has not been included a maximum mark of 10 is available for this skill area.

In the '*Acid rain*' activity, candidates must record appropriate readings to find the mass of sodium carbonate in order to meet the descriptors at level 8. This was frequently missed out which meant that the maximum mark available for this skill area was 7.

Analysing

Candidates are expected to explain the steps of their calculations. If, for example, candidates use a formula to link variables such as concentration and volume of a solution, they should indicate what the symbols in the formula refer to.

Candidates must calculate the concentration of both solutions in the activities involving a titration. Often one of the concentrations was assumed instead of being calculated. This was a particular issue where the determination of the solubility of calcium hydroxide had been used as an assessment activity.

If candidates carry out the activity '*Comparing the enthalpy of combustion of different alcohols*', they need to explain the steps in all types of calculation for one alcohol, even if they subsequently use a spreadsheet for other alcohols, in order to achieve maximum marks.

In the activity, '*Comparing the enthalpy of combustion of different alcohols*', candidates need to include a minus sign in front of the values that they had calculated in order to fully satisfy the descriptors at level 11. In drawing conclusions from this activity, some candidates were confused about the exothermic and endothermic nature of bond breaking and bond making processes.

Calculation of average titres

Candidates are required in assessment activities involving a titration to calculate an average titre. They should clearly show how they do this by writing down and adding together all of the appropriate titres and dividing this total by the number of titres.

Candidates are required to clearly describe the outcome of their calculations rather than assuming that this is evident from the figures within a calculation.

Evaluating

Overall, candidates tended to do less well in this skill area than in the other three. Marks awarded by centres did not always reflect this and the application of the coursework descriptors was often rather generous. The main reason continues to be that candidates include insufficient information about limitations of the experimental process or about those features of the procedure that were important in ensuring accurate and reliable data. Candidates were expected to include comment on at least one relevant point to achieve a mark of 2, two relevant comments to achieve a mark of 5, 3 comments for a mark of 8 and 4 comments for a mark of 11.

Some centres gave higher marks than was appropriate for few or irrelevant comments on limitations of experimental procedure.

Calculation of uncertainty associated with measurements

When considering the uncertainties associated with data, it is expected that candidates will calculate a value associated with a single representative measurement that they have recorded for each type of measurement. Some centres may wish to teach their candidates how to calculate the uncertainty associated with the difference between two measurements such as a temperature change or difference between readings of a burette and this is equally acceptable.

It is expected that candidates will include a correct calculation of the uncertainty associated with two types of measurement at level 8 and three types of measurements at level 11

In addition, candidates are required to identify the relative significance of uncertainties associated with measurements and of limitations of experimental procedure to fully satisfy the descriptors at level 11. This was frequently not included in candidates' evaluation of their work and this omission was not always identified by centres.

2854 Chemistry by Design

General Comments

This paper seemed to provide plenty for candidates to consider. There were many good answers and even those who found it more difficult tried their best. A good standard was noticed in both calculations and long answers.

Comments on Individual Questions

1 This was a high-scoring question. Most candidates scored well on the first page, though the answers to part (a) were not always correct. In part (c)(i) there was a tendency for some to write H_2 instead of $2H^+$. There were some good answers to part (d), including the QWC, even though there were some testing words such as 'column', 'stationary' and 'distinguishes' to be dealt with. Most divided by 28 in part (d)(ii) but most then went on to multiply by three, rather than dividing. Part (e)(i) was more open-ended than many questions on these topics recently but candidates did well and many scored good marks here. In part (e)(ii), many failed to notice that it was operating costs not set-up costs that were asked for and they failed to mention that a lot of energy was needed to maintain the high pressure. Part(f) was often well done, though a few tried to make it a K_c calculation and others found the powers confusing, preferring to multiply by four, rather than raising to the power.

Numerical answers: 1(d)(ii) 1.5 x 10^{-7} *1(f)(ii) 4.10 x* 10^{-9}

2 This question was quite well done. Again many scored good marks on the first page, the most common error being failure to describe the 'unpaired' electron in a radical. Parts (b)(iii) and (iv) were usually correct. In part (b)(v), many candidates described the reduction but only a few scored the second mark for doing more than restating the question (eg they might have scored by saying 'the OH is changed to water'). Part (c) caused few problems. There were some good attempts at part (d), with a few having difficulty converting the pH into $[H^+]$. Part (e) was again done well, though quite a few candidates still think that colour is a result of electrons dropping energy levels.

Numerical answers: 2(d)(ii) 2.6 2(d)(iii) 2000

3 This question caused a few more problems. The number scoring in part (a) was surprisingly small, though part (b) was much better. Most managed part (c)(i) but a lot were led astray in part (c)(ii) into taking the square root of the solubility product. Many scored on part (d). There were good marks in part (e), the most common omission being failure to give a reason that the elements form 2+ ions. Many candidates benefited from the decision to allow a description of the hydration energy of strontium ions as 'larger' than that for barium ions. Part (f) was open-ended and caused some problems. Some candidates confused enthalpy and entropy and others confused ΔS_{tot} and ΔS_{sys}. Part (g)(i) was usually correct and many candidates scored some marks in part (g) (ii), though few got all three. Dioxygen was a common wrong answer here.

Numerical answers: 3(c)(ii) 3.6 x 10–9

4 This question on Colour by Design proved to be the hardest. Many could name two functional groups in part (a) with relatively few scoring three. In part (b)(i), many candidates realised that only the phenol group would react and scored high marks accordingly. In part (b)(ii), either 'yes' or 'no' was accepted, provided it was backed up by

a correct reference to the chromophore or delocalisation. Few appreciated in part (c) that the sulphonate group was the most responsible for the solubility. Of these, few mentioned ion-dipole forces and very few their strength relative to the hydrogen bonds in water. Part (d)(i) was relatively seldom correct but part (b)(ii) was well done. In part (b)(iii), 'coupling' was seldom seen and even 'electrophilic substitution' was not always present. Most candidates nominated hydrogen bonding in part (e)(i) and many interpreted the question correctly and drew in these bonds in the numerous permissible places. The main error was to involve the hydrogen of the methyl groups or to connect (possibly carelessly) two hydrogen atoms. Answers to part (f) were variable but many were correct.

5 This was a higher scoring question. Most spotted 'hydrolysis' in part (a)(i), but few could identify all three interactions in part (a)(ii), 'dative covalent' being the most problematic. In part (b), some candidates were not specific enough in naming the part of the body in which hydrolysis occurred. Many got part (c), though some ringed slightly too many atoms. There were just a few who did not score two marks in part (c)(ii). In part (c)(iii) most candidates answered the second part of the question, some the first, with very few attempting both parts. Part (c)(iv) was often well done, though care had to be exercised as to which C=O absorption was quoted. Most candidates identified the protons correctly but hardly any spotted that there were only four CH_2 hydrogens in this environment as the others were close to electronegative atoms.. Part (c)(vi) was often well done, with many candidates saying that the object and mirror image were different. In part (c)(vii) many scored, the most popular wrong answer being 'mass spectroscopy'.

2855 Individual Investigation

General Comments

The standard of candidates' work was similar to last year. Some of the Investigations seen during moderation were of a very high standard, but there was also considerable variation between centres.

Investigation topics

Investigations covered a range of topics but reaction kinetic studies continue to be the most dominant group, both overall and within many centres.

Investigations into aspirin also proved popular but some of these tended to be rather superficial and compared the composition of commercial tablets rather than investigating more chemical aspects such as the purity of aspirin before and after recrystallisation or its hydrolysis in warm, moist conditions. Some candidates did not appear to realise that salicylic acid was a likely contaminant of lab prepared aspirin and consequently analysis and conclusions were flawed.

Analysis topics were well represented including the determination of copper, manganese, calcium (in milk), iron (in cereals and green vegetables) dissolved oxygen. Investigations involving the loss of Vitamin C tended to score more highly than simple estimation of how much there was in a samples of fruit juice.

Electrochemical experiments often produced a low mark because candidates did not research the Nernst equation and chose to investigate concentrations that were too close to each other. More unusual topics included commutative reactions, iodine value of fats and oils, and partition equilibria.

A few candidates continue to choose to investigate the synthesis of organic compounds. Investigations of this kind generate little data and often result in low marks.

In some cases, investigations into kinetics systems were little more than extensions of standard practical procedures and had little originality since they set out to find out something which was already well known. This approach may be perceived as a 'safe' option for candidates but it tends to encourage a rather sterile approach to investigations and severely reduces the opportunity for candidates experience a real sense of scientific exploration. In particular this approach seems to penalise the less well organised candidates.

A minority of candidates chose investigations that were of relatively low demand. It is expected that there will be a clear and identifiable progression in candidate performance from GCSE through experimental skills assessment at AS level to the individual investigation at A2 level.

The overall approach to writing a report on the practical work should also show a clear progression from GCSE through AS to A2 investigations. It is expected that candidates will satisfy the points highlighted in the detailed mark schemes used in AS assessments and build upon this to explain and justify their approach using ideas taken from both the AS and A2 parts of the specification. Specific examples of the need to satisfy AS coursework descriptors are included in the sections on the four skill areas below.

Limited scope of investigations

In some cases, the limited scope of investigations suggested that far less time had been spent on practical work than the 15 to 20 hours indicated within the specification. This invariably reduces the marks available to candidates. This seems to be an increasing issue for some centres and has considerable impact on the marks achieved in all skill areas since candidates generate less data which in turn provides less opportunity for analysis and evaluation.

In a typical kinetics investigation, for example, candidate need to look at the effect of changing the concentration of several reactants on the rate of reaction as well as finding the activation enthalpy and/or exploring the quantitative effect of catalysts in order to satisfy the descriptors at level 11.

The quantity and quality of annotation of candidates work by teachers varied considerably between centres. In some cases comments focused on the general performance of candidates rather than relating performance to the coursework descriptors. In a minority of cases, annotation of candidate' work and comments on cover sheets were very brief and these centres found the award of appropriate marks much more difficult. Effective application of the mark descriptors is helped considerably if brief comments are included on the candidates work or cover sheet to indicate where particular descriptors have not been met since this explains the award of a lower mark.

Some centres annotated candidates work by indicating where descriptors had been met in particular parts of the text by using symbols such as 5a or 8b. While this may be a useful strategy for identifying where specific points within a set of descriptors have been met, it can also lead to an inappropriate award of marks where the meeting of a single point is taken as evidence of meeting the whole of the requirements at a particular descriptor level. A much better way to ensure the secure award of marks, and to assist the moderation process, is for brief comments to be added at the end of each section, or on the candidate cover sheet, to indicate where and why a descriptor had not been met which therefore explains the reason for the award of a lower mark.

Planning

Candidates need to satisfy both strands of the descriptor requirements to be awarded marks at any level of performance. In some investigations candidates included a great deal of experimental detail but little supporting theory. It is expected that candidates will include most key points at level 8 and all of them at level 11. It is also expected at the higher mark levels that the chemical ideas used in the report will focus on the particular investigation undertaken rather than be presented as a general context.

Some candidates started their report with a hypothesis. This rarely helped the written report and often distracted the candidate and reduced the quality of the overall investigation. Some candidates gave very vague aims which lowered the clarity of the report. Candidates may well find it helpful to revisit their aims towards the end of their investigation to ensure that they have covered what they set out to investigate.

To meet the descriptors at level 11, candidates are expected to explain and to justify the choices they have made in developing their plan. A strategy that did seem to help some candidates was the inclusion of sub-headings taken from the general marking descriptors such as ‘Explanation of why this plan will help ensure my results are accurate and reliable’. In examples of good practice, come candidates commented on the number of points necessary to produce a useful graph, the reason for repeating or not repeating experiments and the range of data collected in the context of their specific investigation.

The quality of the referencing of resources consulted during planning is expected to increase to meet the more demanding descriptors at levels 5, 8 and 11. At level 11 the plan should include a reference section in which individual references are given in sufficient detail that another candidate could find them and are linked by a simple numbering system to specific sections in the main body of the text.

Use of the Internet

The vast majority of candidates make use of the internet to look up supporting chemical ideas and to help devise the experimental plan. At level 11, it is expected that candidates when referencing their use of internet sites will describe the content of the site as well as providing a detailed web address that could be used to access the information. It is expected that candidates will refer to written documents as well as internet sites.

The quality of the risk assessment is also expected to increase to meet the more demanding descriptors at levels 5, 8 and 11. At level 11, it is also expected that risk assessments will be comprehensive, realistic and selective and will, for example, pay attention to the concentration of solutions used.

There was an increasing tendency for some candidates to use measuring cylinders to measure accurate volumes of solution, for example in a serial dilution, instead of burettes or pipettes. The use of such equipment for accurate measurement is not appropriate at this level.

Some useful planning strategies

Candidates should be given guidance by the teacher about the type of investigation that will allow them to demonstrate their practical skills and understanding of chemical ideas. Some centres provide a bank of ideas including stimulus materials to direct candidates' research towards appropriate experimental methods and relevant theory. These centres also provide an opportunity for candidates to suggest their own investigation area that can be agreed with the teacher as providing suitable and workable opportunities for investigation.

The use of a preliminary experiment to determine appropriate amounts of materials or conditions can be a useful strategy that informs the rest of the investigation.

Where candidates set out to find out how much of a component is in a set of samples such as vitamin C or aspirin, it is helpful if they can obtain external benchmarking of their data by using a second method of analysis, by using one sample whose composition they know about or by analysis before and after adding a known amount of the component to a sample under investigation.

Sufficient time should be given to candidates so that they can prepare their plan in detail, including an effective risk assessment, before they begin practical work.

Implementing

It is expected that written evidence will be provided by the centre to support the mark awarded in the manipulating strand of this skill area. This can take form of comments or a tick list of generic skills and abilities demonstrated by candidates during their practical work. A significant number of centres did not include this expected documentation.

The data recorded by candidates was sometimes incomplete and lacked appropriate units. All the raw data obtained by the candidate should be included in their report and not just averages. When a titration is carried out, for example, all burette readings should be recorded, not just titres. The standards applied when awarding marks in the recording strand of manipulation should at least be those used at AS level. The lack of any units attached to data, for example, means that a maximum mark of four is available in this skill area.

Data should normally be recorded in tables which include detailed headings which help the reader understand how the data has been gained. A table described as number 5 or from experiment 2 does not achieve this.

Quality of recorded data

Recorded data should be of appropriate quality in order to access the higher mark levels. If, for example, candidates find that titration values are very low, they should make appropriate adjustments to the dilution of the solutions and repeat the titration so that higher values can be achieved before moving on to another aspect of their investigation. If the investigation involves the collection of a gas, candidates should ensure that the time intervals at which the volume is recorded do not mean that most of the gas is produced in the first few intervals. If a candidate is using a water bath to carry out an experiment at an elevated temperature then they should record the beginning and end temperature during the period of use. A time recorded from a stop watch of 2 minutes 15.28 seconds does not show the chemical maturity expected at level 11.

Analysing

Most candidates processed the data which they had collected in an appropriate format by carrying out calculations or drawing graphs. In some cases, however, calculations were not well explained and some centres did not take sufficient account of this when awarding a mark in this skill area.

Computer generated graphs caused some problems for candidates because they were too small or they did not have a fine enough grid for results to be read off accurately. Sometimes, a hand drawn graph or a line on computer generated graph points can lead to greater control and accuracy.

Drawing appropriate graphs

To meet the descriptors at level 11 it is expected that all appropriate graphs will be drawn. This means that in a kinetics investigation candidates will draw a graph derived from the Arrhenius equation to determine the activation enthalpy and will plot rate against concentration squared to confirm that a reaction is second order with respect to a particular reactant.

It is expected that candidates will include graphs with an appropriate title, with labelled axes including units, that a line of best fit will be drawn and that, overall, the graph will be well presented. Most graphs are expected to have these features at level 11 and some to show them at level 8.

Candidates are also expected to draw relevant conclusions from their raw or processed data linked to the chemical ideas and understanding that had been described in the plan. This was generally much less well done than the processing of data, often being descriptive rather than evaluative, and some centres awarded higher marks than were warranted by rather superficial comments. It is expected, for example, in a typical kinetics investigation, that the candidate will find the order of reaction with respect to all reagents and construct an appropriate rate equation at level 8 and will also calculate the rate constant and the activation enthalpy and/or devise an appropriate reaction mechanism at level 11. This is one of the key areas for improvement in many centres.

Drawing conclusions

In examples of good practice, some candidates identified general trends in the data which they had collected or picked out clear outcomes. They then went on to calculate differences within the data set or differences from expected behaviour. This quantitative approach allowed them to comment with authority on the fine detail of the results they had collected.

Evaluating

This tended to be the lowest scoring skill area for many candidates who did not demonstrate the expected improvement and progression from their AS coursework.

Many candidates calculated the uncertainty associated with some, but not all, of the types of measurements they had recorded. In investigations that involved recording times with a stop watch or stop clock, it was quite rare for candidates to estimate the uncertainty associated with this type of data. In some investigations the uncertainty associated with data is complicated because the conclusions are based on the best-fit straight lines on graphs. One way of dealing with this issue is by including error bars on the graphs.

Comments on experimental procedures

Candidates are required to comment on their experimental procedures. This was often done much less well with candidates tending to make general statements about the overall accuracy of their investigation instead and this significantly reduced the mark that was appropriate overall for this skill area. Candidates were sometimes given higher marks for this skill area than the relevance and detail of their comments on experimental procedures would justify. It is expected, for example, that a candidate will include at least two relevant and valid comments on experimental procedures at level 5, three comments at level 8 and five comments at level 11. This is a further key area for improvement in many centres.

Many candidates suggested at the end of their report changes they would make to the way they had carried out their investigation if they were to repeat it, but they did not always indicate how or why these changes would help produce more accurate or reliable data. The use of sub-headings to prompt responses that would meet the needs of the descriptors seemed to work well in some centres.

Comments on the relative significance of uncertainties associated with measurements and limitations of experimental procedures

In examples of good practice, some candidates commented in detail on each aspect of their experimental methods, identifying specific points that caused them to have a lack of confidence in their data. This allowed them to consider the relative significance of both these limitations and the uncertainties associated with measurements so that they could decide on which areas should be most usefully developed further to improve their investigation in the future.

Grade Thresholds

Advanced GCE Chemistry (Salters) (3887/7887)
June 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2848	Raw	90	60	52	44	36	29	0
	UMS	120	96	84	72	60	48	0
2849	Raw	90	70	63	56	49	42	0
	UMS	90	72	63	54	45	36	0
2850	Raw	75	60	53	46	40	34	0
	UMS	90	72	63	54	45	36	0
2852A	Raw	90	74	68	62	56	51	0
	UMS	90	72	63	54	45	36	0
2852B	Raw	90	74	68	62	56	51	0
	UMS	90	72	63	54	45	36	0
2854	Raw	120	90	81	72	64	56	0
	UMS	120	96	84	72	60	48	0
2855	Raw	90	76	68	60	52	44	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3887	300	240	210	180	150	120	0
7887	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
3887	19.4	38.4	57.6	74.5	87.2	100	10100
7887	29.8	54.7	74.5	88.5	96.9	100	6952

17052 candidates aggregated this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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