GCE

Chemistry (Salters)

Advanced GCE **A2 7887**

Advanced Subsidiary GCE **AS 3887**

Report on the Units

June 2007

3887/7887/MS/R/07

Oxford Cambridge and RSA Examinations

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REPORTS ON THE UNITS

Chief Examiner's report

Once again it is great to report an increased number of candidates and Centres at both AS and A2. Standards were maintained across both AS and A2 with very similar proportions of grades being awarded compared with last year.

All Principal Examiners reported excellent work from many candidates. The major criticisms this year were the standard of literacy in extended answers and failure to answer the question set. At AS particularly the quoting of old mark-schemes was sometimes seen. It must be realised that questions on the same topic are differently worded each year, so slightly different answers are often required.

Candidates at AS were still hesitant about significant figures. In both AS and A2, candidates are strongly advised to go back and check their calculations once they have completed the paper. Many would benefit from this since few seem to have difficultly in finishing.

Principal Examiner's Report

2848 Chemistry of Natural Resources

General Comments

Candidates' marks covered almost the full range, from single figures to the high eighties, although marks above seventy-five were rare. There was no suggestion that candidates had a problem with the length of the paper, with answer spaces that were left blank (of which there were few) indicating a lack of knowledge and understanding rather than lack of time.

Good attempts were made at many calculation questions, with answers being clearly set out, and showing what was being calculated at each stage. This allowed candidates to gain credit via the 'error carried forward' rules if they had made a mistake. There were also good responses some of the questions about intermolecular forces and their effects on chemicals' properties.

Marks were generally much lower on questions that required candidates to write a reaction equation, discuss equilibrium processes or explain a practical technique. 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
This was a high scoring question for many candidates.

a) Most answered this correctly.
b)
 i) Most candidates gained credit here.
 ii) Most candidates scored one mark, but few gained both, often because of a misconception about the role of the detergent in the process.
c)
 i) A significant number of candidates failed to score the mark here, writing CuS instead of Cu_2S.
 ii) Most candidates gained some credit, often by application of 'error carried forward' from an incorrect copper sulphide formula in the previous part of the question.
 iii) This question was generally well answered.
d)
 i) Many candidates failed to score on this question. Answers that included a diagram rarely showed where the solid collected. Written responses did not comment on the increase in speed of the process over conventional filtration.
 ii) In general, the very best candidates only answered this question correctly. Many gave an answer that was not an ion.
 iii) Many scored two marks, with candidates giving clearly set out answers that showed a progression of logical steps. A surprisingly large minority did not score the mark for two significant figures. In some cases this seemed to be because the candidate did not notice the instruction. Other candidates did not seem to understand and stated 40.0g as being to two significant figures.

Question 2
This question was often reasonably well done, with the exception of the colour change required in part (b). Calculating values for oxidation states was generally well done.

a)

i) Most scored well on this question. The most common reasons for failing to score marks were forgetting to include the '+' sign or putting the signs after the numbers.

ii) Many scored one mark; in some cases by error carried forward from incorrect oxidation states in part (i).

b)

i) Many candidates failed to score. Purple was often incorrectly given for the initial solution colour. In cases where one mark was scored, it was usually for the second answer of 'colourless'. The very best candidates did often score both marks.

ii) Very good candidates scored both marks for answers with clear working. Weaker candidates often scored at least one mark. A common error was failing to convert the volume to dm^3.

iii) This mark was often scored, in some cases by error carried forward from the previous answer. The most common error was giving the answer '1'.

iv) Again, many candidates scored at least one mark and often both marks. Some scored one for showing some understanding of what was required; again error carried forward was applied.

v) Fewer candidates scored full marks on this part than on the previous parts of this calculation sequence. Many did gain one mark for the relative formula mass of sulphur dioxide.

vi) This part of the question was less well done, mainly because of poor wording of the answer. Candidates often answered by restating the question and just said that the sulphur dioxide was effective, without explaining what they meant by that.

Question 3

Scores on this question were much lower than on the first two, with parts requiring answers linked to reaction mechanisms being the least well done.

a) Most gained this mark.

b)

i) Many scored at least two marks. Some lost marks for careless mistakes, such as giving HO_2 as the formula of water.

ii) Marks for this were generally very low, often due to vague answers or poor wording in the response. The top candidates scored both marks.

iii) The majority of candidates scored this mark.

iv) Many candidates scored a mark for the first part of this question, but it was much more rare for a candidate to gain any credit in the second part. Many incorrect answers stated that the permanent dipole – permanent dipole forces between molecules of bromomethane are stronger than those between molecules of chloromethane.

c)

i) Many gained two marks, with most getting at least one mark for correctly drawing the bonding electron arrangement.

ii) Most gained this mark.

iii) Many candidates scored both marks.

iv) This mark was often awarded. Incorrect answers often showed an oxygen molecule, instead of an oxygen atom

v) A good proportion of candidates scored both marks.

d)

i) Although many candidates gained the first mark for the correct left-hand side of the equation, far fewer worked out what the second product was, making the award of the second mark less common.

ii) This was not well done, even by candidates who had written the correct structural formula for methanol in the equation in part (i).

iii) Many candidates gained both marks for their answer.

e)

- i) Many correct answers were given, with the explanations being generally much more clearly worded than those in other parts of the paper.
- ii) Good candidates scored this mark. Many candidates identified the correct bond, but gave incorrect explanations for their choice.
- iii) Even the best candidates rarely scored this mark; failing to appreciate the usefulness of the information in the first line of the question.

f)

- i) Most candidates gained both marks here, if they knew the formula for methane. The most common error was giving an incorrect formula, such as CH_3.
- ii) Only the best candidates were able to explain themselves clearly enough to gain the mark for this part.

Question 4

The quality of answers to this question was very varied, although in most cases it was found to be one of the harder questions on which to score. Most candidates scored well on the question asking about crystallinity and intermolecular forces. Answers involving reaction rates and equilibrium processes were often weak.

a) Most gained this mark.

b) A minority of candidates became confused, because the reaction they were given was reversible, and gave answers in terms of the effects of the reaction conditions on the position of equilibrium. The best candidates realised their error when they went on to the next part of the question and corrected their response, usually ending up with a high proportion of the available marks. Many candidates gained some credit for discussing the effect of increased temperature on the reaction rate, although few gained all the available marks because they only mentioned more successful collisions and did not precisely link the rate change to the fact that more collisions have energy greater than the activation enthalpy. A significant minority thought that increasing the temperature lowered the activation enthalpy for the reaction. The accounts of the effects of increased pressure tended to score most of the available marks. The mark for QWC was often not scored because answers lacked technical detail.

c)

- i) Few candidates scored well on this part. Explanations often failed to mention the effect of changing conditions on the position of equilibrium, which limited the total possible score.
- ii) Marks here were better, but again few scored both due to poorly worded responses.

d)

- i) This was generally well answered.
- ii) Most candidates scored this mark.
- iii) Many candidates gained two marks here – and it was unusual for any candidate to fail to score. Where only one mark was gained, it was usually because the property that was quoted was not relevant to the stated use.
- iv) Many gained the mark although some answers were again poorly worded.

e)

- i) Most candidates failed to score here. Equations often had the electrons on the wrong side or gave incorrect products.
- ii) Answers to this part were generally very weak, even from good candidates. Some gave a description of the reaction mechanism instead of defining the terms. Definitions of the word ‘addition’ were often very vague. Few candidates showed any understanding of the meaning of ‘electrophile’.

f)

- i) Many scored this mark, with a common incorrect response being hydrochloric acid.
- ii) A good proportion scored this mark, often by drawing correct diagrams to support a brief written explanation.

g)

i) Most scored this mark.
ii) There were many good responses to this part, including the award of the QWC mark, with answers being much more accurately worded than in most longer answer questions on the paper.

2849: Chemistry of Materials (Written Examination)

General Comments

All Assistant Examiners commented that the paper was accessible, of the appropriate standard and length and discriminated effectively between the most able and the weakest candidates. There were fewer candidates this year with marks in single figures; at the lower end the candidates' knowledge of structure, organic chemistry and rates of reaction was better developed.

It was good to see that there were candidates of all abilities who were prepared to plan answers for the extended writing questions. Consequently such candidates gained good marks and in general the quality of their writing, grammar and spelling was of a much better standard.

Many candidates, across the ability range, made silly unforced errors, often with the easier questions. There was no evidence that there was a time problem with the paper, so candidates need to make sure that they read the question more carefully. Command words, such as 'describe' and 'explain' were sometimes confused, the wrong compound considered despite the use of **bold type** and structures misread.

Calculations were not a real problem this year, though more than expected had problems analysing graphical data.

There was a better factual knowledge of organic chemistry, though this was not extended to the d-block elements.

Comments on Individual Questions

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1) *This proved to be a good starter question for most.*

(a) Most identified the ester correctly. The commonest error was missing out the —O— link.

(b) A wide range of answers, in the range 0-10, the usual choice was 2 due errors in assigning bonds to the carbon atoms in the skeletal structure.

Tip for students:
Draw the C-H bonds out on the given structure. checking that every carbon atom in the structure has 4 bonds.

Those who drew these bonds out on the structure often got the correct answer of 3.

(c) Much better than in previous papers, though a few hedged their bets by including ninhydrin as well!

(d) A few failed to add up the masses of the atoms correctly or thought that the molecular ion peak was at M_r –1. Some gave a totally unrealistic number for the mass, greater than 1000 or less than 50.

Tip for students:
Check that mathematical answers are of a viable magnitude for the question. If not then look again at your calculations.

In (ii) most knew that the peak at 15 was due to a methyl but failed to include its positive charge.
The use of n.m.r. data was much better and the 2 marks for the types of proton were often gained. However, many candidates gave 2:1 as the relative intensity of peaks; it was difficult to see how they arrived at this conclusion, whilst some confused the data with i.r and wrote in terms of medium/weak.

(e) Very few gained both marks; A good number of the more able knew that the equilibrium position moved to the right but then wrongly attributed this to the catalyst lowering the activation enthalpy.
The repeating unit for the polyester was often correct but some included an extra oxygen in the chain. Some gave answers containing multiple repeating units.
In the last part many thought that the reaction was a condensation, presumably because they were still clued into polymerisation from part (ii).
Many excellent answers for the drawing and explanation of geometric isomerism, although some answered using optical isomers. This was usually Centre dependent.

2) (a) There were some excellent answers on redox reactions and teachers have obviously been effective in teaching their students. The commonest errors were in not explaining the choice of Cd as the positive electrode in terms of electron flow as requested in the question.
Combining the half equations was most encouraging, though some failed to cancel species occurring on both sides of the equation.
In part (iv), the mark most commonly lost was for not mentioning concentration or just giving it as 1 mole.

(b) Breaking the ring was usually correct though some chose the wrong side of the carbonyl group.
The repeating unit part was often correct but a number showed poor understanding of an amide group often inserting an extra oxygen.
Few really understood part (iii) though there were excellent answers from some able candidates. A number identified the process as addition rather than condensation for which they received credit.
The understanding of how intermolecular forces affect the properties of polymers was generally very good. Some did suggest that the forces present between poly(ethene) chains were a result of permanent dipoles.

3) (a) Some poor diagrams due to misinterpretation of the given skeletal formula and an inability to draw 3D structures on paper.

Tip for students:
Draw a tetrahedral framework using the conventional plain, dotted and wedged lines before adding the detail around the asymmetric carbon atom. Check that there are 4 bonds to carbon, NOT 3 or 5.

A majority correctly identified the NH_3^+ part though some failed to give the charge.

(b) Not all students were familiar with the recrystallisation process; reflux and distillation discussions were not uncommon. The understanding of the terms solute and solvent were generally poor for this level. Few identified a suitable property, generally they were the most able. Most just said that 'the solvent had to dissolve the solid'. Many failed to gain the mark in part (iii); they tended to state that since it was pure that it was therefore free from harmful effects. Some did use the information given to good effect. Many candidates thought that solids were to swallow than liquids!

(c) Many correctly identified the ketone (though spelling it correctly seemed to be a problem!) but many lost marks for the amine; the commonest errors were naming it as an amide, aldehyde or even secondary amine.
The use of the Data Sheet in identifying cathinone was generally good though some incorrectly stated that the sharp peak at 3300 cm^{-1} was due to an –OH group.
Ethanoylation of an amine was poorly understood, most tried to react any part of cathinone other than the $–NH_2$ group.

(d) This was answered very well indeed; many took time to plan their response using the space at the bottom of the page and therefore kept their answer to an appropriate length. Most used chemical terminology although some die-hards still clung to enzymes 'dying and denaturing'. The mark that proved to be most difficult to gain was for the correct use of activation enthalpy (energy). They failed to discuss its relevance to the increase of reaction rate as the temperature increases.

4 (a) Most candidates were able to give two half-lives, though the justification for doing so was not always easy to judge from the graph. The second time was often given as twice the first. However in their responses to part (ii) they often incorrectly considered that the half lives had to be exactly identical for the order to be 1, if they were different then it must be 2!
Some candidates did not write an equation for the rate but rather just gave the right hand side. Units were the biggest problem, few were able to work them out or even learn the appropriate responses for 1st and 2nd order processes. Answers often included a g, *eg* $g\ s^{-1}$.
In some cases the ability to extrapolate the graph was poor, and also incorrect units were regularly given for the calculated mass.

(b) Generally this was very well done; the reagent was well known and the observations even better known, though a few thought the group was an alcohol or even a hydroxide.

(c) The most common answer was to think that the original compound was being neutralised rather than hydrolysed so drawing the phenoxide ion of paracetamol.

(d) Both parts were answered well; clearly colorimetry was understood and the experimental technique learnt. In the last part some lost a mark for omitting 'draw a tangent' and others were not specific about where to draw the tangent; 'at the beginning' or 'on the steepest part' were common responses.

5 *This proved to be the hardest question but it discriminated well between weaker and the more able students, though there some Centre dependence.*

(a) Generally the electron structure of a Cu atom was done well; some lost marks for filling the 4s rather than the 3d whilst others omitted the 3s and 3p orbitals/subshells.
In part (ii) some wrote 's' rather than '4s'.
Surprisingly few were able to write the formula for an ethanoate ion correctly; the charge was often given as 2- and only one O atom was common.

(b) Most candidates gained marks for drawing the structure of the complex. Especially charge, shape and bonding via the oxygen atoms in water. The hardest mark to gain was for bonding, some thought it was ionic or even hydrogen. Others just omitted to state or show in the diagram that this part of the question had registered with them.
Only the most able candidates showed any awareness of the reaction between ammonia solution and aqueous copper (II) ions. However many more gained a mark for giving the correct state symbols for a precipitation reaction.

(c) Very badly done; many answered by stating 'all wavelengths of light other than blue are absorbed and blue is reflected', thus failing to gain any marks. Students need to focus on absorbtion by a specific range and transmittance of blue. Not too many emission of light this time.

Generally the level of marks on this question was centre dependent, with candidates of all abilities from some centres scoring well.

(d) Many identified the brown stain as a compound of Cu *eg an oxide, a nitrate, or a sulphate* rather than Cu metal. Some correctly identified the redox process involved but then contradicted themselves by oxidising copper (II) ions using nitrate ions. Some thought that NO_2 caused the brown stain.
Others tried to use all three equations to produce the brown stain, usually showing much confusion about their understanding of the data.
There were some excellent answers from students happy with redox and electrode potential data, the best did not need all the lines given on the paper.
Too many still tried to approach the problem using artificial rules such as 'anticlockwise'. They invariably failed to gain any marks.

2850: Chemistry for Life

General Comments

This paper proved accessible to a wide range of candidates with, pleasingly, fewer candidates than usual scoring in single figures and a significant proportion of candidates able to score in the mid-sixties and over.
The more able candidate tackled all questions confidently with question 1 generally well answered by most candidates with many scoring full marks for this gentle opener. Question 4 proved the most challenging.
Calculations were reasonably well attempted. The grid for question 2 (f) seemed to help students organise their calculation but again significant figures appear a mystery to some candidates. Unfortunately some candidates still do not read questions carefully enough and attempted almost flawless answers to questions asked on previous papers. Also it would be worth centres explaining some of the command words to their candidates.

Tip for teachers

Explain to candidates the following command words

Compare: Write about what are similar and different about two things (Remember two different descriptions do not make a comparison).
Eg calcium is more reactive than magnesium with water.

Describe: Write what something is like or does.
Eg bubbles of hydrogen slowly collect on the surface of magnesium when it reacts with cold water, but for calcium bubbles of hydrogen gas are given off quickly.

Explain: Write about why something happens or what something means.
Eg structural isomers are compounds with the same molecular formula but different structural formulae.

Suggest: Write down possible reasons for something, using some information given to you or your own knowledge.
Eg It is easier to dispose of sulfur as a solid than in the form of a gaseous compound

There was no evidence reported by the examining team of problems with time.

Comments on Individual Questions

Q.1 Candidates often scored highly on this question
- (a) Well answered.
- (b) (i) The role of the smoke detector itself in preventing a health risk from the alpha particles was often missed.
- (c) (i) The most common error here was to have the fraction, mass/molar mass, the wrong way up.

(ii) The significant figure mark was the most commonly lost mark on this part question

Tip for students
Always lay out calculations carefully and check whether the answer seems reasonable, given the data, at <u>each</u> stage of the calculation.

(d) Generally well-answered.

Numerical answers (c) (ii 0.0004

Q.2 Probably the second best question scored by candidates but a wider range of marks than for question 1.

(a) (i) More able candidates scored all three marks on this but a disappointing number of candidates either had the wrong number of outer electrons, not in pairs or did not understand a dative bond.

(ii) This topic once again showed up weaknesses in candidates understanding. Particular concerns being the failure of candidates to realise that it is the electrons around the central atom that are key to shape (not the lone pairs on the outer atoms), and also too many candidates still talk in terms of maximum rather than minimum repulsion between electrons.

(b) This question highlighted a worrying lack of knowledge of molecules that should have been learnt at GCSE level (eg H_2SO_4), as well as missing out or using inappropriate state symbols.

Tip for candidates
As a general rule try to get used to putting state symbols in for all equations as a matter of course. This will act as insurance for those questions which state 'include state symbols' – and therefore provide a mark for the appropriate symbols.

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(c), (d) and (e) were variably but reasonably well-answered

(f) The grid certainly helped candidates structure their calculation. There were many full marks but common errors such as not putting in a sign, particularly when positive, still persist.

(g) The most common error here was to reword the stem of the question!

Numerical answers (b) (i) 1.5 (f) -486

Q.3 This question probably was the most discriminating on the paper.

(a) (i) This should have been an easy starter, but a surprising number of students identified more than one hydrocarbon!

(ii) This required care but was not difficult, yet there were many wrong answers.

(b) Again variably attempted with many candidates still seemingly uncomfortable with gas volumes.

(c) (ii) Often correct but a significant number of candidates answered in terms of why Group 2 elements form 2+ ions and not in terms of why they do <u>not</u> form 3+ ions, thus missing at least one mark.

(iii) Many candidates scored three marks but then lost out on the remaining two by giving a rote answer in terms of electron shells, thus answering a question from a previous paper!

Numerical answers (b) 1.4

Q.4 This proved the hardest question on the paper.

(a) (i) Candidates often suggested <u>no</u> pollution or <u>no</u> greenhouse gases emitted, therefore scoring zero.

(ii) and (iii) These questions were linked and a sensible choice of producing hydrogen (not hydrolysis or decomposition by heating) was needed to gain the mark in part (ii).

(b) (i) Ionic dot-cross diagrams once more caused problems for candidates with too many covalent structures or no charge being shown on the ions.

(c) (ii) Far too many students struggled to put together a coherent, logical answer to this question, despite the fact that it is a course activity and often used by Centres as an assessment piece. A worrying misconception is that bond breaking is responsible for the exothermic nature of a combustion reaction. The negative sign also seemed to show up a basic lack of understanding, with a number of candidates suggesting that this meant the enthalpy change was decreasing with increasing C atoms.

(iv) The standard of drawing was poor in many cases and candidates were in danger of losing marks if bonds were draw to the wrong atoms. Chains twisting or changing direction were all too often regarded as isomers and there were lots of butanol structures which at least carried an ecf mark on naming the structure.

Tip for teachers
Make sure your students handle molecular models or use computer graphics when dealing with structural isomerism. Hopefully this will reduce the number of students who still think that they can simply twist or change the chain direction to get a new isomer.

Principal Examiner's Report

Chemistry (Salters) Skills for Chemistry: Open Book Paper 2852 01

General Comments

This year, the candidates were presented with two articles about how catalysts are used to reduce pollution from vehicles. The chemistry discussed in the reports linked directly to familiar concepts covered in the AS course, for example free radical chain reactions, equilibria, catalysis, rates and the gases produced in vehicle engines.

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. Where chemical structures were handwritten, there were often errors due to candidates not checking their work carefully (see below).

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.

Communication skills were not as high scoring this year as in previous years. Common errors were repeated errors in equations due to typos in the use of subscripts in formulae or typos in the balancing of equations. A surprising number of candidates did not include enough diagrams to score the marks in C4, despite plenty being available for copying in the articles provided.

Candidates made better use of planning this year. Most reports were balanced, with the last bullet point fully addressed. This implies that candidates had planned their word counts effectively.

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'. It asked students to outline the main pollutants formed by vehicle engines and the problems they cause. This information was easy to research using the articles and course textbooks. Most candidates answered well. Common errors were to miss out important details, for example, many candidates stated that nitrogen oxides are formed from nitrogen and oxygen, but did not make it clear that these gases come from the air in the engine or that the reaction only takes place at high temperatures. Some did not give the environmental impacts of the gases, implying poor planning.

The second part of this bullet asked candidates to explain why different engines produce different emissions. This was discussed in the provided articles. Again, most candidates answered well, outlining clearly, for example, why engines with different air-fuel ratios produce different percentage emissions of hydrocarbons and NOx gases.

Teacher's tip
This first bullet is a good one for a 'first practice'. Set this paper as a homework task. Ask the students to tackle the first bullet point only. Look for the students ability to hit marking points 1a to 2c and 9a to 10c within about 300 words. Ask the students to produce a summary, a full bibliography and also mark equations and diagrams – this will be a good exercise for a 'mini open book' report.

Bullet point 2
This short bullet was almost a direct 'lift' from boxes 1 and 2 of Article 1. Again, it proved very straightforward for candidates who gained lots of chemistry marks easily. This bullet was also a good opportunity for candidates to include lots of equations which counted towards their equation marks.

However, common errors in tackling this bullet included an over-reliance on equations to score chemical points. Chemical points are not usually scored from equations; examiners look for an explanation accompanying each equation. For example…
The equation,

$$O_2 \rightarrow O + O$$

is a relevant equation, but marking point 3a demands that candidates give the following information,

> *3a At high temperature, homolytic fission of an oxygen molecule produces two oxygen atoms/free radicals*.

An equation alone does not give all this information, so a candidate who only gives the equation cannot score 3a.

Teacher's Tip
Ask students to make sure that they put each equation into words, giving the names of the reactants and products as well as any important conditions or features of the equation eg 'high temperature' or 'homolytic fission'

Bullet point 3
This bullet scored a large chunk of the marks (10). The bullet was broken down into three 'sub-bullets' to help the candidates to plan their answers. There was some evidence to suggest that candidates did not make the best use of their time over the two weeks that they had available to complete their report. The earlier sections were often much better done. This section often appeared to be poorly planned.

Most candidates gave very good explanations of heterogeneous catalysts, showing very good research skills by finding diagrams either from the course text or other sources which showed how heterogeneous catalysts work. Similarly, the Noxer blocks reactions involving NOx were usually well explained by candidates making good use of the sources in Article 1.

However, the conversion of pollutants by catalytic converters proved more difficult. This area of the report was often a good discriminator between more able candidates. Very few gave a full explanation of why the conversion of carbon monoxide, hydrocarbons and NOx is different under conditions of different oxygen concentrations.

Teacher's Tip
This bullet would be a good one to use for a 'second practice' as it demands that candidates structure their work carefully. It also demands that candidates access information from both articles and from outside sources, so it is a good practice for research skills.

Bullet point 4
The final bullet was a short three mark task asking candidates to outline the outstanding problems left facing scientists to reduce pollutant emissions from cars. There was plenty of material in the second article for the candidates to make use of here. Answers were not usually very high scoring. It appeared that some candidates had used up their word count by this stage and so omitted the last bullet. This is poor technique because not only are the marks lost that could have been scored here, but examiners will also deduct balance and clarity marks (C1) so up to 5 marks can be affected. Again, it is important to stress to students the need for careful word count planning at the beginning of the process.

Research (marking points R1 to R3)
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.

See 'general points' at the beginning of this report for more information about referencing of websites.

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 redrafted 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 eg about environmental problems or engine design points.
- Using vague sentences eg 'car emissions are harmful and affect our atmosphere' or 'catalytic converters remove carbon monoxide from exhaust emissions' (but no mention of 'how'). It is important that students judge the level of their points – they need to be 'AS level' not 'GCSE'.

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
- ❖ **Redraft** 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.

Principal Moderator's Report

Chemistry (Salters)
Experimental Skills
2852/02

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', 'Comparing the enthalpy of combustion of different alcohols', and 'The determination of the solubility of calcium hydroxide'.

Very few Centres submitted candidates' work for moderation chosen from more than two different activities. For an increasing number of candidates, work from a single activity was submitted for moderation.

Most Centres submitted the expected evidence such as a check list of practical techniques to support the marks awarded for the manipulation strand of the implementing skill area and the Centre Authentication Form (CCS 180) with the work sent for moderation.

An increasing 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.

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.

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.

In some cases, 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.

Teacher Support Booklets:

Two booklets have been published by OCR to support teachers in setting and assessing coursework. They are an essential reading for Centres embarking on coursework setting and marking for the first time.

'Teacher Support: Coursework Guidance' provides guidance on all aspects of coursework, including exemplar assessment activities and associated detailed mark schemes to match the new assessment descriptors in the 3rd edition of the Chemistry (Salters) specification.

'Teacher Support: Exemplar Coursework Guidance Units 2852/02 and 2855/01' provides examples of candidates work with a commentary on appropriate assessment of this work using the assessment descriptors in the 3rd edition of the Chemistry (Salters) specification. These booklets contain answers to many frequently asked questions about coursework in this specification.

Comments on Individual Skill Areas

Planning

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 more 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 the 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
- 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 eg 25cm^3 or 1000cm^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.

IIn 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 their calculation for one alcohol, even if they subsequently use a spreadsheet for other alcohols.

In the activity, ‘Comparing the enthalpy of combustion of different alcohols’, many candidates did not include a minus sign in front of the values that they had calculated. 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.

Some Centres gave higher marks than was appropriate for brief comments on limitations of experimental procedure. Most limitations described using most appropriate detail are required to meet the descriptors at level 8.

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 and this is equally acceptable.

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.

Principal Examiner's Report

Salters Chemistry: Chemistry by Design 2854

General Comments

This paper produced a large spread of marks right up into the hundreds. A lot of candidates showed that they could cope well with this long synoptic paper, which had more unfamiliar contexts than usual. The standard of calculations was usually good as was understanding of weak acid and buffer chemistry and K_p equilibria. Spectroscopy was particularly well done and organic concepts and reactions were often correct. Enthalpy cycles were less well understood, however. In general, many candidates lost marks because they were unable to express themselves in a lucid fashion, using correct chemical terminology. The naming of particles as ions, atoms or molecules was often confused.

Comments on Individual Questions

Question 1

Many candidates did well on this question. Part (a) was actually one of the most difficult, though only a few did not score in part (b). Most could gain both marks in part (c) and full marks in part (d). Part (e) was usually well done, showing the usual good understanding of infrared spectroscopy. Some lost marks by naming functional groups rather than giving the bonds and a few gave the wrong absorption for the C=O group. Most knew part (f), though some left out the acid. Most could do part (g). In the calculation for part (h) (i), the commonest error was to multiply by 1000 rather than dividing, a result which would have worried the athlete concerned. Part (h) (ii) was the least successful in the question, followed by part (h) (iii). Candidates need to learn the mechanics of a glc chromatograph. In part (h) (iii) the mark-scheme was widened to allow semi-correct phrases such as "the mass of the molecule". Candidates are advised to write "relative molecular mass" in future.

Numerical answers: 1 a 26, 1hi 6.1 x 10^{-10}

Question 2

This question was found harder but many good marks were seen. Most could draw the ethanoate ion correctly and a gratifying number knew which bottles to reach for to get the ions concerned. They could often describe the reactions in part (c) and suggest a suitable reason in part (d). Part (e) was usually respectably done. There was the usual confusion over electrons emitting light by jumping down again and the hardest mark was that for the second bullet point. Part (f) was usually completely correct. Candidates found difficulty expressing themselves in part (g). Many omitted to mention *lines* in part (g) (i) and some did not state clearly that each element (not "atom") had its own energy levels (not "electron configuration")

Question 3

This question was found hard by many candidates. Many seemed to have forgotten that glass was opaque to infrared radiation in part (a). In part (b) (i), $5d^{10}$ was the only extra material that was accepted – the correct answer was in the minority here. There were lots of ways of answering part (b) (ii) correctly, either by considering the charge on the thallium ion, or by comparing Tl with another better-known Group 3 element. Many scored one mark but some did not write accurately enough to score the second. Part (c) (i) mostly saw some marks scored but relatively few emerged unscathed. A common error was to assume that Tl^+ was formed and/or to omit the "3" before the Br terms. Error carried forward for the labels of the energy levels enabled more marks to be scored than would otherwise have been the case. Just a very few papers were seen where the +5438 value seemed to have been misprinted as +5433. Such scripts were checked carefully to ensure that the candidates were given maximum credit. In part (c) (ii), most candidates could name "ionisation enthalpy" but relatively few said it was the "sum of the first three". In part (h) (iii), the commonest answer was lattice enthalpy. Part (d) was a rather different mole calculation and it was gratifying to see that over half the candidates could get this right. There was a lot of confusion on page 12 with some candidates losing credit by their inability to express themselves clearly and use appropriate chemical language. For example, the "atom" was quite often said to be large in part (e) (i). In part (e) (ii), the hardest mark was that allotted to describing the hydration energy as "the sum of anion and cation" (or alternatives). In part (e) (iii), almost all candidates could get the sum right but fewer could name the enthalpy change. Part (f) was disappointing. Some answered as if TlBr were covalent. Many mentioned high melting point but some then lost a mark by describing the "intermolecular forces" as strong. Many failed to notice that TlBr had been described as insoluble higher up the page. They were still credited with a correct description of ion movement, though. In spite of poor marks here, most candidates managed to score for their quality of spelling, punctuation and grammar.

*Numerical answers: 3ci **1** +336 **4** –975 3d 2.2 3eii +325*

Question 4

This question was better done, with many hardly dropping a mark on page 13. A few continue to define "weak acid" (part (b) (i)) in terms of ability to donate protons rather than in terms of reaction with the solvent. Most scored in part (c) (i). In part (c) (ii), quite a few clearly understood what was going on but failed to name oxygen (just saying "the air"). Most scored in part (d) (i) but some did not realise the scope of the answer required in part (d) (ii). They either answered fully on increased yield or on increased rate. For the former, there was a need to make it clear that the equilibrium moved to oppose change and to identify the side with the fewer molecules. For the rates part, "more collisions" was not adequate, there had to be some mention of frequency of collisions. The least scored mark was for saying that the particles are closer together at higher pressure. Most candidates managed to use the correct technical terms here and score for quality of written communication. In part (d) (iii), vague answers ("expensive" or "dangerous", without qualification) did not score. Part (e) was often well done. In part (e) (ii), just a few found the squares and cubes a bit daunting. However, the significant figure mark was awarded far more often than previously, which was great to see.

Numerical answers: 4a +5, +3 4biii 2.2 4eii 28.8

Question 5

This question was definitely the hardest, though there were some easy marks. Most could name the amide group and could attribute the proton shifts to parts of the ethyl group. Some drew a bewildering number of hydrogen-bonded water molecules and were rewarded by a policy of looking for correct points and ignoring the incorrect. The mark for the straight N–H–O and O–H–O was the hardest but it was fairly often awarded. Most could do part (b) (ii) and many could analyse the unfamiliar molecule and unfamiliar chemistry to score in part (c). It was a shame when candidates had done this and then showed the sodium ion covalently bonded to the nitrogen. Part (d) was a return to the very familiar and most candidates could score here. The calculation in part (d) (iii) was usually correct. Part (e) was supposed to be challenging and so it proved to be. References to "fatty blood" meant that some candidates had not appreciated that this was a question about the relative solubilities of the ion and the molecule in water and in fat. Some tried to answer in terms of receptor sites. Those who got on the right track were disconcerted by hydrogen bonding, often stating that the ion would form fewer such bonds than the molecule. Others implied that the ions and molecules were undissolved to start with. Those who avoided all this did not always express themselves clearly and name the intermolecular forces they were talking about. Quite a few candidates understood what lay behind part (f) and there were some good answers here.

Numerical answers: 5dii 4.0×10^{-8} *5diii 0.98 5f [salt]/[acid] for aspirin =* 8.3×10^{3}

Principal Moderator's Report

Chemistry (Salters)
Individual Investigation
2855/01

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.

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. Some candidates chose investigations that were insufficiently demanding or had too little scope and this limited the marks that could be available. 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.

Investigations into kinetics systems were in some cases 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, it should be possible for a candidate 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.

Some Centres used an out-of-date mark scheme which invariably led to the award of inappropriate marks

The quantity and quality of annotation of candidates work by teachers varied considerably between Centres. In some cases comments focussed 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.

Most Centres were aware of the hierarchical nature of the coursework descriptors and applied them effectively. There are still a significant number of Centres, however, who do not apply the descriptors in a hierarchical manner but use a form of 'best fit' approach. This often results in a generous application of the marking descriptors. In a significant minority of Centres higher marks were awarded when key criteria at a lower level had not been met.

Teacher Support Booklets:

Two booklets are published by OCR to support teachers in setting and assessing coursework. These are essential reading for Centres managing and assessing coursework for the first time

'Teacher Support: Coursework Guidance' provides guidance on all aspects of coursework, including examples of suitable assessment activities and the new detailed assessment descriptors in the 3rd edition of the Chemistry (Salters) specification.

'Teacher Support: Exemplar Coursework Guidance Units 2852/02 and 2855/01' provides examples of candidates work with a commentary on appropriate assessment of this work using the assessment descriptors in the 3rd edition of the Chemistry (Salters) specification.

These booklets contain answers to many frequently asked questions about coursework in this specification.

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 theoretical background while in other cases they included much background but little experimental detail. It is 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.

There was a further significant increase this session in the use by candidates 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 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 which will allow them to demonstrate their practical skills and understanding of chemical ideas.

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 a significant number of 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 the higher mark levels 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.

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. 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 our 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.

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.

Candidates are also required to identify key limitations of 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. 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.

Advanced GCE [Chemistry (Salters)] (3887/7887)
June 2007 Assessment Series

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2848	Raw	90	65	57	49	42	35	0
	UMS	120	96	84	72	60	48	0
2849	Raw	90	66	59	52	45	38	0
	UMS	90	72	63	54	45	36	0
2850	Raw	75	55	48	42	36	30	0
	UMS	90	72	63	54	45	36	0
2852A	Raw	90	73	67	61	55	49	0
	UMS	90	72	63	54	45	36	0
2852B	Raw	90	73	67	61	55	49	0
	UMS	90	72	63	54	45	36	0
2854	Raw	120	89	80	71	62	53	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	20.3	40.6	59.0	75.0	87.6	100	9828
7887	28.8	52.4	72.7	87.0	96.5	100	6755

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

Statistics are correct at the time of publication

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