

# **Chemistry (Salters)**

Advanced GCE A2 7887

Advanced Subsidiary GCE AS 3887

## **Report on the Units**

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**June 2006**

**3887/7887/MS/R/06**

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Any enquiries about publications should be addressed to:

OCR Publications  
PO Box 5050  
Annersley  
NOTTINGHAM  
NG15 0DL

Telephone: 0870 870 6622  
Facsimile: 0870 870 6621  
E-mail: [publications@ocr.org.uk](mailto:publications@ocr.org.uk)

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### 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 a slight increase in the proportion of A grades awarded at A-level.

All Principal Examiners reported excellent work from many candidates. A larger proportion than usual seem to have let themselves down, however, by poor examination technique and inadequate preparation.

Standards were maintained in coursework both at AS and A2. At AS, a smaller proportion of Centres were out of tolerance and had to be moderated down. However, at A2 the proportion was larger than in 2005. The Principal Moderator hopes that these Centres will take advantage of the INSET training on Coursework in the Autumn.

#### INSET dates for Autumn 2006

***Get ahead – raising standards through examination feedback***

A full day course aimed at improving candidate performance by giving feedback from the June 2006 session on the written papers and coursework.

**Course dates and codes** Wednesday 18 October 2006, London (CCHR501); Thursday 2 November 2006, Coventry (CCHR502); Thursday 7 December 2006, London (CCHR503).

**Fee** £120 including refreshments, lunch and course materials.

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**Course date and code** Tuesday 21 November 2006, London (CCHR601).

**Fee** £120 including refreshments, lunch and course materials.

Places may be booked on these courses using the booking form at the back of this report; we are unable to accept telephone bookings. Please quote the course code in any correspondence.

## 2848 – Chemistry of Natural Resources

### General Comments

Candidates' marks covered a wide range, from single figures to the early 80s, although marks above 70 were rare. There was no indication that candidates had a problem with the length of the paper, as answer spaces that were left blank (of which there was an unusually high number) indicated a lack of knowledge and understanding rather than a time constraint.

Good attempts were made at most calculation questions, with candidates setting out their answers sufficiently clearly, and stating what was being calculated at each stage, to allow them to gain credit (and to gain marks *via* the 'error carried forward' rules if they had made a mistake). Most candidates scored well on questions requiring them to draw a diagram.

Marks were generally much lower on questions that required candidates to name an organic compound, show a reaction mechanism, discuss the effects of intermolecular forces or write a chemical equation. A limiting factor for many candidates was their poor literacy skills, with many showing a weak grasp of the appropriate use of technical vocabulary.

### Comments on Individual Questions

- 1 This was a high scoring question for many candidates.
- (a) (i) Most answered this correctly, although 'methyl' was a very commonly seen incorrect answer.  
(ii) This was generally answered well, with the most common mistake being a structure with too many hydrogen atoms, leading to some carbon atoms having five bonds to them.  
(iii) Few candidates scored both marks, although many did get one for 'methylbut'.
- (b) (i) A significant number of candidates scored the mark here for stating 'colourless'.  
(ii) Most candidates gained the mark by stating it is saturated.  
(iii) The most common outcome here was for candidates to gain one mark for a suitable saturated skeleton. Only the best candidates scored both marks, the most common errors being to include too few bromine atoms or to put them in incorrect positions.  
(iv) Many scored both marks, but a surprising minority failed to select two answers, as was indicated in the rubric.
- (c) (i) Many candidates failed to score on this question. Those who did attempt it, tended to be confused as to which equations to select. Those candidates who correctly chose **equations 1.1** and **1.2** often failed to write the overall equation correctly and included the NO and NO<sub>2</sub> in their answer.  
(ii) This question was well answered by a small percentage of candidates. Many of those who gained no credit failed to realize that the answer was linked back to the equations given earlier.

**Tip** It is worth reminding candidates that answers to parts (i), (ii) *etc.* of a lettered part question will often make use of their previous answers within that lettered part, or will link back to information included in the stem of that part of the question.

- (iii) Most scored the mark here, with a small proportion of candidates confusing tropospheric and stratospheric effects.

- 2 This question was often reasonably well done, with the exception of those parts that required candidates to explain the effects of intermolecular forces on the properties of materials.
- (a) (i) Most scored this mark.  
(ii) Many scored one mark for indicating that the second monomer needs to be unsaturated. Gaining both marks was less common, with candidates often failing to put across the idea of different monomers.
  - (b) (i) Many candidates scored at least two marks. Common reasons for not gaining credit were the incorrect positioning of the lone pair along the hydrogen bond and the 'straight' O–H–O combination.  
(ii) Very good candidates scored the mark by giving an accurate description of the effect of the intermolecular forces that are in operation. Weaker candidates gave vague answers, often referring to the acrylic acid, instead of the polymer formed from it, or discussing the interaction of the paint and the paper it was being applied to.
  - (c) (i) Few candidates scored well here, with hydrogen bonding given as present in both polymers being a common error. Also, some candidates gave an abbreviated answer pd-pd, which gained no credit. Many incorrect responses were centred round an answer involving the difficulty of packing the chains together due to the presence of branching.
- Tip** Practise identifying the intermolecular forces between various pairs of molecules. Remember not to abbreviate the names of intermolecular forces on the examination paper, particularly when the answer includes a mark for the quality of use and organisation of scientific terms.
- (ii) Most gained a mark for showing correct diagrams for the isomers and many went on to get the second mark for *cis* and *trans* too.
  - (iii) Poor wording of answers often made it difficult to give any credit. Many candidates gave answers that referred to the monomer instead of the polymer formed from it.
- 3 This question showed a lack of knowledge and understanding of reaction mechanisms and a poor ability in writing chemical equations. Calculations were, however, generally well done.
- (a) (i) Most gained this mark.  
(ii) Many candidates got the mark for homolytic, with a few incorrectly giving photodissociation.
  - (b) (i) Many scored both marks for clearly set out and well explained answers. A common mistake was failing to multiply by 1000, which led to some candidates only gaining one mark.  
(ii) Again, many candidates gained both marks. Of those who did not, a significant number gained some credit for appropriate working under the application of the error carried forward rule.  
(iii) A good number of correct responses were seen, although some misread the question and discussed the comparison of amounts of energy instead of frequency.

- (c) (i) Many gained two marks, but few gained the third one for mentioning that it is the *high frequency* uv that is removed.  
(ii) Most gained this mark.  
(iii) Few scored here, with the answer space often left blank. Of those who did attempt it, many did not write the final equation with the Br and BrO removed.  
(iv) This mark was often awarded.  
(v) Many candidates scored at least one mark, for showing the right-hand graph with a lower activation enthalpy than the one on the left. Many fewer candidates went on to gain the second mark for correctly labelling of the activation enthalpy on both diagrams.  
(vi) 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. Those who chose increased pressure as their second factor tended to score both of the available marks. A minority of candidates became confused, because of the context of the question, about what was wanted in the answer and tried to give answers in terms of the effects of the uv light. Although credit was given for this in the mark scheme, most answers that took this route were not written with sufficient clarity to lead to marks being awarded.
- (d) (i) Although some candidates gained the first mark for the correct left-hand side of the equation, few had any idea of the type of product that would form, making the award of the second mark quite rare.  
(ii) Most candidates scored something, often for a correct diagram to illustrate the polar bond. Marks were gained by fewer candidates in the written part of their response, usually due to poor wording. This included confusion over the use of the terms atom and molecule and vague descriptions of the unequal distribution of the electrons, rather than precisely discussing the positioning of the bonding electrons between the two bonded atoms.  
(iii) Many candidates failed to attempt this question. Of those who did give an answer, one mark was often scored for the curly arrow showing the movement of a lone pair of electrons from the oxygen to the carbon in the bromomethane molecule. It was rare for any candidate to score both marks.  
(iv) Many correct answers were given, even if the previous part of the question had not been attempted.  
(v) Good candidates scored both marks. Occasionally a candidate gained one for state symbols if they gave an equation that had a suitable structure, but was not correct. Many failed to give an answer or gave something that was not an ionic equation.  
(vi) A significant number of candidates scored the mark in this question.

*numerical answers: b(i)  $4.82 \times 10^{-19}$  J; b(ii)  $7.27 \times 10^{14}$  Hz*

- 4 The quality of answers to this question was very varied. Most candidates gained some credit for calculations and values for oxidation states.
- (a) Most gained at least two marks, with the mark for the oxidation state of iodine in the iodate(V) ion being awarded less often.



Report on the Units taken in June 2006

- (b) (i) Most got the mark for sulphur.  
(ii) Most candidates gained at least one of the two marks for the calculation because they showed a correct method, allowing credit to be given under the application of the error carried forward rule even if they had made one mistake. Most then went on to get the last mark as well, although some good candidates surprisingly gave an answer to three significant figures deliberately (*i.e.* they wrote '3 s.f.' in brackets next to their answer) when the question clearly asked for two significant figures. Some weak candidates gained the final mark for significant figures provided they showed some working for the calculation, even if that working gained no credit.
- (c) (i) Few candidates gained both marks, with many trying to give an answer that included iodate(V) ions. Some scored one mark for correctly showing two iodide ions producing an iodine molecule.  
(ii) Many gained the mark for stating iodine in iodate, or quoting iodate ions.
- (d) The most able candidates easily scored both marks, but most candidates failed to score at all. The majority of candidates did not seem to understand what was being asked and often attempted to write responses that suggested some type of reaction was occurring.
- (e) Better candidates often scored two marks, with a common mistake that led to only one mark being scored coming from the use of the value 254 instead of 127.
- (f) (i) This was generally well answered, with many candidates scoring at least two marks.  
(ii) Most candidates scored at least one mark, either for correctly giving 4 and 5 or for one subshell being completely correct. A pleasing number gained both marks.  
(iii) Many candidates misinterpreted this question and gave a response involving the wrong combination of halogens (often chlorine reacting with bromide ions). A significant number of candidates failed to gain any credit here. Some responses gave the reverse equation and many answers were not ionic equations. A significant minority of candidates gave no answer.  
(iv) Many gained the mark for mentioning a low temperature, with answers that gained no credit often referring to transporting in lead-lined or steel tanks.
- (g) Most candidates scored at least one mark, often for the correct formulae of the two ions. Many went on to score all three marks, although some had difficulties with drawing the three dimensional aspect of the structure.
- (h) This was generally well answered, although aqueous or hydrolysis were often seen as incorrect responses.

numerical answers: *b(ii)* 3800 g    *e(i)* 0.29 g

## 2849 – Chemistry of Materials

### General Comments

All the examiners thought the standard of the paper appropriate, although several parts of the paper caused much difficulty for candidates, despite being designed to cater for a wide spectrum of abilities. Difficult areas included extended writing involving a redox titration and explanations of the properties of polymers using intermolecular forces. The quality of written communication throughout the paper in many cases was poor. Many candidates lacked an awareness of the length of answer required; there were as many candidates who were far too succinct as there were those who were longwinded, often using inserted sheets to add to the problem. Candidates need to be encouraged to fit their responses into the spaces allowed, hence the need to plan for the extended writing questions. This is where an extra sheet is valuable. The ability to express ideas throughout the paper using appropriate scientific language was again of a poor standard. For example, many were not able to name the apparatus for a titration, whilst in those questions which have a biochemical slant they switched from chemical to biological language.

Candidates were generally more effective in using the Data Sheet and in understanding the differences between n.m.r. and i.r. measurements. Centres have obviously worked hard at this area.

The ability in calculations to use the 'appropriate number of significant figures' was quite poor, most giving their answers to '2 sf' rather than 3, although 1 sf and 2 sf were not uncommon. Most serious candidates tried to set out their working showing symbols, equations and units. However, there were a considerable number of candidates whose scripts were untidy, illegible and, where required, poorly illustrated, with poor explanations and descriptions.

### Comments on Individual Questions

- 1 (a) Most correctly identified the ester but some omitted the O–H bond in the formula of ethane-1,2-diol.

**Teaching tip**

Candidates often draw all C–C and C–H bonds in structures but abbreviate functional groups *e.g.* –OH, –NH<sub>2</sub>, –COOH. They also try to rush diagrams and do not always draw bonds accurately between two atoms. They perhaps need more practice in precision in this area.

- (b) Some good answers, but many were rather vague and failed to give a suitable advantage.

**Misconception**

'Cracking' was a common response. Possibly because of the research being carried out to recycle tyres and discussed in the Open-Book paper. It is not relevant here.

- (c) Rather disappointing in most cases though many gained the mark for focusing on the fact that chains cannot move over each other so easily at lower temperatures.

**Misconception**

Intermolecular forces get stronger as the temperature falls with some citing that polymers become more crystalline at lower temperatures with an equal number suggesting that they become amorphous.

At this level candidates will fare better if they relate low temperatures to lower kinetic energies for the chains, hence the restriction in relative chain movement. An applied force will then cause the 'frozen' chains to break.

- (d) Many did not read the question carefully enough and tried to draw the full structural for compound A. However, the ester link was common but not the rest of the detail required.
- (i) Candidates often switched to structural formulae for some parts of the structure.
- (ii) Candidates did not understand the effect of polymer structure on the strength of intermolecular forces between chains. They generally knew they were stronger in PEN but not why, nor were they able to express their ideas clearly enough in some cases.

**Misconceptions**

Hydrogen bonding exists between chains in polyesters like PEN. Delocalised electrons make it more difficult for a double benzene ring to break.

- (e) (i) The commonest error in writing the expression for  $K_c$  was that they confused this with the  $K_a$  constant discussed in unit 2854. Thus some left out the concentration of water term.
- (ii) Some excellent explanations, though a few confused equilibria with rate of reaction. If a mark was lost it was because of the failure to explain the change in the equilibrium position.
- (iii) Some forgot that the sulphuric acid needed to be concentrated.

- 2 (a) It was not always apparent that candidates could interpret skeletal formulae well enough to tell if a carbon was asymmetric or not.
- (b) Some confused an amide with an amine whilst others tried to add additional C and H atoms.
- (c) In part (i) the commonest error was to use concentrated sulphuric acid, whilst most got part (ii) correct with only a very few citing n.m.r.

Despite the question in part (iv) stating 'paper chromatography' many referred to t.l.c. Thus candidates wrote about plates, ultraviolet radiation and iodine. However, generally it was a well answered question, although the standard of diagrams was poor, even though a wide range of interpretation was allowed.

Most candidates were able to use the *Data Sheet* effectively to establish the presence of a -COOH group and a -CHO group. However, some joined them together to form a two carbon molecule, not realising the wider picture. Some thought the acid contained a phenyl group, not realising that a group of H atoms in such a group would also give an n.m.r. peak.

The answers generally to part (v) were most encouraging. Designed to test candidates at the higher levels, some Centres had covered the topic of acid strength in organic compounds really well so that even their weaker candidates gained credit here.

The commonest error was stating that acids lose an H atom rather than an H<sup>+</sup> ion. The C=O group was often given as the cause for the loss of a proton rather than the stability of the carboxylate anion formed. Some also confused the terms 'dissociation' and 'delocalisation'.

- (d) (i) Answers tended to be longwinded, with candidates using extra space to discuss topics like how an i.r. spectrometer works yet failing to give details of the absorption peaks in an ester.

**Misconception**

Electrons gain energy and emit infrared frequencies. This was a common error with many failing to appreciate the idea of 'bonds vibrating faster' through absorption of infrared radiation of the appropriate frequency.

- (ii) Some forgot the context of the question and identified the presence of a phenol, amide or an amine.

**Teaching tip**

Candidates need to be aware of the specification details regarding interpreting spectra. There are a limited number of functional groups listed. Phenols, amines and amides are not included.

- 3 (a) Few candidates gained both marks. Many forgot that H<sup>+</sup> ions needed to be added as a reactant, and few attempted to incorporate electrons; if they did they were not always on the correct side.

**Teaching tip**

Candidates need practice in writing ion-electron equations, making sure that the charge and mass on both sides balance.

- (b) (i) This was poorly done. Even the ablest candidates often failed to gain more than 2-3 marks.

Most lost marks because of a failure to achieve at least two concordant titres; not using a pipette to measure out the hydrogen peroxide; not adding acid so that the manganate(VII) could operate as an oxidant. In addition many used a beaker rather than a conical flask for the titration, used an acid-base indicator or wrote at length about the use of a white tile and how to read a meniscus (diagrams often incorporated).

The language used was often non-scientific. A burette was referred to as a 'titre' by one group and 'measuring tube/stick' was quite common. Despite the heading at the beginning of this part of the question many failed to concentrate on spelling, punctuation and grammar. Fortunately for them a specific spelling was only penalised once; 'burette' was not the commonest variation by a long way.

- (ii) The commonest errors with the calculation were failure to multiply the moles of manganate(VII) by 2.5 and the significant figures problem. Significant figures were usually given to 2 rather than 3, though 1 and 4 were regularly seen. Some had a difficulty in adjusting for the tenfold dilution factor.
  - (iii) Virtually all were able to calculate the relative molecular mass of hydrogen peroxide correctly. Few could then go on and use it effectively.
  - (c) (i) A very familiar GCSE equation was required. The commonest errors were in giving the state of water as (aq) and hydrogen peroxide as (l). However, many of the weaker candidates did gain the mark.
  - (ii) The understanding of homogeneous and heterogeneous catalysis was nearly always correct.
  - (iii) A majority managed at least two marks but there were similar problems in using scientific language as experienced in part b(i). The weakest candidates used beakers, buckets of water and took readings too infrequently. Some just wrote 'plot a graph' without specifying what was to be plotted. If a gradient was drawn it was not often specified as being at time = 0.
  - (iv) Generally the rate was well calculated. However, many lost the ecf mark for not showing the rate equation used.
- 4
- (a) (i) Rusting of the tap was a fairly common answer. Oxidation was usually suggested but many could not explain why this was so.
  - (ii) The idea of a complex ion was not really understood, most recognised it has a Fe(III) species but wrote  $\text{Fe}^{3+}$  or 'rust'.
  - (iii) Few were able to write a correct ionic equation. The mark most commonly awarded was for the state symbols. Candidates often thought the precipitate was iron(III) oxide and also tried to incorporate water molecules in the equation.
  - (b) (i) Often incorrect answers were given involving the absence of charges and/or C=C bonds.
  - (ii) Well answered though there were a variety of minor contenders: redox, addition, just plain substitution, nucleophilic and 'litigation'.
  - (iii) Some tried to answer this in terms of a chemical reaction in which iron(II) ions were formed (a result of the green colour presumably). Some inevitably, though not as many as previously, thought that electrons having been excited fell down emitting green light. The better candidates were truly excellent here.
  - (iv) Very Centre dependent, a few knew this well, including some of the weaker candidates, and were able to gain the three marks. However, the vast majority thought that the coordination number was the number of ligands in the complex or the charge on the ion.
  - (v) Some excellent diagrams but most were poor. Many failed to appreciate the bidentate nature of the ethanedioate ion, whilst drawing octahedral structures remains a real struggle for most.

**Teaching tip**

Diagrams of complexes are best drawn showing the atoms donating the electron pairs bonded to the central atom. Then the usual wedge and dashed lines can be used to show the ligands not in the plane of the paper.

*Report on the Units taken in June 2006*

- 5 (a) (i) Some described hydrogen bonding in biological systems, though many recognised that a base accepts protons. However, few appreciated the role of the nitrogen's lone pair of electrons in the process. Part (ii) was almost always correct.
- (iii) Sometimes not enough detail was given in drawing the appropriate hydrogen bonding (another example of poor examination technique); other errors were lone pairs or charges missing or lone pairs not aligned with the H-bonds but at right angles. Internal H-bonding was seen regularly.
- (iv) Not always correct; often given as just helix or even pentagon, linear, or tetrahedron.
- (b) (i) Well answered, most gaining both marks.
- (ii) A wide range of responses; from really excellent chemistry based outlines to the essay based biological style treatise, where many wrote down all they knew about protein synthesis or genetic engineering.

Candidates need to use the mark allocation as a guide to the depth of answer required.

## 2850 – Chemistry for Life

### General Comments

The paper generated a very wide range of performance from candidates, with scores from some very weak candidates in single figures to an encouraging number of candidates scoring in the 60–70+ mark range.

Questions 1 and 2 proved the most challenging and gave the widest spread of marks, with Question 3 and particularly Question 4 being generally the best answered.

There were many straightforward questions on this paper but some questions had been designed to give students an opportunity to apply their understanding, particularly the sequencing of ideas, and not simply regurgitate rote learned material. Understandably these former questions proved the most discriminating and, whilst in some cases the context may not have keyed in the students thinking as intended, such questions are important if the most able candidates are to be given the opportunity to shine.

#### Tip for teachers

Although there are always a substantial number of marks on the paper for correct responses to fairly standard questions, there will also be opportunity for more able candidates to use their thinking skills. It is worth Centres giving students practise at answering questions on familiar topics from slightly different angles and contexts.

Calculations, in common with recent sessions, were reasonably well dealt with along with the ability to produce balanced equations.

Time did not seem to be an issue.

### Comments on Individual Questions

- 1 The context used for this question spanned ideas from both examinable units and consequently the question was relatively long. The decision to put it first was made because it was thought that candidates would be at their freshest, best able to cope, and would find the later questions relatively straightforward, with less chance of 'running out of steam'.

Part (a) was correctly answered by most candidates, in contrast to part (b)(i), which rarely generated the correct response. This part question was designed to continue the context of control of gases in the head space in packaging, and allow candidates to recall their GCSE chemistry, namely  $\text{CO}_2$  is an acidic gas, and therefore CaO is basic.

The mark scheme in b (ii) included a wide range of more general properties, not only chemical patterns, and this mark was consistently scored.

In (b) (iii) common mistakes were to have the fraction giving the amount of CaO the wrong way round, although 'ecf' (error carried forward) marks were awarded if clear working was included.

#### Tip for candidates

In calculations make sure you clearly show all the stages of your working. It will make it easier for the examiner to give you credit even if you make an early arithmetical slip.

Some students are confused between decimal places and significant figures; nevertheless many candidates obtained the correct answer.

Most candidates scored all four marks on (c)(i), however, the need to put together a logical sequence of ideas in order to score all 5 marks on(c)(ii) tested many students. The most able students usually scoring 4/5 marks with 2 marks (maximum distance apart and  $120^\circ$ ) common for the majority. Although lone pairs are not present in the ethane molecule the importance of **all** electron dense regions around a central atom in dictating the shape is still being missed by some candidates. A common wrong answer being a bond angle of  $109^\circ$ , possibly because the candidates treated the 'second pair' of electrons in the double bond as another, fourth, electron pair.

Part (c)(iii) was usually well answered but (c)(iv) seemed quite Centre dependent with candidates from some Centres producing almost the text book answer and others producing spurious answers based on enzyme kinetics. Absorption and adsorption were often confused.

Part (c)(v) scored one mark for a large number of candidates (the idea of the honeycomb/sieve structure of zeolites being met in both *Storylines* and an activity, albeit in the role of separation of branched and straight hydrocarbon molecules), but the second mark proved elusive with the mark scheme allowing any comment suggesting the size of the 'pores/channels' need to be about the dimensions of the water molecule (otherwise it will either pass right through or not be absorbed in the first place.)

*Numerical answer (b) (iii)  $340\text{cm}^3$*

- 2 Part (a) was designed to look at mass spectroscopy from a slightly different angle and part (a)(i) had two obvious mistakes. Many candidates correctly identified these mistakes and their corrections (included in the mark scheme was, mass/charge ratio instead of mass, as an alternative pair). Some students did go off on a tangent re-writing whole phrases.
- 3 (a) (ii) yielded the correct  $\text{C}_{70}$  for most candidates.

Part (b)(i) was generally correctly answered although some suggested 14 and 12 neutrons and a small but worrying number cited different numbers of protons.

Part (b)(ii) showed up confusion in some candidates' minds about the general nature of radioactive decay. It was hoped that candidates would argue thus: little radioactivity means very few (not 'none')  $\text{C}^{14}$  atoms left, because many half-lives have passed, because  $\text{C}^{14}$  atoms in ethanol from oil have been around for a very long time (or the reverse argument). A significant number of candidates got there but many contradicted themselves by suggesting  $\text{C}^{14}$  atoms in ethanol from grapes had a shorter half-life, or no radioactivity was left in oil-derived ethanol.

Part (C) yielded 2 from 3 for most candidates with the third mark only occasionally scored, being for stating the lines got closer. A few candidates still got absorption and emission spectra mixed up.

The majority of candidates in (a)(i) correctly wrote the equation for the first ionisation of Cs. State symbols were sometimes unclear or wrong and less frequently there was an electron affinity.

Logical and concise sequencing of ideas was again a problem for some candidates in (a)(ii) although most got there in the end.

In part (b) a substantial number of candidates knew they had to find the mole ratio but a significant number inverted the fraction and ended up with  $\text{Cs}_2\text{O}$  receiving 'ecf' marks, again, if the working was clearly shown.



Part (c)(i) was misinterpreted by some candidates since they missed the transition from Cs to Xe, nevertheless a large proportion of candidates realised that the 'simple' explanation required was merely that the number of outer electrons equalled the group number.

Part (c)(ii) was correctly answered by most.

Part (d) required candidates to think a little more about a nuclear reaction. In order to score all three marks they needed to first work out that the process must be beta decay and then put together the correct equation. Pleasingly many candidates were able to think their way through this.

- 4) In part (a) a large number of candidates produced an appropriate dot-cross diagram, with far fewer candidates than in previous similar questions missing off the non-bonding pairs. Part (b)(i) produced many completely correct answers with full credit being given to any candidate who halved the final answer to give a value per mole of  $\text{N}_2\text{O}$ . Unfortunately some candidates are still missing signs off their final answer and this can lose them possible 'ecf' marks. If examiners cannot follow the calculation this often also results in an unnecessary loss of marks (see earlier '**Tip for students**'). Part (b)(ii) was usually correctly answered and part (c) yielded more correct answers than recent entropy questions. Parts (d)(i), (ii) and (iii) were all well answered. Part (e)(i) produced some strange equations, typically with oxygen missed out as a reactant, but many completely correct responses. Part (e)(ii) produced several 'quotes' from the text book but unfortunately some candidates were unsure of, or forgot to include, the source of the nitrogen and oxygen.

*Numerical answer (b) (i)  $-1092 \text{ kJmol}^{-1}$*

## 2852/01 – Skills for Chemistry: Open-Book Paper

### General Comments

This year, the candidates were presented with two articles about the production of rubber and the recycling of tyres. The chemistry discussed in the reports linked directly to familiar concepts covered in the AS course, for example addition polymerisation, structures and properties of polymers and crude oil as a non-renewable resource.

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. Candidates need to note that web addresses should be given in full (URLs). In simple terms, this means that the address should end in *xxx.htm* or *xxx.html* or *xxx.shtml* or *xxx.asp*, all of which would lead to a specific page on the site. Additionally, for the 'detail' of sources mark, the address should be accompanied by the name of both the web site and the page, to enable tracking of the page.

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 who include a lot of extra 'technical' information (e.g. about tyre specifications, technology, industrial processes etc.) do not gain extra marks and are 'wasting' their word count.

There was evidence this year of poor planning and use of time or words by many candidates. Many candidates gave too much emphasis in their reports to the first bullet point, leaving insufficient words or time to properly address the later bullets. Similarly, the last bullet was also more poorly attempted than the others, implying a 'rush' to finish the report. As the last bullet carried 10 of the available 26 marks for Chemistry and Evaluation, this led to poor scores for many candidates.

#### 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. 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.*

Another outcome of poor planning is shown when sentences are 'lifted' from the articles rather than used to make clearly argued points. Candidates who draw their responses directly from the texts of the articles without any selection or interpretation cannot clearly address the bulleted tasks.

A significant proportion of candidates continue to attempt to evade the 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 and will be penalised by the examiner as additional word count. This could result in the last sections of the report being disqualified from scoring.

Across the whole mark range candidates scored lower on Evaluation than on Chemistry, this led to the evaluation marks and the communication marks being the main discriminators for the paper this year. Many low evaluation scores were caused by too little time and words being left to do justice to the last bullet point.

**Comments on Individual Questions**

**Bullet point 1**

This bullet asked candidates to discuss the formation of rubbers and to highlight the similarities and differences between natural and synthetic rubbers. There were six marks available for this section from a total of 26 for the bullets overall. From a total word count of 1000, it would be reasonable to expect that candidates should use about 200 words to cover this bullet. Most candidates spent far too long discussing the first bullet, showing poor planning. This left them with too few words to properly address the later points, particularly bullet 4 which should have formed almost half the report as it carries 10 marks.

Other points relating to bullet 1:

- Most scored well. Candidates find 'give an account' tasks relatively straightforward.
- There were a large number of technical errors in equations and structures. Commonly, the 'n' before monomers or 'n' subscript in a polymer were missing in equations. Also bonds in structures were often drawn carelessly to the 'H' atoms in CH<sub>2</sub> groups. Such errors counted as 'technical errors' and lost marks for communication under C2b.
- Candidates copied out material from the articles, which only gives access to the lower grade marking points. They were asked to compare the similarities and differences between rubbers. Many did not clearly do this.

**Teacher's tip**

Set this paper as a homework task. Ask the students to tackle the first bullet point only. Mark it for technical errors and look to see that they have planned to cover the information in about 200 words. Look also for a clear comparison of similarities and differences rather than 'copied' extracts. Use the outcome as a teaching tool to show the importance of proper planning and attention to correct use of structures.

**Bullet point 2**

This section linked closely to bullet 1 but led on to the process of vulcanisation. The bullet specifically asked candidates to discuss properties linked to structure. Some candidates supported their work by referenced chemical detail taken from the course books – this earned them marks. Again, copying out the articles only gives partial access to the marks.

**Teacher's tip**

Students should cross-check the course text book for each chemical concept mentioned in the bullets (e.g. structure and properties of polymers). Additional chemical points can easily be scored by including a brief outline of the underlying chemistry.

Some candidates provided extra chemical information that had been researched from other sources, such as the full structures of vulcanised rubber. This is exemplary; research should be focussed on the chemical content of the articles. Candidates who include 'technical' research e.g. flow charts for industrial processes of vulcanisation, do not gain additional marks as such information is not relevant to the bullet task.

### Bullet point 3

This was intended to be very straightforward. Candidates needed to produce charts or tables to summarise the benefits of using synthetic rubbers and of using additives. However, marks were lost because so many merely copied out **Table 2** from **Article 1**. Copying sections in this way does not earn marks; marks were only awarded where there was evidence that the candidate had processed the information e.g. by producing an original table. A straight copy of **Table 2** counted for a diagram mark in communication C4, but did not earn any marks in the main report. Some gave the information as 'prose'. Information presented as prose gained only partial credit.

### Bullet point 4

This bullet carried the largest mark allocation. The marking points mainly counted towards the 12 evaluation marks available in the mark scheme. Marks were generally poor for this section for the following reasons.

- Many candidates had not planned their word count properly, so had 'run out of words' and needed to condense this bullet into too few words. At 10 marks, this bullet should have been given about 400 words of the report.
- Some candidates appeared to have 'rushed' this section. Clear points in the articles had not been 'lifted' into the reports.
- In discussing the use of 'non-renewable resources' the language used was often too vague to score. Candidates find it more difficult to make evaluation points clearly. For example 'recycling tyres saves non-renewable resources' is a rewording of the bullet (no marks). More detail was needed such as 'using carbon from tyres to make activated carbon saves coal and peat which are non-renewable'.

#### Teacher's tip

Students should use as many equations/structures/diagrams from the original articles as possible – these often score chemistry or evaluation points as well as going towards the 'equation and diagram' marks (C3 and C4). Remember they are 'word count free' – they do not 'count' towards the word count.

Remember to include any important information in separate sentences above the equation – if marking points are scored directly from an equation, that equation does not 'count' towards the equation mark.

### 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:

- failing to provide a list of sources;
- 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;
- 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;
- 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 e.g. about recycling or using additives in tyres rather than focussing on the chemical reactions in the report.
- Using vague sentences e.g. 'rubbers are all made from polymers' rather than 'most polymerisation reactions to form rubbers are addition reactions'. 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...

- Candidates who had spent too much time on bullet 1, and too little on bullet 4, lost marks under C1.
- 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 wrongly that are given in the report, many of which would be identified if the candidate ran a spell check.
- Technical errors in equations often lost both C2b marks (see discussion of bullet 1). Again, candidates need to check that they copy structures carefully.
- A surprising number of candidates did not use enough diagrams, formulae or equations to score the easy C3 and C4 4 marks.

## 2852/02 – Skills for Chemistry: 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', 'Comparing the enthalpy of combustion of different alcohols', and 'The determination of the solubility of calcium hydroxide'. Some Centres used activities that were of lower demand such as the use of an acid-base titration without the need to make up a standard solution or to dilute one of the solutions. This limited the ability of candidates to access the higher mark levels. Where a Centre designed activity is used, instructions given to candidates and a detailed mark scheme should be supplied with the moderation sample.

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 tick list of practical techniques to support the marks awarded for the manipulation strand of the implementing skill area and the Centre Authentication Form (CCS160) with the work sent 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 sometimes resulted in the award of higher marks than would have been the case if the correct descriptors had been used.

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. Centres which used a 'tick list' of the key descriptors to match against candidates' work avoided this problem.

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.

*There were a reduced number of cases in this session where the marks awarded by the Centre were too generous and outside of the tolerance allowed by OCR. There were 66 Centres (13%) in this category compared to 79 Centres (17%) in the June 2005 session.*

### Teacher support booklets

Two booklets have been published by OCR to support teachers in setting and assessing coursework.

'*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.

There was a significant increase in candidates 'cutting and pasting' web addresses to describe sources they had consulted. It is expected that candidates will include a short description of the content of the web site in addition to the web address to satisfy the descriptors at level 11.

#### Common problems in planning included:

##### Titration

- 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 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. 25 cm<sup>3</sup> or 1000 cm<sup>3</sup>
- 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 °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  $\text{cm}^3$  rather than 'mls'.

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.

## 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.

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.

## 2854 – Chemistry by Design

### General Comments

Many candidates showed a good understanding of the very varied and synoptic Chemical Ideas in this unit; some were limited by their lack of examination technique. Candidates answered well on spectroscopy and many explained the origins of colour effectively. Answers on buffer solutions and solubility were more mixed and the question on structure and bonding caused many problems. Calculations were often well done and quality of written communication in longer answers was quite good. There were few empty spaces.

### Comments on Individual Questions

- 1 This provided quite an easy start for most candidates. Most scored on part (a) and on (b)(i), though in part (b)(ii) marks were sometimes lost by inaccurate expression. Key words were 'molecules' (or particles), 'colliding' and 'activation enthalpy', though answers that talked about the activation enthalpy being 'overcome' seldom gained full credit. Part (c) raised few problems. Some candidates did not understand the thrust of part (d) and some answered on a small scale: 'matches' or 'flints'. Part (e) was usually well done, as was part (f), though there was a small but significant minority who thought that the pressure they had (correctly) stated in part (i) was 'not very high'. Part (g) was well done as was part (h), most candidates realising that they had to mention that we eat the plants (or something similar). Part (i) was surprisingly badly done and some attention needs to be paid to this area. A significant minority of candidates failed to name the type of bonding correctly – metallic or hydrogen bonding being popular. This made scoring further marks difficult. Others described ionic bonding in terms of intermolecular forces or failed to mention that it was the ions that were hydrated. Relatively few said that the ions moved in describing conductivity and some said that ionic substances had free electrons.

*Numerical answers: (a) 0, +2; (c)(ii)  $1.3 \times 10^{-6}$*

- 2 This was one of the harder questions for many candidates. Many failed to score full marks in part (a) and quite a number put the double bond at the opposite end to the carboxylic acid group in part (b). Part (c)(i) was usually correct but most failed to give the starting colour in part (c)(ii), and quite a few tripped up with the perennial misuse of 'clear'. The calculation of the iodine number in part (c)(iii) was tricky but well laid-out answers were able to gain partial credit and many did. Significant figures let a few down, but fewer than usual. In part (d), candidates found it hard to express themselves fluently. In part (e) a large number failed to realise that a skeletal formula was required, though most got the structure right. Part (f) was often quite well done, though again clarity of expression was sometimes lacking. An easy point that was usually missed is that both cholesterol and octan-1-ol are virtually non-polar and hence dissolve in each other.

*Numerical answer: (c)(iii) 465*

- 3 This question was quite well done. Part (a) was surprisingly poor with very few referring to the effect of hydrogen ions on the equation given. Part (b) was usually good. Parts (c)(i) and (d) were of high demand but the better candidates did well here. Part (c)(ii) was more routine and was often answered well. Part (e) had several marking points that are often seen on this paper and many candidates did well. The extra part was relating the larger chromophore in **form B** to the absorption of visible light. Those who answered in terms of wavelengths rather than frequency often got confused and a handful confused **form A** and **form B** half-way through their answer, with unfortunate loss of marks. Fewer cases of 'emission' of light were seen than in previous sessions. The quality of written communication mark was usually scored but candidates are advised to write in short sentences for such parts. Part (f) was reasonably done, though parts (iii) and (iv) were found harder than expected.

- 4 This long question attracted some good marks from many candidates. Most scored in part (a), though “ecf” had often to be used through part (b) and many fell into the ‘kJ trap’. Quite a number answered both parts (ii) and (iv) in terms of thermochemistry, rather than entropy. Parts (c) and (d) were usually well done, indicating a good understanding of weak acids and pH. Part (e) was reasonably done, though relatively few scored the high-level mark for realising that a buffer solution only works because the concentration of both acid and conjugate base are high. Some contradicted a previously correct answer by adding  $A^-$  instead of alkali. The buffer calculation in part (e) (ii) was often well done. It was pleasing to see the quality of many answers to part (f). Some failed to give enough detail, for example not saying that the ‘peak of highest mass’ of value 192 corresponded to the  $M_r$  of citric acid. Most wrote in correct chemical terminology and scored the two quality of written communication marks.

Numerical answers: (b)(i) +540; (b)(iii) +305  $J K^{-1} mol^{-1}$ ; (d)(ii) 2.6; (e)(ii) 3.4

- 5 This question was found hard by some candidates who had previously done well, and *vice versa*. It did test a variety of basic chemical points. Most scored on part (a), provided they mentioned that the ‘VI’ referred to the oxidation state of chromium, not ‘it’ or ‘chromate’. Many tried to write a full equation in part (b), and often not very successfully. Part (c) was very variable but most scored both marks in part (d) and the mark in part (e)(i). Part (e)(ii) was usually well done, though many failed to draw a sufficiently detailed diagram of the energy levels in an atom and some failed to relate the energy change to the frequency. Almost every candidate correctly identified cadmium for the first mark in part (e)(iii) but there were a good proportion of ‘cadmium sulphate’, ‘cadmium sulphur’ or ‘cadmium yellow’ for the systematic name. Part (f) was often well done. Those who decorated the diagram with extra data lost marks if this was incorrect. Many scored on part (g)(i), but in part (g)(ii), the commonest error was to name the ionic product as  $K_{sp}$  which contradicted this mark. Others compared the numbers incorrectly as they were confused by the negative indices. In part (iii) there were many wrong suggestions (e.g. ‘sodium chromate’) as well as ‘barium chromate’. Those who identified lead chromate nearly always scored the mark for the reason as well.

## **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.

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

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.

In some cases, the limited scope of the investigation suggested that far less time had been spent on the practical work than the 15 to 20 hours indicated within the specification. This invariably reduces the marks available to candidates.

Some Centres used an out-of-date mark scheme which 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 focused on the general performance of candidates rather than relating performance to the coursework descriptors. In a minority of cases, annotation of candidates' 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.

There were an increased number of cases in this session where the marks awarded by the Centre were too generous and outside of the tolerance allowed by OCR. There were 80 Centres (17%) in this category compared to 50 Centres (12%) in the June 2005 session.

#### **New teacher support booklets**

Two booklets are published by OCR to support teachers in setting and assessing coursework.

'*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.

### **Comments on Individual Skill Areas**

#### **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, some 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 risk assessment and 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, 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. 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.

#### **Some useful planning strategies**

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.

#### **Quality of recorded data**

The 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.

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 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. 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 2006 Assessment Series**

**Unit Threshold Marks**

Unit		Maximum Mark	a	b	c	d	e	u
2848	Raw	90	63	54	46	38	30	0
	UMS	120	96	84	72	60	48	0
2849	Raw	90	61	54	47	41	35	0
	UMS	90	72	63	54	45	36	0
2850	Raw	75	58	50	43	36	29	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	90	79	69	59	49	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 (*i.e.* after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
<b>3887</b>	300	240	210	180	150	120	0
<b>7887</b>	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
<b>3887</b>	19.8	39.8	59.2	75.0	87.8	100.0	9171
<b>7887</b>	28.5	52.3	72.8	87.6	96.7	100.0	6637

For a description of how UMS marks are calculated see;  
[www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp](http://www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp)

Statistics are correct at the time of publication.



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**Head office**  
**Telephone: 01223 552552**  
**Facsimile: 01223 552553**

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