

Chemistry

Advanced GCE **A2 7882**

Advanced Subsidiary GCE **AS 3882**

Report on the Units

June 2008

3882/7882/MS/R/08

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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Advanced Subsidiary GCE Chemistry (3882)

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Chief Examiner's Report

General Comments

This June's session continued to see entries rise across all units. For AS-level aggregation, entries increased from 14,835 in June 2007 to 15,165 for June 2008. For A-level aggregation, entries increased from 11,113 in June 2007 to 11,473 for June 2008. For *Chains and Rings* and *How Far? How Fast?*, the entries continued to exceed 20,000.

The overall standard of work continues to improve across most units. As in previous sessions, the most popular optional units continue to be *Biochemistry* and *Transition Elements*, with the strongest cohort of candidates taking *Transition Elements*.

Detailed comments follow on the performance of candidates in each unit assessed in June 2008.

This session is the last large AS entry for the legacy (3882) specification. Note that legacy AS units (2811–2813) are offered for the last time in June 2009. From September 2008, all new candidates embarking on a two-year A level programme must study the new specification (H034/H434). It must be noted that the new specification contains several important changes from the current specification. There are now only two theory units in each of AS and A2. The third unit for AS and for A2 is a separate practical unit. All new units have been completely revised and the arrangements for the assessment of practical skills have been extensively revised.

Further details of the new specification and changes to assessment arrangements are available from the OCR web site:

www.ocr.org.uk/qualifications/asa_levelgcceforfirstteachingin2008/chemistry_a/index.html

There is no facility to mix and match units from the legacy (3882/7882) and new (H034/H434) specifications.

AS units for the legacy (3882/7882) specification will still be offered in January and June 2009 to allow next year's A2 candidates an AS re-sit facility. No legacy AS units (2811–2813) will be offered beyond June 2009. Next year's A2 candidates will have a similar A2 re-sit facility for the legacy (3882/7882) specification in January and June 2010.

Entry to modules

For the academic year, 2008–2009, the following codes should to be used for entry.

AS candidates

For **candidates starting Chemistry AS (H034)** in September 2008

Not for candidates taking A2 units in the legacy (3882/7882) specification

F321	Atoms, Bonds and Groups	January 2009 and June 2009
F322	Chains, Energy and Resources	June 2009
F323	Practical Skills in Chemistry 1	June 2009

In subsequent years, F321 and F322 will be available for entry in both January and June sessions

A2 candidates

For candidates planning to **complete the full legacy A level (7882) in June 2009**.

This will also include any '**one-year' candidates** intending to study chemistry A level in the single year 2008–2009.

AS

- 2811 Foundation Chemistry
- 2812 Chains and Rings
- 2813 A How Far? How Fast? + Coursework
- 2813 B How Far? How Fast? + Carry forward coursework mark
- 2813 C How Far? How Fast? + Practical exam

A2

- 2814 Chains, Rings and Spectroscopy
- 2816 A Unifying Concepts + Coursework
- 2816 B Unifying Concepts + Carry forward coursework mark
- 2816 C Unifying Concepts + Practical exam

Options

- 2815 A Trends and Patterns + Biochemistry
- 2815 B Trends and Patterns + Environmental Chemistry (*June entry only*)
- 2815 C Trends and Patterns + Methods of Analysis and Detection
- 2815 E Trends and Patterns + Transition Elements

INSET events for new GCE Chemistry A, for first teaching from September 2008

OCR AS Level Chemistry A (H034): *Get Started – towards successful delivery of the new specification.*

These **new full day** courses will give guidance and support to those planning to deliver the new AS/A level Chemistry A (H034) specification.

Course dates and codes – Tuesday 23 September 2008 (London, OSCD201), Wednesday 1 October 2008 (Birmingham, OSCD202), Thursday 2 October 2008 (Leeds, OSCD203), Tuesday 7 October 2008 (Cardiff, OSCD204), Wednesday 8 October 2008 (Taunton, OSCD205), Tuesday 14 October 2008 (Durham, OSCD206), Wednesday 22 October 2008 (London, OSCD207).

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

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

INSET cont'd.

OCR A2 Level Chemistry A (H434): *Get Started – towards successful delivery of the new specification.*

These **new full day** courses will give guidance and support to those planning to deliver the new A2 level Chemistry A (H434) specification.

Course dates and codes – Friday 13 March 2009 (Birmingham, OSCD401), Wednesday 18 March 2009 (London, OSCD402).

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

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

2811 Foundation Chemistry

General Comments

In general, this paper revealed a strong cohort of candidates who appeared rather better prepared than in previous years to answer the sort of questions that they might expect to encounter in this exam. The ability of candidates to present arguments in a logical way has certainly improved over the years and it was impressive to see the reasoned answers that a question such as 2(c) produced and in particular by the approach of candidates in answering 4(b). It was also pleasing to see how many candidates had put in the groundwork in preparing for the paper and had clearly learned a number of set answers. This was first apparent in the responses to 1(d) (i) where although the change to relative molecular mass threw many candidates nevertheless many had learned the definition for relative atomic mass and so still gained two of the three marks that were available here. Again the same happened in 3(b) (ii) where almost no candidates attempted to explain the reaction of chlorine with water but most were able to recall the chloride ion test using silver ions. Of course, relying too heavily on these set pieces has its downside as was experienced by the candidates who in 2(c) contradicted themselves when it came to describing the trend in atomic radius across the period. Finally a comment should be made about the number of relatively strong candidates who, as part 4(a) revealed, are comfortable to write the formula of calcium chloride and calcium hydroxide as CaCl and CaOH, respectively. It is so important that these aspects of basic chemical literacy are secure and such a shame to see otherwise good candidates losing marks at AS level for something so straightforward.

Comments on Individual Questions

- 1) (a) Virtually every candidate got off to an excellent start with this straightforward opening question.
- (b) This part was certainly more challenging than part (a) but again the vast majority of candidates clearly knew how to handle such a calculation. There were of course a few who slipped up and did not give the answer to the required number of decimal places but these were pleasingly few.
- (c) Many and varied were the ways in which candidates sought to convey the idea of metallic bonding but here again the answers were usually correct with most candidates collecting both marks. The most common error was to label the metal ions either as nuclei or atoms. A few candidates chose to draw a closed packed arrangement of ions surrounded by electrons and so didn't gain the first mark.
- (d) (i) Answers to this part of the opening question were a little disappointing. Most candidates had clearly learned the definition for relative atomic mass but the change to relative molecular mass revealed how little the majority of candidates really understood the origin of the definition they had memorised. Consequently, it was rare to award the first mark and candidates had to make do with the two marks associated with references to one-twelfth the mass of carbon-12.

(ii) There was a rather mixed bag of responses to this question. The majority of candidates were able to use the relative atomic masses of indium and chlorine and so deduce the correct empirical formula to be InI_3 . Some candidates used the atomic numbers in place of the atomic mass while a few made the much more serious error of simply taking the ratio of the percentages they were given. What was slightly surprising was that many candidates having reached InI_3 by

various means gave this as the overall answer and made no effort to convert this into the molecular formula.

- 2) (a) Although at face value this may look a relatively straightforward question what became apparent when marking the scripts was that a candidate's performance here correlated highly with their overall performance in the paper. Of the various parts candidates found (iv) and (v) the most challenging. It is also noteworthy how even good candidates who scored well elsewhere on the paper failed to pick up marks on the more straightforward parts of this question. This shows how often the candidates' grasp of the fundamental points can be less sound than we imagine.
- (b) (i) In the main this was well answered. Most candidates sensibly chose easy examples such as NaCl and picked up both marks.
- (ii) Again this part provided relatively easy marks. What was perhaps a little surprising was how many candidates chose more complex examples such as CO₂ or even CO rather than straightforward molecules such as H₂O. The commonest error was to see drawn a 'dot-and-cross' diagram of a molecule of an element rather than a compound. When correct this was credited with one mark only.
- (c) In the main this question produced a very strong set of responses. Of the four marking points that which was forgotten the most often was either the idea of the electrons being in the same shell or of the nuclear attraction increasing. Some candidates having stated correctly that the radius decreased then went on to contradict themselves by talking about the shielding and distance remaining the same. Others confused this trend with that in first ionisation energies with a consequence claimed increase at Group 3. This highlights the danger of regurgitating learned answers.
- 3) (a) Weak to middle ability candidates found this question difficult. In contrast, able candidates solved the whole question with ease. The question itself was relatively dense with information and it was clear from the working that in many cases candidates were unable to extract the pieces of data they needed for each part.
- Thus in part (i) even when candidates did eventually arrive at the correct answer, unnecessary calculations, for example involving the relative molecular mass of chlorine, could often be discerned beneath the crossing out. Undoubtedly the same candidates would have flown to the correct answer had they only been told the volume of chlorine gas and that volume which is occupied by one mole.
- Part (ii) was rather poorly answered. Many candidates made the link to the answer to part 3(a)(i) but were unable to convert the number of moles into the correct concentration. A significant number, however, did not use their answer to part 3(a)(i) at all.
- Part (iii) also presented candidates with a significant challenge. Most were able to work out the initial amount of HCl but for a significant number this proved to be their only mark in this question. Of those who ventured further the most common mistake arose from errors involving the stoichiometry of the equation. Some candidates forgot to double their answer from part 3(a)(i) while others chose to double the initial amount of HCl.

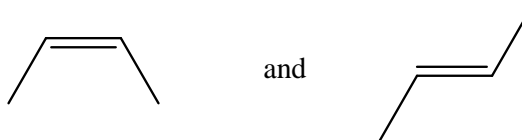
- (b) (i) Most candidates handled this question well and the majority of those who gave an equation picked up both marks. Those who give an incorrect equation or failed to give an equation at all often gave descriptions in a confused way about displacement reactions and muddled halogens and halides, thus failing to pick up a mark.
- (ii) Most candidates focussed exclusively on the need to explain the formation of a white precipitate. Thus now on familiar territory, a good number were able to produce ionic equations for the formation of silver chloride. A significant number of candidates, who did not identify AgCl as a solid in their ionic equation, also failed to make sufficiently clear that the white precipitate was indeed silver chloride. In considering the reaction of the chlorine, some candidates suggested that it would undergo a displacement reaction with silver nitrate presumably confusing chlorine with chloride. Small indeed was the number of candidates who stated the correct reaction of chlorine with water. The difference between chlorine and chloride is beyond many candidates and commonest error seen was an equation between Ag^+ and Cl_2 to produce a 'precipitate' of AgCl_2 .
- (c) (i) This was well answered. Some candidates stated that electronegativity was the attraction of electrons in a bond but forgot to comment on what was attracting them; others forgot to point out that electronegativity considers bonding electrons. Many candidates, however, had clearly learned the correct definition and were rewarded with both marks.
- (ii) In the main this was well answered. Candidates chose from the full range of possible ways of representing bonds in three dimensions using solid, open and dashed wedges, and dashed lines. Few candidates gave incorrect bond angles.
- (iii) Identifying chlorine as being more electronegative than H or giving the correct partial charges was a reasonably easy request and the vast majority of good candidates picked up this opening mark. The case of CCl_4 proved much more difficult. A large number of candidates approached the problem by likening CCl_4 to a hydrocarbon and so concluded that the lack of a dipole arose from the very similar electronegativities of carbon and chlorine. Few candidates were able to say that the dipoles in each individual bond would cancel and even fewer were able to say that this is because of the symmetrical nature of the molecule. Weaker candidates approached the question by discussing intermolecular forces and often failed to pick up any marks here.
- 4) (a) Most candidates moved quickly to gain the marks for identifying CaO , CO_2 and H_2O but from here the performance of the candidates became rather patchy. As in previous years it was depressing to note how even able candidates are comfortable with writing CaCl or CaOH . The identification of $\text{Ca}(\text{HCO}_3)_2$ proved by some margin to be the hardest mark to obtain.

- (b) Generally it was very pleasing to see how strong the answers were to this closing question. Most candidates gave correct equations although some forgot the state symbols. A reasonable number of candidates did not gain a mark available for identifying that two electrons are being transferred from each calcium to each oxygen atom. Although occasionally it was clear that some candidates thought it was only a single electron, this was usually an oversight of the candidate to go into a sufficient level of detail. When it came to describing the trend in reactivity down the group many candidates gave excellent answers and more than this they presented their argument in a very clear and logical way. Even candidates who scored less of the marking points still wrote in a very clear way that was easy to follow.

2812 Chains and Rings

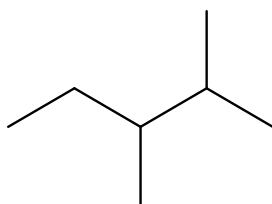
Comments on Individual Questions

- Q1 (a) Straightforward with many scoring all four marks. Common errors included:
- (i) C_3H_{16} instead of C_6H_{16}
 - (ii) molecular formula instead of empirical formula
 - (iii) many variations on hexan-2-ol
 - (iv) bromine instead of HBr
- (b) The improvement in accurately describing mechanisms continues with many candidates scoring 4/4. It was surprising to see a high number of ethene based intermediates. Surprisingly many weaker candidates expecting to see 'bubbles' when bromine is added to the alkene.
- (c) Poorly answered, with only the most able scored both marks.
- Q2 (a) Straightforward recall, although a considerable number failed to score the mark.
- (b) Six easy marks for the careful candidate. Many lost marks by careless slips in names or the drawing of structures/bond linkage.
- (c) Proved to be difficult. Many struggled to restrict hydrogen bonding to the hydroxyl group and many incorrectly drew the H-bond to the alkyl hydrogens.
- (d) Generally well answered.
- (e) Interpretation of the spectrum proved to be more difficult than in the past. The peak at around 3000 cm^{-1} was often misinterpreted as being indicative of the O–H bond not being present. As in previous papers the balanced equation for the oxidation of an alcohol to a carboxylic acid proved to be difficult. Many tried to use molecular formulae for the alcohol and the carboxylic acid and they would have been better advised to use structural formulae.
- Q3. A simple straightforward question but very few scored full marks. Part (a) was generally well answered but in (b) many/most ignored the instructions to draw skeletal formulae and those that did often didn't include the double bond. It was rare to see



- Q4 (a) In the previous question, skeletal formulae seemed to present a problem but in part (a)(i) they seemed to make the question more accessible. In the past drawing isomers has always proved to be difficult but not so this time. Many candidates scored the marks by accident rather than by design. The geometry was often poor but it was not penalised.

It was not uncommon to see



drawn as



which despite the poor geometry gained the mark.

- (a) (ii) required precision and care and (iii) was an easy mark for most candidates.
 - (b) Able candidates scored both marks but many didn't show an unambiguous formula/structure for cyclohexane and lost a mark. A substantial minority wrote equations for cracking rather than for reforming.
 - (c) (i) Very straightforward but many did not quote their answer to three significant figures
(ii) The equation proved to be demanding with very many ignoring the oxygen already in the alcohol. Able candidates picked up both marks.
 - (d) Many confused volatility with viscosity and lots associated gases with 'danger' and 'explosions'.
- Q5. (a) Candidates fell into one of two categories and scored either very high marks or very low marks. Many left the whole page blank. Weaker candidates seemed to be taken aback with the question and were clearly not expecting it. Part (a) was straight recall from the specification; 5.2.6 (a) and (e). Able candidates scored well by simply using three equations and by giving exact details of the reagents and conditions. The quality of written communication was allocated for the correct usage of two or more chemical terms in the correct context.
- (b) The response to this mechanism was more polarised than the response to the mechanism in Q1 (b) and only the most able scored maximum marks. Many elected to use a random mechanism of their choice rather than follow the instructions in the question.

2813/01 How Far? How Fast?

General Comments

It was evident that the vast majority of candidates were well prepared for this unit test and very few scripts with significant gaps were seen. The paper proved accessible so that correct answers were seen to all parts of all questions.

Perhaps not surprisingly most candidates coped well with the 'standard' style explanations and calculations that appear on this paper but it was pleasing to note how well more able candidates answered the less traditional questions. There were several examples in the paper where candidates were given the opportunity to apply their knowledge of the basic concepts to solve problems in less familiar contexts and many impressive answers, using logical chemical arguments, were seen. Examples of questions to which this applied are discussed in the comments below.

Comments on Individual Questions

Q1 (a)(i) This was the only formal definition that needed to be quoted and it was disappointing how few candidates scored both marks. Most candidates did recognise that all similar definitions are based on the use of 1 mole so that this was generally stated but often it was a mole of something other than a particular bond. One mole of compound or of atoms or of molecules was frequently quoted.

(ii) Most candidates approached this calculation correctly so that, even if an arithmetic error resulted in full marks not being awarded, it was rare for some credit not being given. Some candidates were confused with the sign of the bonds broken and bonds made.

Ans: $-1276 \text{ kJ mol}^{-1}$

(b)(i) Many correct answers were seen but candidates would be strongly advised to draw a logical cycle so that the numbers they write follow the chemistry involved. It can be difficult to give credit for answers that involve numbers apparently appearing from nowhere.

Ans: $-2807 \text{ kJ mol}^{-1}$

(ii) Most candidates were able to recognise respiration.

Q2 Candidates sometimes seem to confuse the effect of changing conditions on rate and on an equilibrium position but, on this occasion, these were separated so that this was less of a problem than has been seen in some previous sessions.

(a) In the consideration of the effect on the equilibrium position candidates, almost without exception, recognised that the use of Le Chatelier's principle was needed and generally applied this satisfactorily to explain the change in colour when the temperature was increased. However the consideration of the change in colour when the pressure was increased was an example where more able candidates showed they really understood the concepts involved and less able ones tended to contradict themselves. It was clear that most recognised that they needed to

consider the number of moles of gas on each side of the equilibrium and many stated that this meant that an increase in pressure would not affect the equilibrium position. Weaker candidates often then tried to move the equilibrium to the left hand side but it was pleasing to note some well thought through explanations of the phenomenon described.

- (b)(i) Candidates generally recognise the link between collision frequency and rate of reaction. In the consideration of the effect of temperature it was necessary to point out the significance of exceeding the activation energy to be awarded both marks.
- (c) To successfully answer this question, candidates needed to interpret the data given graphically and many did so successfully. A few answers involving increases in temperature/ pressure or the addition of a catalyst were seen but most recognised that additional hydrogen must be present to give the curves shown.
- Q3 (a) Most candidates were able to label the Boltzmann distribution diagram correctly and only a few showed confusion between the effect of adding a catalyst and the effect of changing the temperature by drawing an additional curve.
- (b)(i) Most candidates recognised that the loss in mass was due to a gas being given off but answers suggesting that the reason was that the zinc dissolved or that heat was lost were seen.
- (ii) Most candidates recognised that the rate of reaction would be faster and therefore drew a line below the original. Far less realised that the line must reach the same horizontal line at the end of the reaction.
- (c) Apart from a few diagrams showing an endothermic reaction, most enthalpy profile diagrams were correct. The calculation of the activation energy for the reverse reaction did however give more problems with every combination of 120 and 250 being seen.

Ans: 370 kJ mol^{-1}

- Q4 (a)(i) Candidates who explained the conditions logically, considering both yield and rate, scored well. Others knew that compromises were needed but did not explain why scored less well. The connection between increased pressure and increased rate was the point that was most commonly omitted.
- (ii) Whilst some well-explained answers were seen, many candidates tried to use fractional distillation in some way so that a liquid mixture was heated. Some candidates appeared confused about which boiling point was highest.
- (iii) Most candidates correctly described recycling of the unused hydrogen and nitrogen
- (b) Many candidates were able to give an acceptable equation for the addition of an acid to ammonia but correct equations for the reaction between phosphoric acid and ammonia were limited to the most able. Candidates did not appear to recognise that the phosphate ion is $3-$ and so did not give a correct formula for ammonium phosphate.

2813/02 Practical Skills in Chemistry 1

General Comments

Most Centres entering candidates for the Coursework option have been doing so for many years and have well-established procedures for ensuring that the published criteria are adhered to. Such Centres provide the Moderators with the easy task of agreeing with the levels awarded and endorsing their marks. Nevertheless there still remains a small group who either seem to ignore the guidance provided by OCR or who over-value their Candidates' work to the extent that all the marks lie close to the limits of the tolerance allowed. The latter group is a real concern since it is all too easy for that tolerance to be exceeded triggering a change to the marks submitted. It needs to be emphasised that, although a measure of professional judgement may have to be used, there are many criteria which must be regarded as absolute. An example is the necessity at P7a to provide references which are at least to the chapter of a book or beyond the first '/' of an internet reference. In the introduction to the planning exercises this is clearly indicated to the Candidates.

Another general issue concerns listing the hazards that may occur during the course of an experiment. This is required for the award of I7a. General laboratory procedures such as wearing safety glasses are not what is required; neither are statements from Hazcards covering every conceivable risk. The intent is that candidates will consider the risks that may be involved using the chemicals in the context of the experiment that they are about to do.

It was mentioned in last year's report that there was a growing tendency for Candidates to round numbers too early in their calculations. It is worth emphasising again that if this is done it leads to an erroneous answer which cannot be accepted even if the calculation has otherwise been completed correctly. Occasionally Candidates reduced a number to two significant figures at an intermediate stage in a calculation and then quoted the final answer to three.

The award of a mark for the use of spelling, punctuation and grammar must also be taken to cover the correct use of super- and subscripts. This can be an issue if Candidates choose to word-process their scripts and P7a cannot be obtained if there are persistent errors in the quotation of chemical formulae.

When evaluating experiments many candidates include failings due to the incorrect use of apparatus or their own mistakes in handling chemicals and equipment. These should not be included. Evaluations should be restricted to errors inherent in the procedures used and the measurements made.

There remain two points which, although not directly relevant to the award of marks are worth mentioning. Chemical names should not begin with capital letters. Scales are no doubt used in the home but in the laboratory balances are employed to weigh substances.

AS

Nearly all Centres used the exemplar experiments this year but there were a surprisingly large number who did not issue their Candidates with the proformas provided. In many cases it was felt that this was a significant disadvantage since the guidance that these provide (especially in the Evaluation) directs their answers to the points that will gain marks.

The 'Which equation is correct?' experiment was probably the most popular choice for the assessment of skill P. Although it was often well done it is a pity that so many pluck a random mass of copper carbonate out of the air and then calculate the volume of gas that would be produced rather than starting with what would be an appropriate volume and working backwards to the mass. The 'Limewater' plan was also used widely but it should be mentioned that a mark

Report on the Units taken in June 2008

for describing the dilution cannot be awarded if the volume of the 2 mol dm^{-3} hydrochloric acid could not be accurately measured – for example 3.375 cm^3 .

Skill I experiments were often well done but there were the usual issues of Candidates failing to provide initial burette readings or forgetting to include units. The issue of units is also still apparent in the assessment of skill A and candidates continue to be cavalier in their approach to what is necessary. A common, if perhaps less serious, error is to put Kj mol^{-1} instead of kJ mol^{-1} .

As always, skill E tends to identify those Candidates who have a more mature grasp of experimental procedures and the work seen continued to emphasise how important it is to give them plenty of practice before attempting the assessment.

2813/03 Practical Examination 1

General Comments

The standard of most scripts was pleasing and a majority of candidates were able to make a reasonable attempt at most parts of the paper. More candidates than usual were able to achieve very high marks, but there were also those who obtained very low marks. As usual, the Evaluation proved to be the most demanding section of the paper. Centres are reminded that good quality results from Supervisors are an essential part of the assessment process. In a small number of cases, it seemed likely that the quality of data submitted by the Supervisor was poor.

Comments on Individual Questions

Plan Most candidates, even weaker ones, were able to pick up many of the marks for the basic aspects of the Plan. Certain marking points were, however, often omitted. Many candidates did not dilute the sulphuric acid before using it in the titration: it is customary to use solutions that are around or below 0.1 mol dm^{-3} . Justification of quantities needed in a procedure is a high level skill. Many candidates, even if they are able to produce relevant figures, are not always able to explain clearly the significance of their figures. During a titration, the target volume of solution used from the burette should be between 20 and 30 cm^3 . It was disappointing that many candidates quoted the indicator colour change the wrong way round, especially if they had chosen to put the acid into the burette for the titration.

The gas collection experiment was generally described well. Diagrams drawn by hand should make use of a ruler, should be labelled and should be of a reasonable size. When calculating what quantities they would use, relatively few candidates explained the significance of the capacity of the syringe (or whatever collecting vessel they were using). Some candidates omitted the precaution of separating the reagents inside the flask to prevent premature start of the reaction and consequent loss of gas. It was encouraging to note that an increased percentage of candidates were aware of the need for excess metal or metal carbonate in this procedure, and that many were able to calculate what the minimum mass needed would be.

Most candidates wrote up their Plans well and scored both of the quality of written communication marks. However, some failed to state a word count and others were careless in their precise use of units and chemical formulae. The quality of most word-processed Plans continues to be high, though it would be even better if all candidates had learned how to print sub- and super- scripts. The use of internet sites as secondary sources continues to grow, though not all candidates are adept at selecting only relevant material from them.

Test Part 1 Many candidates scored very highly on page 3, particularly on the accuracy marks for the titration carried out, where it was common for all 7 marks to be earned. Some candidates remain careless with their presentation of data. **B** Weaker candidates sometimes fail to use appropriate significant figures and quote units. A small number of Centres do not train their candidates to record all titration data (not merely the titre value itself). Some candidates did not read the safety question carefully enough: the context was a comparison of the hazard level KOH in solid and aqueous form.

B Part 2 A disappointingly large number of candidates were unable to calculate the mass of pure KOH in 5.50 g, given its 86% purity. However, most were able to proceed with the rest of the calculation with some degree of success, because 'error carried forward' marking is always applied in the Analysing sections of this Paper. A few candidates showed a serious disregard for the importance of significant figures: sometimes answers were all rounded down to one, rather than the three required by the rubric. By **(f)** the calculation was becoming more demanding. Many candidates worked out the inverse ratio to the one required at this point. Good candidates were then able to move successfully on to **(g)** and to explain the 1:1 mole ratio in the correct equation. However, very few candidates were able to answer **(h)** correctly. '3' was the common answer, despite the clear and correct responses often given in **(g)**. **(cont)**

Part 3 The Evaluation section proved challenging as always, particularly in view of some novel material that was included. In **(a)**, most candidates were able to attempt the calculation, although the majority wrongly assumed a 1:1 reacting mole ratio in the calculation. Very few applied their answer to 2(g) to this question. Discussion of errors in **(c)** was often poor, even though a wide variety of responses were credited. The most frequently suggested good answers discussed oxide layer on the surface of Mg, the very small mass of acid weighed out and avoiding escape of gas before the bung could be fitted. Part **(d)** proved difficult. Many candidates were aware that a ratio approach would be necessary, though inability to understand significant figures often led them to the wrong conclusion about the need for further repeats. As usual, many candidates were unclear about the meaning of "reliability" in the second half of this question

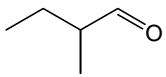
2814 Chains, Rings and Spectroscopy

General Comments

The paper produced a good range of marks with a significant number of centres preparing their candidates very well. The paper contained a mixture of familiar material and problem-solving questions designed to give more able candidates a chance to show their ability at the subject. It is pleasing to see that the more able candidates clearly enjoy solving the spectroscopic problems. Some candidates found the problem-solving questions difficult, although it was good to see most having a good attempt. Most candidates seemed to finish the paper in the time allowed although a few looked like they may have been a little rushed at the end.

Comments on Individual Questions

Q1

- (a) A straightforward start to the paper. Most candidates knew that Tollens' reagent gives a silver mirror with an aldehyde. Other suitable mild oxidising agents such as Fehling's solution were accepted, but acidified potassium dichromate also gives a positive result with many alcohols so is not suitable.
- (b) Again, most knew that 2,4-dinitrophenylhydrazine solution will give an orange precipitate with a carbonyl compound, and that the melting point of the product can be checked against known values to identify the compound.
- (c) Most candidates also knew that the m/e value of the molecular ion peak would be 86 – calculated as the M_r of the aldehyde from the given formula.
- (d) Candidates are becoming more confident with skeletal formulae, and although some still included hydrogen atoms, many gave a correct formula, as shown. For part (ii), any unambiguous structure of the two additional isomers was accepted.
- (e) This part gave an opportunity for more able candidates to demonstrate their ability to interpret the spectrum and deduce that 2,2-dimethylpropanal was the only isomer that had all the methyl protons in the same environment and/or had no protons on the adjacent carbon atoms. Any suitable way of identifying this isomer was accepted.

Q2

- (a) The overall equation for the nitration of benzene was well known although fewer candidates correctly identified the catalyst as concentrated sulphuric acid. This reaction only works in a non-aqueous environment and candidates must be careful to consider whether the acid is concentrated or dilute.
- (b) This mechanism was well known, although some candidates did not show the regeneration of the sulphuric acid, either by a separate equation or in their mechanism. A few also lost marks by being inaccurate in drawing the delocalised intermediate or showing a curly arrow starting from the H atom rather than the C–H bond.
- (c) Nearly every candidate identified a dinitrobenzene isomer as the likely product of further heating. Any position of the nitro group on the benzene ring was accepted.

- (d) This part gave candidates the opportunity to structure an answer showing the three-step synthesis of an azo dye from nitrobenzene. Many candidates who had revised well scored full marks. Some however omitted to reduce the nitrobenzene to phenylamine before reacting with nitrous acid and hydrochloric acid to make the diazonium salt. The correct structure of any suitable azo dye that could be made from phenylamine was accepted.

Q3

- (a) Most candidates could draw the zwitterion of alanine.
- (b) This part required candidates to appreciate that the two amino acids could be connected either way round to give two different dipeptides. Allowance was made in the marking, here and also in part (c), for any difficulties candidates may have had interpreting the given formula of valine.
- (c) Many candidates identified that only the carboxyl group would be ionised after reaction with aqueous sodium hydroxide.
- (d) Again, many identified that the amino group would be ionised, but only more able candidates recognised that the crystals would also contain the chloride ion.
- (e) This part tested knowledge of acid chlorides and their use to synthesise other functional groups. This is still less well known than other parts of the specification, but more candidates seemed familiar with their chemistry than in previous years.
- (f) A good number of candidates could draw valid structures to fit the formulae given. However not all recognised that an α -amino acid must have an amino and carboxylic acid group attached to first carbon in the chain. Any isomers that fitted this requirement were credited.

Q4

- (a) Nearly all candidates recognised either the *cis-trans* isomerism in fumaric acid or the optical isomerism in malic acid. To score full marks, candidates needed to identify both and give a good explanation of at least one of them. Explanations of *cis-trans* isomerism could be in terms of either the restricted rotation around the C=C bond or the need for two distinguishable groups on both carbons of this bond.
- (b) Any suitable base or metal was accepted to neutralise succinic acid. Most scored one mark, but some candidates struggled to put together a correct balanced equation.
- (c) Many candidates suggested cyclic compounds that fit the formula given, but succinic anhydride was the only answer accepted. Candidates were expected to consider a structure that could be formed by loss of water from the dicarboxylic acid. Only the most able candidates scored this mark.

- (d) This part proved challenging as candidates had to be clear about the expected spectrum both with and without D₂O. A fair number did not realise that the peaks due to the COOH groups would not show in the presence of D₂O and only two peaks would remain. These would be a doublet and triplet with relative areas 2:1. Without D₂O, there would be five peaks in total as the two COOH protons are not in the same environment. To score full marks they were expected to explain the role of D₂O in removing OH protons and also to explain the splitting of at least one of the non-labile protons in terms of the number of protons on the adjacent carbon. In the last part, candidates had to identify the correct chemical shifts for the two peaks in succinic acid. Many gave the wrong range for the CH₂ protons, not recognising the effect of the adjacent carbonyl in the acid group. The symmetry of the molecule or the equivalence of the groups was needed to explain why there were only two peaks overall.

Q5

- (a) Most candidates made a good attempt at the structure of addition polymer, although some lost the mark through not connecting the bond to the carbon of the side group.
- (b) A number of candidates recognised that the ester group would be hydrolysed under these conditions to give a carboxylic acid. Meanwhile others spotted that the nitrile group would be hydrolysed to a carboxylic acid. Very few identified both.
- (c) The first part of this question also proved challenging, although the ablest candidates identified both the methanol and concentrated sulphuric acid catalyst needed to form the ester. The use of HCN and a nucleophilic addition reaction followed by the loss of water was recognised by many more candidates.
- (d) This calculation was relatively straightforward, but a significant number of candidates lost the last mark by not rounding their answer to two significant figures. The answer was 3.8 kg of the product compound.

Q6

- (a) Most candidates drew a polymer formed from one of the dicarboxylic acid monomers and ethane-1,2-diol. To score both marks a correct repeat must be drawn with 'end' bonds. A few attempted to join the two acids to give an anhydride. Some credit was given for this as long as the repeat was correct.
- (b) Nearly all candidates recognised this as condensation polymerisation.
- (c) It was pleasing to see a good number of candidates interpret the information about the amounts of each monomer given in the question to deduce that the sequence must involve monomer **H** alternating with either one of the acids in between.
- (d) To score full marks in this part, candidates needed to recognise that the reduction of an aldehyde to an alcohol with NaBH₄ would happen at both ends of the molecule. Candidates must also beware of representing the aldehyde group as 'COH'. This is unclear and should always be written as 'CHO' instead. In the last part most identified the peak in the 1680–1750 cm⁻¹ range expected for **J** and peak in the 3230–3550 cm⁻¹ range for **H**. The peak for the C–O bond would also be present, but this is harder for identification as there are many other peaks in that range.

- Q7 (a) This question gave candidates the opportunity to demonstrate their understanding of the different electrophilic reactions involving bromine. Marks were available for identifying whether addition or substitution would occur and for the correct balanced equations. The bromination of phenol needed to show the substitution to give the 2,4,6-tribromophenol, as it is very hard to stop the reaction before this product is formed. To explain the difference in reactivity, candidates needed to go beyond just stating that benzene was stable. This is true, but just restates that it is unreactive. The origin of its stability is the delocalisation of the π -electrons compared to those in cyclohexene. Similarly in phenol, the addition of the lone pair of electrons from the oxygen into the delocalised p-system is needed to explain the activation of the ring. Marks were available for describing the relative electron densities of the π -bonds in cyclohexene, benzene, and phenol and the effect these would have on the attraction for the bromine molecule or its relative polarisation.
- (b) This last question was designed to identify the ablest candidates who would realise that only the 1,4-dimethylbenzene isomer of C_8H_{10} could give one bromine substituted compound under the conditions for aromatic mono-substitution. Only very few spotted this, although a fair number did score some credit with a valid aromatic isomer of C_8H_{10} for compound **K**.

2815/01 Trends and Patterns

General Comments

The average mark for the paper was 28 which was considerably higher than the mean mark in the June 2007 examination paper. The whole mark range was covered from 1 to 45. There was very little evidence that candidates ran out of time and only a small proportion of candidates left significant number of part questions blank.

The specification grid for this examination paper indicates that about 30 marks are allocated to synoptic ideas. There was evidence from the candidates' answers that they found the synoptic aspects of the examination much more demanding than those questions based on the content from the Trends and Patterns part of the specification.

As in previous sessions many candidates did not use chemical terminology with precision although there was a little improvement over previous examination papers over the use of the terms atoms, ions, molecules, compounds and elements.

Candidates found the long question on copper complex ions much more accessible than previous long questions that focussed on synoptic ideas. Candidates often used the bullet points in the question to organise their answers.

Comments on Individual Questions

- Q1 This synoptic question required candidates to link knowledge and understanding from the *Trends and Patterns*, *Foundation Chemistry* and *How Far? How Fast?* modules. Many candidates found this question demanding.

In part (a) a small, but significant, proportion of candidates stated that the decomposition temperature of BaCO_3 was lower than that of SrCO_3 and as a result were awarded no marks. Many candidates did not specify the particles involved and so were not given full credit. Candidates needed to compare the ionic radius or charge density of the two cations, relate these to the polarisation of the carbonate ion, the distortion of the electron cloud around the carbonate ion and the weakening of the carbon–oxygen bond within the carbonate ion.

Common misconceptions included the polarisation of the cation rather than the anion and referring to the weakening of the ionic bond rather than the covalent bonds within the carbonate ion.

A significant proportion of candidates in part (b)(i) could not write a balanced equation even if they wrote the correct formulae of the products.

The most popular answer was $\text{Mg}(\text{NO}_3)_2 \rightarrow \text{MgO} + 2\text{NO}_2 + \frac{1}{2}\text{O}_2$.

In part (ii) candidates often referred to the wrong particles or did not mention a particle at all. Reference to oxide and nitrate without reference to ions was allowed. Many candidates either referred to the difference in charge or radius of the nitrate and oxide ions. Fewer candidates could clearly explain that this would lead to stronger electrostatic attraction between ions. Common misconceptions included reference to the radius of magnesium oxide or of magnesium nitrate or reference to polarisation of the oxide and nitrate ions.

In part (c) (i) only a small proportion of candidates were able to assign the correct oxidation numbers. In particular candidates did not know how to work out the oxidation number of sulphur in a sulphate ion. A common misconception was to use a 'total' oxidation number for example the oxidation number of oxygen in FeSO_4 being -8 . The relationship between the changes in oxidation number and oxidation and reduction was well known.

In part (ii) a significant proportion of candidates was able to use the enthalpy changes of formation to calculate the enthalpy of reaction as $+339 \text{ kJ mol}^{-1}$. The most common misconceptions were reversing the energy cycle to get -339 kJ mol^{-1} or to forget to use the correct mole ratios and get -590 kJ mol^{-1} .

In part (iii) candidates needed to calculate the percentage purity of hydrated iron(III) sulphate and the answer needed to be quoted to three significant figures to be awarded full marks. Answers of 76.8, 76.9 and 77.0 were given full credit. Good answers were exemplified by an organised series of steps. Two of the different approaches used by candidates were:

- Method 1 – moles of SO_2 made, then moles of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in sample, then mass of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in sample and finally the percentage purity
- Method 2 – moles of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in 2.784 g, moles of SO_2 that should be made, moles of SO_2 made and finally the percentage purity

Many candidates could not correctly calculate the M_r of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, while other candidates used the M_r of FeSO_4 . A significant proportion of the candidates did not use the molar ratio of $\text{FeSO}_4 : \text{SO}_2$ given in the equation.

Q2

Candidates found this synoptic question about iron and molybdenum one of the more accessible questions on the examination paper.

The majority of candidates could construct the equation for the reaction between aluminium and molybdenum(VI) oxide in part (a). Common errors in the formulae included diatomic aluminium and aluminium oxide being AlO_3 or Al_4O_6 .

In part (b) only a small proportion of the candidates could not give the electronic configuration for Mo^{3+} and an even smaller proportion could not explain why iron is a transition element.

In part (c) only a very small proportion of candidates were able to construct redox equation. Candidates often did not cancel out the water molecules and the protons. One mark was given for equations that had the correct molar ratios of MoO_2 , $\text{Cr}_2\text{O}_7^{2-}$, MoO_4^{2-} and Cr^{3+} .

A significant proportion of candidates in part (d)(i) were not able to deduce the formula for potassium ferrate(VI). A common misconception was to have the formula KFeO_4^- or $\text{K}_2\text{FeO}_4^{2-}$.

In part (ii) a large proportion of candidates was able to calculate the moles of KOH as 0.04 and of Fe_2O_3 as 0.00627. Significant figures were not assessed in this question so 0.006 was allowed. To be awarded the last mark a clear explanation of why Fe_2O_3 was in excess was needed. An error carried forward mark was available for candidates with incorrect moles of KOH and/or Fe_2O_3 .

Many excellent explanations were given with the best answers calculating the actual

mass of Fe_2O_3 needed to react with the 0.04 moles of KOH, or calculating the volume of KOH needed to react with the 1.00 g of Fe_2O_3 .

Q3 This question focussed on oxides and chlorides and involved synoptic assessment of topics from the *Trends and Patterns* and *Foundation Chemistry* modules.

Many candidates were awarded at least half marks for part (a). Some of the misconceptions or errors about the second ionisation energy of calcium were to fail to include state symbols, include electrons on the left hand side of the equation or to include two electrons on the right hand side of the equation.

The majority of candidates recognised the enthalpy change of atomisation of oxygen.

A significant proportion of candidates referred to the second ionisation energy of oxygen rather than the second electron affinity of oxygen. Other candidates just referred to electron affinity.

The majority of candidates could write the equation to represent the enthalpy change of atomisation of calcium.

Candidates needed in part (b) to be able to identify the bonds or force that needed to be overcome and the relative strength of the force or bond. Ionic bonding, giant ionic, giant intermediate or electrostatic attraction between ions for aluminium oxide and van der Waals' forces for aluminium chloride were given credit. A further marking point was given for a comparison of the strength of the bonds or force. Good answers referred to strong attraction between ions and weak van der Waals' forces between molecules of aluminium chloride.

Common misconceptions included aluminium chloride having strong intermolecular forces, having a giant structure with molecules or having a giant ionic structure. Another misconception was that covalent bonds were weaker than ionic bonds although this was seen somewhat less than in previous examination papers.

In part (c) candidates only had to recognise that aluminium oxide did not react with water whereas aluminium chloride does to make an acidic solution. A common misconception was that aluminium oxide reacts with water to make aluminium hydroxide. Only a very small proportion of candidates referred to the polarisation of water molecules by aluminium ions.

In part (d) (i) a significant number of ionic '*dot-and-cross*' diagrams were drawn by candidates. Other candidates were not awarded a mark because they included an extra electron that should have been lost in order to make the positive ion.

Although most candidates stated that PCl_4^+ was tetrahedral, fewer candidates were able to explain this prediction. Good answers referred to the electron repulsion of four bond pairs. A significant number of candidates did not refer to the number of bonds or bond pairs. A common misconception was the idea that atoms or ions repelled each other.

- Q4 Many candidates found this question accessible and a significant proportion scored more than six out of the eleven available marks. Only an extremely small proportion of candidates included examples from the chemistry of iron.

The best answers were quite short and concise and used the bullet points as a template for their answers. There was no need to give more than one example of the structure and shape of a copper complex ion, one ligand substitution reaction and the colours of two copper complex ions. Candidates that included more than this often included either irrelevant chemistry or gave contradictory information.

The majority of candidates were awarded the Quality of Written Communication mark which required the correct use of three technical words listed in the mark scheme. Most candidates stated that the bonding in a complex ion is called dative covalent or coordinate. Only a slightly smaller proportion of candidates stated that a ligand donates a lone pair.

Most candidates described $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ or $[\text{CuCl}_4]^{2-}$ as copper complex ions. A significant proportion of candidates were not able to write the correct formula for the copper ammine complex either having the wrong number of ammonia ligands or including the wrong charge. A large proportion of candidates could draw the three dimensional representation of their chosen complex, either an octahedral and/or tetrahedral copper complex but a smaller proportion could state the correct bond angle.

Candidates that gave non-existent copper complex ions were not awarded marks for the shape.

Only a small proportion of candidates gave a written definition of ligand substitution, but a much larger proportion gave balanced equations that illustrated ligand substitution. Balanced equations could score all the marks available for ligand substitution but often candidates included non-existent complexes or had the wrong formula. A significant proportion of candidates did not include the charge on the complex ion. The reaction of $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ with NH_3 or Cl^- were the most common examples of ligand substitution. A small proportion of candidates confused precipitation with ligand substitution.

Most candidates could give the correct colours for at least two copper complex ions.

2815/02 Biochemistry

General Comments

The entry was similar to June 2007 and an improvement has been apparent in the scripts, particularly at the top end with a good number of scores in the high thirties and low forties. All questions were accessible to the better candidates, though a few did prove elusive (as in 2(d)(i), 4(d) and 5(a)(i)). As always the best scripts were clearly written with confident use of chemical terms and accurate structures. At the lower end, a significant minority of the candidates knew very little of the specification. They often compounded their difficulties with poor English expression.

Comments on Individual Questions

- 1 (a) (i) This was an easy start and the great majority pinpointed the helical and pleated sheet areas in the structure of catalase.
(ii) Nearly all identified hydrogen bonding, but only half could draw this accurately. The minimum allowed was CO....HN. Many used hydroxyl groups, unsuccessfully. Other drew diagrams which suggested that the relevant N and C atoms were part of R groups instead of being in chain.
- (b) Most were able to identify the structural features of the histidine side-chain which could contribute to tertiary structure.
- (c) (i) Candidates found this straightforward.
(ii) This part proved more difficult with no response from weaker pupils. Alternatives were seen but several put 'breaks ionic bonds' without explaining how.
- 2 (a) All except the very weakest scored one mark and most scored two. The commonest near-miss errors were to suggest a ketone or a carboxylic acid. Too many had fewer than four bonds to some carbons. Some drew hydroxyl groups on the left of their vertical chain as OH-C.
- (b) Most scored the mark for their glycosidic bond, but several lost it by leaving a free OH group on one of the carbon atoms involved. The stereochemistry was easy for those who had their glucose on the left and above the galactose before linking. Many of those with glucose in line on the right managed to invert the molecule and keep accurate track of all the stereochemistry.
- (c) (i) Simple filtration was all that required. Vague responses such as 'drained' did not score.
(ii) Two advantages of immobilising enzymes were easily found from all the alternatives available. Stability to heat and reuse were the commonest correct responses. There were still a few unsuccessful references to 'costs'.
- (d) (i) Most scored one of the marks usually for 'more frequent collisions' or for a remark on the abundance of free active sites. A second mark here was rare.

- (ii) The majority of candidates correctly referred to the reversible occupation of the active site by an inhibitor with a similar shape/structure to that of the substrate. The usual error was to suggest that the inhibitor had the same structure as the substrate.
 - (iii) The great majority earned this mark. Those that did not drew the curve for non-competitive inhibition or drew a curve that was ambiguous.
- 3 Scores on this question on the structures and functions of amylose and cellulose went largely by Centre. There were excellent answers from those who had learnt it; it was very difficult for those who had not. Fragments of biology did not score well. There were suggestions of branched structures, using 1-6 links, for amylose – perhaps confusing with amylopectin. A few thought that the monomers were held together in the polysaccharide by hydrogen . Others suggested that cellulose has a pleated sheet structure. Most of those successful with this question were able to write functions for the polymers, but only the better candidates related these to the structures as asked.
- 4
 - (a) Nearly all scored one or two marks here, with the link between glycine and phosphate proving to be the most difficult. The charge on serine confused some candidates who tried to make the link to phosphate ionically. A few could not draw glycerol, in spite of the hint on the facing page.
 - (b) The great majority correctly used van der Waals' forces. Hydrogen bonding and hydrophobic bonding were the usual errors.
 - (c)
 - (i) Many balanced the equation correctly, but others were unable to suggest products that made chemical sense.
 - (ii) Most knew that the reaction produced soaps or soapy detergents.
 - (d) Most answers scored the first mark for noting that carbohydrates are already partially oxidised. Only the better candidates could explain where the energy came from during oxidation. 'From breaking bonds' was still a popular incorrect response.
- 5
 - (a)
 - (i) Many, even good candidates, gave only C3 or C5 but not both as required. In same cases they used 3' and 5' with apparent confidence in (d).
 - (ii) Usually correct.
 - (b)
 - (i) Most understood the ideas of polymer and condensation in a general sense, but were unable to put this in context. Better candidates had no such trouble.
 - (ii) Most candidates correctly suggested hydrogen bonding or van der Waals' forces, but there were few diagrams showing the chemical structures involved. Most diagrams simply showed the AT and CG pairs as letters, and these were allowed to score. There was some confusion with tertiary structure of proteins.
 - (c) Many candidates scored full marks with accurate descriptions of replication. A large minority chose to describe transcription and/or translation instead. m-RNA was frequently produced, which was then sometimes linked up with a single strand of DNA. Almost all mentioned the semi-conservative nature of replication, but few drew diagrams to show that they understood what this meant. There was confusion about the chemical interactions involved, and the reasons for nucleotide complementarity are poorly understood.

2815/03 Environmental Chemistry

General Comments

A full range of marks was again seen from the small entry. More scores were seen in the high 30s and low 40s than in previous years. The better candidates displayed good knowledge across the syllabus and the ability to work things out in the examination room. They used technical terms and equations with confidence. Candidates in the middle of the range displayed sound knowledge of several parts of the syllabus, and showed improvement with equations. At the lower end a substantial minority of the entry displayed little knowledge of the chemical content of the syllabus.

Comments on Individual Questions

- 1 All candidates managed a few marks; few scored full marks.
 - (a) (i) & (ii) proved to be the easiest marks on the paper. The commonest errors were to suggest carbon dioxide as the gas. Some thought aerobic conditions would lead to the formation of methane.
 - (b) (i) The majority suggested two suitable materials, usually homing in on textiles and paper or cardboard. The corresponding polymeric compounds provide more elusive except for the best candidates.
 - (ii) Most candidates scored the mark for mentioning the reduction of the bulk of waste by incineration, or the subsequent saving of landfill space. A few repeated the production of energy given in the stem of the question.
 - (iii) The majority discussed the formation of dioxin, but a few thought that very high temperature rather than too low was the cause of the problem.
 - (c) Many answers correctly gave car batteries, and old lead piping and roofing material were also accepted. Pencils, even old pencils, were not.
2. This tested knowledge of the detailed structures of clays and discriminated well in the top half of the entry. Weak candidates scored one or two marks at the most.
 - (a) (i) Most scored the marks for the formula (SiO_4) and drew an acceptable diagram showing the 3D tetrahedral shape. Several used wedged bonds in such a way that their structure could not possibly be tetrahedral. Only the more able candidates knew that the bonding within the layers was covalent, and involved sharing of only three of the corner oxygen atoms in each unit with neighbours (Si-O-Si). Hydrogen bonding was often invoked incorrectly.
 - (ii) AlO_6 and $\text{AlO}_4(\text{OH})_2$ were accepted as formulae; the use of six OH groups was a common mistake. Only the better candidates could draw acceptable octahedral structures. The usual errors were to show all bond angles as 60 degrees and to use wedged bonds incorrectly.
 - (iii) The best candidates realised that covalent bonding, Si-O-Al , was required. Hydrogen bonding or van der Waals' were the usual alternative. Candidates were perhaps thinking of the attractions between layers.

- (b) (i) Most candidates were able to suggest a suitable cation. A few gave their ion the wrong or zero charge.
- (ii) A third of the entry knew that the extra surface area of the 2:1 clays was the key. Comments about the relative ease of the entry between layers and the lack of hydrogen bonding between layers were equally acceptable.
- 3 (a) The majority of candidates knew that the cause of the increased acidity was sulphuric acid. Sulphurous acid was a frequent alternative, often with correct equations for its formation and complete dissociation – these were accepted if sulphuric acid was not mentioned.
Half of those who mentioned sulphuric acid thought that it was formed by direct combination of sulphur dioxide and water. Only the best knew that oxidation was involved, and they were able to write appropriate equations.
Most could write the correct equation for the formation of carbonic acid, but relatively few named it. Dissociation was more usually shown as complete rather than as partial, which would actually be the case in rain water. Many candidates knew that sulphuric (sulphurous) acid is stronger than carbonic.
- (b) (i) Half the candidates knew that the calcium ions were removed from solution by making an insoluble solid. Most of these wrote the correct equation, often with state symbols. Incorrect products included calcium oxide and even calcium metal, neither of which would achieve the removal of hardness.
- (ii) Most correctly chose ion exchange or the use of sodium carbonate. The usual wrong alternatives were soda lime or quicklime, both of which would leave calcium ions in solution.
- (c) Half the candidates knew that chlorine forms chloric(I) acid or chlorate(I) ions and that these act on bacteria because they are oxidising agents. Everyone else simply stated that chlorine kills bacteria which did not score.
- 4 (a) This provided easy marks for all candidates.
- (b) (i) About half the entry knew that the gases absorb infrared radiation, but many did not realise that it is the absorption and re-emission of infrared from the earth that is crucial. Few mentioned the extra vibration of bonds in the gas molecules that is a result of the absorption process. The uses of UV or plain radiation were the commonest errors.
- (ii) These marks were frequently scored by those who had a zero score for (i). Concentration, residence time and ability to absorb infrared were the usual choices.
- (c) This was a lifesaver for many of the weaker candidates. They knew the chemistry involved and were able to write one or two correct equations, a notable improvement on previous years. The commonest mistake was to use oxygen or ozone molecules to regenerate Cl radicals from ClO instead of the correct oxygen atoms.

2815/04 Methods of Analysis and Detection

General Comments

Candidates for this option continue to show a very pleasing level of understanding of this area of Chemistry that encourages candidates to apply their knowledge in a relevant way. Many candidates demonstrated that they are competent in applying knowledge of how analysis techniques are used and that they understand the scientific principles behind how they work.

Comments on Individual Questions

- 1 (a) (i) Candidates were required to give fragments from 1-chloropropane that give rise to the M and the M + 2 peaks. A surprisingly large number of candidates did not gain these marks either because they did not distinguish between the presence of chlorine 35 and chlorine 37 or because they did not include the positive charge on the fragment. This omission is always penalised once within the paper, but many candidates lose a mark every year because they are not precise in their written answers.
- (ii) Many candidates were able to give the ratio of 3:1
- (b) Many candidates were able to give a fragment from the 1-chloropropane molecule that would not be given by the 2-chloropropane molecule.
- (c) (i) A significant proportion of candidates were able to correctly work out that the two molecules were CO₂ and C₃H₈. However, perhaps as many as 20% of candidates did not show their working, even though the question expressly instructed them to do so.
- (ii) Candidates who were precise in their language were able to score this mark easily, those who had a tendency to be vague found it more difficult to score. This is because the mark was for an answer in terms of exactly the same molecular mass or the same number of each type of element. Common insufficient answers were 'the same elements are present' and 'mass the same'.
- 2 (a) (i) & (ii) There was about a 50% split between those candidates who understood tlc and those who did not. Those who did were able to identify the solvent as the mobile phase, silica or alumina as the stationary phase and to describe the principles of adsorption clearly. Those who were confused framed their answers in terms of paper chromatography.
- (iii) The majority of candidates were able to identify ninhydrin or iodine as a locating agent.
- (b) The process of two way chromatography was well explained by many candidates. The idea of a second solvent being used after rotation was a clear response in many answers. However the third mark for explaining why this process is more effective was not scored particularly often. Common errors were answers that just repeated the question and said 'and so this is more effective'.

- (c) (i) & (ii) It was pleasing to see that many candidates were able to identify that three amino acids had been separated by solvent 1, and also that a large proportion of candidates were able to estimate an R_f value in the range of 0.23 to 0.33
- (d) It was pleasing to see that a great many candidates were able to identify that glycine would accept a proton onto its acid group at pH 2.
- (e) Almost all candidates were able to identify the spots as C - D - B - E. Those that did not score full marks were the ones who did not label each spot and assumed an unlabelled spot was the one they had left out. Candidates should be reminded of the need to be clear about their response and to give a full answer rather than to leave something out because they think it is obvious.
- 3 (a) Weaker candidates found this question and part (b) the most difficult on the paper, often because their scientific language and expression was not precise. For part (a) candidates needed to describe an electron (not an atom) falling from a higher energy level to a lower energy level AND emitting energy in doing so; it was this latter piece of information that was most often omitted by candidates.
- (b) (i) & (ii) Candidates needed to be clear about where the electrons were falling from, and to where, to get marks in this question. The single series needed multiple higher levels to one common lower level whilst the several series are formed by electrons falling from higher levels to more than one lower level. As already stated, candidates who were less precise in the way that they expressed ideas were the ones who were less likely to score marks.
- (c) (i) & (ii) It was pleasing to see that these calculations were correctly done by many candidates. Most errors in part (i) were from candidates who were unable to convert nm to m or who did not state the correct units of Hz. In part (ii) there was a significant number of answers that did not multiply by L , the Avagadro constant. Also a significant number of candidates did not give an answer to three significant figures despite the instruction in the question.
- (d) The majority of candidates were able to read the value of the concentration of sodium ions as 550 from the graph and gained a mark for doing so. The fully correct answer of 5.5% was not especially common as many candidates had difficulty with manipulating all of the powers of 10 involved, but many did gain the final mark for converting the mass of sodium ions into a percentage of the food sample.
- 4 (a) Most candidates were able to calculate the empirical formula for compound **F**. Those candidates who did not go on to score all three marks for this part were those who rushed their answer and so left out steps of working, or who thought the working irrelevant. Candidates who did not read and follow the instruction to show all working penalised themselves by being unprepared to be clear and detailed in their scientific answers.
- (b) Many candidates were able to work through the two spectra and to make correct conclusions without scoring all of the marks. Candidates are reminded that in this type of question there is only one mark for deduction of the correct structure, with many more marks being available for interpretation of the evidence in each spectrum. However, many candidates did use all of the information in the spectra. Marks for the nmr spectra were awarded for identification of the delta value, the group responsible, the splitting pattern and the reason for this splitting. Common errors were to omit one of these pieces of information, or to quote directly from the

Data Sheet without any thought to the relevance of this data. For example a number of candidates combined the nmr peaks at 3.7 ppm and 5.3 ppm and used the whole range of 3–5 ppm to assign the two peaks as one OH peak. In the IR trace there were two common errors; firstly to quote the OH absorbance as 2500 to 3000 cm^{-1} from the data sheet when the trough was out of this range, secondly to miss the C–O absorbance in the region 1100 cm^{-1} .

2815/06 Transition Elements

General Comments

This paper produced a good range of marks and there were some outstanding scores. Sadly there were also some very low scores. Most candidates attempted to answer all the questions on the paper and most scripts were legible. There were some very good diagrams, but also some poor attempts at drawing 3-D representation of optical isomers.

The section of the specification relating to the splitting of d-orbitals and colour continues to be problematic for a large number of candidates.

Candidates have a tendency to be too brief when describing, for example, what they would see during the titration of a copper(II) solution.

Calculations were generally carried out well. Even weaker candidates often managed to arrive at a final answer, although they often failed to scale titration volumes up to total volumes. This gave a final answer which was out by a dilution factor of 20.

There was some evidence to suggest that candidates do not read the questions properly, e.g. question 1(b) clearly asks for a displayed formula but many candidates used:
 $\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{NH}_2$.

Comments on Individual Questions

Question 1

A majority of candidates scored well on this question. The main mistakes were for the colour change in (a)(i), not using a displayed formula in (b) and not using 3-D representation in (c)(ii). Many candidates gave the structural formula for the whole complex in (b). If the ligand part was drawn as a displayed formula, they were credited with the mark.

Question 2

This was probably the highest scoring question on the paper, with many candidates achieving full marks. When marks were lost it was usually for omitting the word voltage or emf from the definition in (a) or for not knowing the material for the electrode of the $\text{Fe}^{2+} / \text{Fe}^{3+}$ half cell, the common misconception being iron. In (c)(ii) a common mistake was to add the two half equations as written to give an equation for the reaction between Fe^{3+} and I_2 .

Question 3

This proved to be a challenging question for all but the most able candidates. Many failed to label the axes in (b) despite the stem clearly asking this to be done. Few candidates were able to fully describe why d-orbitals split although more could explain why different ligands produce different colours. It was quite common to see the answer for (d) written as the answer for (c) and when this occurred, candidates were credited with the marks for part (d), despite most simply writing the same answer down twice.

Question 4

Many candidates scored well on this question. They clearly understand the relationship between electrode potential and reaction probability. Whilst many knew what disproportionation means, a surprising number seemed to not have heard of the concept. Quite a lot of candidates did not know that copper(I) compounds are stable mainly as solids.

Question 5

Candidates who had clearly experienced the experiment to determine the % of copper in a sample of brass tended to do very well. It seems likely that a number of candidates have not had the opportunity to carry out this titration.

There were many mistakes on the equations for the reactions involved. Candidates, in particular, did not know the formula $\text{S}_4\text{O}_6^{2-}$. There were many equations written which balanced atomically but not electrically.

Most candidates made a creditable attempt at the calculation. A common mistake was to not scale up from 25 cm^3 to 500 cm^3 and this gave the common wrong answer of 4% rather than the expected 80%. These candidates were awarded 3/5.

A surprising number of candidates thought that brass contained nickel rather than zinc

2816/01 Unifying Concepts in Chemistry

General Comments

In general the performance of candidates on this paper was a considerable improvement on that of previous years. Certainly Questions 1 to 4 revealed that candidates had prepared well for the exam and that their grasp of equilibria, reaction kinetics and acid/base chemistry was very sound. In particular the candidates' responses to the question about buffers were in a different league to those answers that were given in previous years. Question 5 was undoubtedly the most difficult question on the paper by some margin and here for many candidates their run of success through the preceding questions came to an abrupt halt. There were a few able candidates who lost marks here particularly in part (d) for errors that they should not have made but in general candidates honestly struggled because of the challenging nature of the questions. Taking the paper as a whole, however, I was impressed with the way that candidates tackled the questions presenting their arguments in a logical fashion and setting out their calculations clearly and in a step-by-step manner.

Comments on Individual Questions

- 1) (a) Almost every candidate got off to a good start with this question. Of the few errors that were seen, one was to invert the expression for K_c while the other was to omit the concentration of water from the denominator.
 - (b) (i) Here again were two relatively easy marks which the vast majority of candidates picked up without any difficulty. If errors were made they were more commonly with the equilibrium amount of ethyl ethanoate and water than with the number of moles of ethanol.
(ii) Although many candidates achieved the mark for a definition of mole fraction, it did not come easily and often definitions were rather long-winded and confused. A varying degree of confusion arose, which sometimes did lead to loss of this mark, between the distinction between mole fraction and partial pressure. The second mark for the correct evaluation of the mole fraction of ethanoic acid was invariably correct even for the weaker candidates who carried forward incorrect values from part (b)(i).
(iii) Almost every candidate used their values from (b)(i) to work out a value for K_c . Most candidates also indicated that this value was dimensionless although some just left the answer line blank and so did not gain credit. What was surprising however was the number of candidates who failed to give the value to two significant figures. Many chose to express their answer to three significant figures while others wrote 0.2 (repeating). It is clear that many candidates were not familiar with using the number of significant figures to which the data in the calculation is given to decide on how accurately they can quote an answer.
 - (c) This was very well answered. When full marks were not awarded it was more often because the candidate had stopped short of a full enough discussion rather than because they have given an incorrect response.
- 2) (a) (i) Almost every candidate worked out correctly the value of the initial rate for experiment 2. The corresponding values for experiments 3 and 4 were slightly more challenging but here again correct answers were the norm. A few candidates wrote nothing here although they went on to give correct answers to the other parts of the question which suggests that they had failed to notice part

- (a)(i).
(ii) Very few candidates had any problems here and the ability to give the correct units was a considerable improvement on previous years.
(iii) This part brought to an end many candidates run of top marks so far in the paper. Of the three possible marks that could be awarded here, the one involving the identification of the species in the rate determining step was the one which candidates picked up the most often. Slightly surprisingly, the rarest answer by some margin was one that explained what is conveyed by the overall equation.
- (b) Answers to this part were slightly disappointing. Although a very large number of candidates did indeed gain the mark one felt that it should have been an even higher number. The most common errors were to confuse the plot required with one showing concentration against time either of a reactant or of a product.
- (c) This was a pleasure to mark as so many candidates had no difficulty at all in going straight to the correct answer. Not only was this the case but their working was usually clear and set out in a very logical way.
- 3) (a) This request for a familiar definition gave most candidates the opportunity to gain two marks.
- (b) (i) Again this part was very well answered. A few candidates did include the concentration of water in their expression but they were a very small minority.
(ii) The opening mark for calculating the $[H^+(aq)]$ was almost always awarded and indeed the majority of candidates went on to gain the second mark for correctly calculating the concentration of the potassium hydroxide solution. Unfortunately, many candidates over-rounded their final answer to 0.5 mol dm^{-3}
- (c) The quality of the answers to this part was very centre specific. Many centres had clearly done an excellent job in preparing their candidates for this type of question and their candidates worked clearly and logically to the correct answer. For others the path was a little more meandering but nevertheless still arrived at the correct destination. When mistakes were made it was interesting that more often than not they occurred in the calculation of the concentration of vitamin C and not in the determination of its pH. For many such candidates a weak grasp of the basics let them down the most.
- 4) The answers to this question were extremely encouraging. It certainly appeared that many candidates had taken the time to prepare well for a question that explored how buffers function and these candidates were rewarded here with very high marks. The opening definition of a buffer was almost always given correctly but it should be noted how many candidates went on to contradict themselves later when they were discussing how buffers cope with changes in proton concentration. The closing part of the question which asked for the composition of a buffer in the range 3.5–4.5 was slightly less well answered which must indicate that for some candidates at least this sort of problem had not been met before. The quality of written communication mark was invariably awarded and indeed most candidates not only wrote a very clear account but supported it with a range of correct equations.

- 5 (a) The first equation for the thermal decomposition of calcium carbonate is one that many candidates will have known since GCSE days and they were not slow to pick up this mark. Likewise the final equation for the production of calcium cyanamide was also correctly given in most scripts. Where candidates really struggled was with the equation for the conversion of calcium oxide to calcium carbide. The most common error was to give oxygen as the other product rather than carbon monoxide or carbon dioxide.
- (b) This was a very challenging question and only the strongest candidates scored any marks here. Fewer candidates used the information in the question to incorrectly propose answers based on ionic bonding. For most the question was just beyond them and their suggestions complied with none of the rules learnt for constructing 'dot-and-cross' diagrams.
- (c) Again candidates found this part of the question extremely challenging. Many did arrive at an equation which formed a calcium compound but often this was the only sensible product that was suggested. Even for those candidates who had given a calcium compound in the equation, few managed to collect a mark for discussing its use with acid soils.
- (d) Overall, answers to this closing part of the final question were disappointing. Perhaps the opening parts had knocked candidates' confidence but whatever the reason marks here could have been higher. The opening equation was straightforward but hereafter there was much confusion. When working out the relative formula mass, a significant number of candidates confused limestone with calcium carbide or even with acetylene itself. Having obtained a certain number of moles from this opening calculation a significant number of candidates then applied a stoichiometric ratio of 1:2 and claimed that the moles of ethyne would be twice as many, despite being given the formula for calcium carbide in the opening part of the question. The final part of the question was also very poorly answered. A large number of candidates clearly failed to recognise ethyne as a hydrocarbon and so instead of the expected combustion products for a hydrocarbon proposed molecules such as glyoxal, $C_2H_2O_2$.

2816/02 Practical Skills in Chemistry 2

General

Most Centres entering candidates for the Coursework option have been doing so for many years and have well-established procedures for ensuring that the published criteria are adhered to. Such Centres provide the Moderators with the easy task of agreeing with the levels awarded and endorsing their marks. Nevertheless there still remains a small group who either seem to ignore the guidance provided by OCR or who over-value their Candidates' work to the extent that all the marks lie close to the limits of the tolerance allowed. The latter group is a real concern since it is all too easy for that tolerance to be exceeded triggering a change to the marks submitted. It needs to be emphasised that, although a measure of professional judgement may have to be used, there are many criteria which must be regarded as absolute. An example is the necessity at P7a to provide references which are at least to the chapter of a book or beyond the first '/' of an internet reference. In the introduction to the planning exercises this is clearly indicated to the Candidates.

Another general issue concerns listing the hazards that may occur during the course of an experiment. This is required for the award of I7a. General laboratory procedures such as wearing safety glasses are not what is required; neither are statements from Hazcards covering every conceivable risk. The intent is that candidates will consider the risks that may be involved using the chemicals in the context of the experiment that they are about to do.

It was mentioned in last year's report that there was a growing tendency for Candidates to round numbers too early in their calculations. It is worth emphasising again that if this is done it leads to an erroneous answer which cannot be accepted even if the calculation has otherwise been completed correctly. Occasionally Candidates reduced a number to two significant figures at an intermediate stage in a calculation and then quoted the final answer to three.

The award of a mark for the use of spelling, punctuation and grammar must also be taken to cover the correct use of super- and subscripts. This can be an issue if Candidates choose to word-process their scripts and P7a cannot be obtained if there are persistent errors in the quotation of chemical formulae.

When evaluating experiments many candidates include failings due to the incorrect use of apparatus or their own mistakes in handling chemicals and equipment. These should not be included. Evaluations should be restricted to errors inherent in the procedures used and the measurements made.

There remain a two points which, although not directly relevant to the award of marks are worth mentioning. Chemical names should not begin with capital letters. Scales are no doubt used in the home but in the laboratory balances are employed to weigh substances.

A2

The majority of Centres use only the exemplar experiments but if Centres wish to use experiments other than the exemplars to assess their candidates, they can of course do so. However it is essential that these are approved by OCR beforehand. At A2 there was concern that some alternatives submitted were less demanding than the published experiments and therefore access to the higher marks was not possible

By far the most popular choice for assessment of skill P was the 'Identification of an organic unknown'. Many obtained high marks but it was not unusual to see scripts where the reaction of phenol with bromine had been forgotten or where it was not realised that phosphorus

pentachloride reacts with carboxylic acids. These errors were unfortunately not always noticed by teachers. There is still an issue over the award of P7b and it must be repeated again this year that full details are expected at this level. The extension of this exercise was also widely used to assess skill A and Candidates usually deserved the high marks they received.

An alternative choice for skill P is 'The determination of a rate equation'. Most Candidates reach level 5 without difficulty but P7b requires some care. Reference must be made to the teacher demonstration and how it governed the subsequent choice of solutions. The use of $1/\text{time}$ as a measure of the rate should also be explained. Regrettably there are still Candidates being allowed to suggest the use of taking gradients from a concentration/time plot as a measure of rate. This would only be correct for a continuous run through the experiment and cannot be given marks when the method described is an initial rates procedure. While this misunderstanding is unfortunate in skill P, it has serious consequences in skill A where only a low mark is possible if the wrong graphs are plotted.

There were generally no problems in supporting the marks awarded for skill I although the quality of the observations did sometimes render the award of I7b somewhat dubious.

It was felt by the Moderators that Candidates were often confused in their approach to skill E and many appeared uncertain as to what they should be looking for. It is important that they should look at an experiment to discern whether procedural or measurement errors predominate. In the iron(II) sulphate and copper sulphate experiments it is undoubtedly the former and it was unfortunate where Candidates spent too much effort in calculating the errors in the titrations which are very accurate. A measurement error worth considering is that of mass but where this was included most failed to appreciate that it was the error in the mass of the solid that is important and not the combined mass of the crucible and the solid. However the main consideration should be assessing the likelihood of decomposition of the anhydrous solid or the absorption of water after heating and the effect this would have on their result. The rate evaluation was generally better done but it was unusual to find a Candidate who appreciated that the error in the timing varies according to the length of time taken for the cross to disappear.

2816/03 Practical Examination 2

General Comments

There was a slightly increased entry for the Practical examination this year. The scripts seen covered a wide range of ability, but the standard of answers to the Evaluation was disappointing, even from some candidates who performed well in other parts of the Paper. Most candidates were able to complete the twin experiments in the Test to a high level of accuracy, but Analysis of their data proved challenging to many. On the other hand, the standard of accuracy shown in the unfamiliar 'thermometric titration' was very pleasing.

The Plan was more open-ended than many that have been set in the past. A number of methods were available to determine the concentration of NaOH, apart from the titration. Precipitation (e.g. of copper(II) hydroxide) was the most commonly chosen and best-described method. However, other valid experiments were used included gas collection (reaction with Al), enthalpy of neutralisation and evaporation to dryness (of NaCl).

There was no evidence that candidates were short of time on the Paper, despite the amount of work to be done. The longer Analysis section was compensated for by the shorter time required for data collection.

Comments on Individual Questions

PLAN The standard of most Plans was somewhat disappointing, and there were very few that scored top marks. It seemed that many candidates described a non-titration method that they had never actually carried out. As a result, the descriptions often lacked important practical details of the procedure. Specific comments will only be made in this Report on the method most commonly described, precipitation of a metal hydroxide.

(A)

The description of the simple acid-alkali titration was done well by good candidates, but many poor descriptions were also on offer. Many candidates omitted to dilute the NaOH before titrating it. At A2 level, it was disappointing that some weaker candidates were unable to score any marks for their description of the titration. Even such basic details as use of a pipette and quoting correct final colour of the indicator were incorrect. Since this was an A2 examination, there was a mark available for justifying the choice of indicator using a pH curve. Relatively few candidates included this in their Plans.

Most candidates described a precipitation and filtration experiment as the second technique. (The second most popular was collection of hydrogen after reaction of NaOH with aluminium: neutralisation of NaOH followed by evaporation of NaCl came third). Candidates were expected to be aware of the precautions used to ensure accuracy during a filtration experiment, such as washing and drying the residue to constant mass. Most candidates realise that excess of the transition metal salt would be needed, though not all explained why. The quality of the calculations of the concentration of NaOH from specimen data was very pleasing.

The Quality of Written Communication mark was generally very good. Some candidates were not awarded both marks because they failed to include a word count and others lost a mark by quoting incorrect chemical formulae or incorrect units in their Plans.

- TEST (B)**
- Part 1** Most candidates performed this mass-loss experiment very accurately and achieved a mass loss within 0.1 g of the norm recorded by their supervisor. A few candidates were guilty of 'fiddling' their results, by making the final reading of the conical flask and contents lower than the initial one. This usually resulted in loss of 3 marks. In the safety question, some answers were not related to the experiment that candidates had just carried out.
- Part 2** Data of good quality was obtained by most candidates. However, some quoted an inappropriate number of significant figures for their thermometer readings. It was pleasing to note that there were very few candidates who were completely unable to follow and carry out the instructions for this novel experiment.
- Part 3** Unfortunately the standard of graphs drawn in **(a)** was often poor. Many candidates extended their y-axis to 0, therefore producing a limited spread of points on the graph grid. Inaccurate plotting of points on the graph was, sadly, common. Some candidates did not have a suitable pencil for this. Although the rubric required two lines/curves, the majority of candidates drew one curve with a maximum, instead of two intersecting lines/curves.
- When reading points from the graph, careless reading from axes and was too often in evidence. In **(d)**, almost all candidates linked the maximum on the curve to neutralisation, but were unable to explain why the temperature rose to that maximum or fell away so quickly afterwards.
- Part 4** This section discriminated well. Good candidates were able to work their way successfully through the whole calculation, while weaker ones were able to pick up only occasional marks. Poor choice of significant figures was often seen in this section. Most candidates were able to balance the two equations, but the second one gave no guidance and so proved more difficult. The final answers obtained for the concentration of NaOH were usually surprisingly close to the true value, bearing in mind the inherent inaccuracies of the two experiments employed.
- Part 5** The evaluation section discriminated well. Most candidates completed **(a)** correctly, though only the better candidates considered the time needed for the CO_2 to diffuse out of the conical flask in **(b)**. Answers to **(c)** were often disappointing and vague. Inaccuracies expected related to heat losses, measuring small temperature differences and measuring the small volumes added from the burette (or the need for more readings at/near the neutralisation point). In part **(d)**, many candidates discussed accuracy rather than reliability, but most were aware of the inadequacy of taking just one reading. Better candidates were also able to comment on the evidence provided for consistency and reliability of data by their graphs.

Grade Thresholds

Advanced GCE Chemistry (3882/7882)
June 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2811	Raw	60	48	42	36	31	26	0
	UMS	90	72	63	54	45	36	0
2812	Raw	60	47	40	33	26	19	0
	UMS	90	72	63	54	45	36	0
2813A	Raw	120	93	84	75	66	57	0
	UMS	120	96	84	72	60	48	0
2813B	Raw	120	93	84	75	66	57	0
	UMS	120	96	84	72	60	48	0
2813C	Raw	120	87	76	65	55	45	0
	UMS	120	96	84	72	60	48	0
2814	Raw	90	66	58	50	42	34	0
	UMS	90	72	63	54	45	36	0
2815A	Raw	90	74	65	57	49	41	0
	UMS	90	72	63	54	45	36	0
2815B	Raw	90	73	65	58	51	44	0
	UMS	90	72	63	54	45	36	0
2815C	Raw	90	74	67	60	53	46	0
	UMS	90	72	63	54	45	36	0
2815E	Raw	90	72	64	56	49	42	0
	UMS	90	72	63	54	45	36	0
2816A	Raw	120	99	89	80	71	62	0
	UMS	120	96	84	72	60	48	0
2816B	Raw	120	99	89	80	71	62	0
	UMS	120	96	84	72	60	48	0
2816C	Raw	120	92	82	73	64	55	0
	UMS	120	96	84	72	60	48	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
3882	300	240	210	180	150	120	0
7882	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
3882	20.0	38.9	57.1	73.2	86.5	100	15165
7882	30.9	56.9	75.8	88.5	96.4	100	11473

26638 candidates aggregated this series

For a description of how UMS marks are calculated see:

http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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