GCE

Chemistry B (Salters)

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

OCR Report to Centres

June 2012

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 specification 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.

OCR will not enter into any discussion or correspondence in connection with this report.

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OCR REPORT TO CENTRES

Overview

Most seemed well-prepared for these units and it was good to see candidates of all abilities demonstrating the knowledge and understanding of Chemistry that they had gained through studying the Salters course. In all units, some really excellent scripts were seen, showing a deep insight into the subject at this level.

On the whole, calculations were well set out, allowing for 'error carried forward' to be given where appropriate. Significant figures remain a real issue, however. Candidates are often at their weakest in logical explanations, where they do not always use the technical language of chemists that they must have been taught.

The AS coursework grade boundaries were the same as last year and many candidates did well here. The item of note is still occasional lapses of administration by Centres. Once again, some excellent pieces of work were seen at the top end of the Individual Investigations. All candidates undoubtedly benefited from carrying out this individual project at A2.

News round-up for GCE Chemistry B (Salters)

A level reform

Over the last year, the future of A levels has received extensive interest. Ofqual is currently running a consultation to seek views from higher education, employers, learned societies, colleges, schools and others.

There is a link to all the relevant consultations, debates and reports at http://social.ocr.org.uk/groups/science/conversations/level-questionnaire-and-level-reform (also see http://social.ocr.org.uk/groups/science/conversations/level-timelines). We would strongly encourage teachers to contribute to the consultation (11 September deadline).

Additionally, if you have suggestions of content you would like to see in any revised GCE Chemistry qualifications please e-mail your comments to GCEScienceTasks@ocr.org.uk, we would be very happy to hear from you.

Keep up-to-date with developments in GCE Chemistry

The OCR community, **www.social.ocr.org.uk/groups/science**, is a useful reference point to help keep teachers up-to-date with GCE Chemistry (and science). It is strongly recommend that you visit the site and register. A selection of posts from the year which may be of interest are for:

- Free drawing software (http://social.ocr.org.uk/groups/science/conversations/free-chemical-drawing-software)
- RSC e-membership (http://social.ocr.org.uk/groups/science/conversations/rsc-e-membership)
- Changes to the definition of the hydrogen bond (http://social.ocr.org.uk/groups/science/conversations/recent-chemistry-news)
- Free e-books for GCE Chemistry A (http://social.ocr.org.uk/groups/science/resources/free-e-books-ocr-level-qualifications)
- The Cambridge Chemistry Challenge (http://social.ocr.org.uk/groups/science/conversations/cambridge-chemistry-challenge)

F331 Chemistry for Life

General comments:

Candidates seemed generally to have been well-prepared for this paper, with few very low marks and a reasonable number of candidates gaining 50 marks or more. The longer answer questions were answered more fully than in recent sessions; again a sign of good preparation.

All four whole questions on the paper showed very similar levels of difficulty and discrimination between different ability candidates, although of course, there was more variety within the sub-questions.

The extra blank pages at the end of the paper were not used as much this session, but still proved useful. Time, once again, did not appear an issue and blank answer spaces seemed to be restricted to a very small number of candidates.

Comments on individual questions:

Question 1

Part (a)(i) was correctly answered by the majority of candidates, however in (a)(ii) some students talked about the decay of an atom and many answers talked in very vague terms about ‘harm’ to the patient. Examiners were looking for more specific answers, such as, ionisation of cells or mutation of DNA.

In part (b)(i) most candidates correctly worked out that 181 was the M_r of FDG, only a minority pointed out that ionisation must occur. Part (b)(ii) was answered well, but no credit was given for decay or decompose.

Part (c)(i) was generally well-answered, but a small minority still drew a covalent structure for this compound, despite being told that the compound is ionic in the stem. Part (c)(ii) provided examiners with a range of answers, many completely correct, however a number of candidates still talk in terms of bonds repelling, although refreshingly few gave the answer ‘as much as possible’.

Question 2

Part (a)(i) was generally well-answered with examiners crediting alkene or C=C, and hydroxyl or alcohol (but not of course, hydroxide). In part (a)(ii) a small but significant number of candidates, including some scoring highly on the paper overall, thought that C_9H_9OH was the molecular formula.

Part (b)(i) was rarely answered incorrectly and a majority of students also calculated the empirical formula correctly in (b)(ii). Part (b)(iii), however, as in previous similar questions, caused some difficulty in explanation. A very common incorrect answer talked in terms of the simplest ratio of the elements, instead of atoms of the elements. In part (iv) candidates only got into problems when they were too specific and talked in terms of atoms or an increase in disorder of the reaction.

Part (c) was answered correctly by most but there were answers involving hydrogen bonding and even metallic.

Question 3

Part (a) was generally correctly answered.

Part (b)(i) however had many, including some better candidates, drawing another 'bent' version of butane. Candidates need to realise that the stem of the name indicates four continuously linked carbon atoms with a methyl branch (which effectively can only go in one place). In part (b)(ii) relatively common incorrect answers included straight chain diagrams and full molecular structures. Candidates talking in terms of the arrangement of atoms in isomers often forgot that they must say the same type and number of atoms.

Part (c)(i) was mainly correctly answered although no mark was awarded for a state symbol of (aq) after the hydrocarbon. In part (c)(ii) some candidates correctly scored both marks with very succinct answers but still a few candidates gave an answer in terms of more bonds being formed, or bond breaking gives out energy. Part (c)(iii) was high scoring, wrong answers however included NO_x and non-scoring vague terms. Part (c)(iv) was also generally well answered although some candidates, again, were too vague in their answers.

Scoring all three marks on 3(d) proved difficult, with many candidates, incorrectly, converting the volume of oxygen into the appropriate volume of air.

In (e)(i), some candidates failed to score because they mixed up the two ways of defining a catalyst without giving the necessary depth in either. Part (e)(ii) was relatively straightforward for most candidates.

Question 4

Part 4(a), in common with similar questions in past sessions, discriminated well between candidates of different ability. Weaker candidates often failed to explain that light energy (photons) are emitted when electrons drop back down energy levels and the idea of elements having unique energy gaps was only recognised by the most able candidates.

The mark for part (b) was successfully scored by the vast majority of candidates.

Part (c)(i) proved trickier. Most candidates produced the correct equation but there was considerable variety in the chosen state symbols and the explanation; many not realising the significance of the 298K. A similar scenario occurred with part (c)(ii), with most candidates scoring the equation mark but significantly fewer being able to give a general explanation of Hess's Law and very few explaining that the initial and final conditions must be the same.

Part (d) was straightforward with wrong answers being restricted to 'Period 3' and 'Group 13, therefore 13 electrons in the outer shell'.

Part (e)(i) was well answered (significant figures still a problem for some, however) and (e)(ii) was correctly answered by most candidates.

F332 Chemistry of Natural Resources

General comments:

A wide range of marks was achieved by candidates for the paper as a whole, covering most of the available mark range. There were few blank spaces on the paper and no indication that candidates had problems completing the questions in the permitted time.

Questions involving calculations were generally answered well, with the majority of candidates setting out their working in a way that made it possible to give credit for partially correct answers and apply ‘error carried forward’ rules. Answers to questions on organic chemistry were often good, as were those dealing with intermolecular bonds.

Answers to questions involving equilibria tended to produce lower marks, with explanations often being muddled or missing key technical terms. Answers requiring an explanation of information given in the question also tended to produce lower marks. The marks for question 5 were often below those for other questions on the paper, suggesting that candidates were less well-prepared for the question involving the pre-release article than they were last session.

Comments on individual questions:

Question 1

Most candidates found that this was one of their better scoring questions.

(a) Most candidates scored on this question, with many gaining both marks. A common incorrect answer was benzene ring.

(b) Most candidates scored one mark for 15 carbon atoms, with many going on to gain the second mark as well.

(c) (i) This question was well answered, with many candidates scoring both marks and very few gaining no credit.
  (ii) A common error was to show only one mole of bromine reacting and then to give more than one product instead of the required addition product.
  (iii) The majority of candidates scored both marks here.

(d) (i) Most candidates who gave a correct reagent also went on the score the conditions mark. However, a large number of candidates failed to score on this question, confusing this reaction with oxidation and giving acidified dichromate ions as the reagent.
  (ii) Most candidates answered correctly.
  (iii) This mark was gained by the majority of candidates.
  (iv) Many candidates scored this mark with a clearly worded definition.

(e) Most candidates scored on this question, with the majority gaining three or more out of the five marks. The fact that there is a difference in result for tertiary and primary alcohols was well-known, as were the colours involved. Where full marks were not achieved, this was often as a result of not giving a sufficiently clear explanation of how the type of alcohol affected the result (such as ‘there is no colour change with compound A because it is a tertiary alcohol’ without going on to say that it therefore would not be oxidised by the dichromate).

Question 2

Many candidates gained a good proportion of their marks from this question.

(a) Many candidates found working out the completely correct name for this compound demanding. Many candidates gained one mark for dichlorotrifluoroethane. A smaller proportion went on to gain the second mark for a correct sequence of numbers.

(b) Many candidates missed the point of this question and gave answers that related to the physical properties of compound D, such as a low boiling point, rather than the ease of producing it directly from crude oil with no further processing being required.

(c) Most candidates scored the mark here.

(d) (i) Most candidates scored here. The most common incorrect answer showed only the C–F bond as being polar.
(ii) Many candidates scored at least one mark for realising that the phenomenon was linked to the concept of electronegativity. A large proportion of candidates went on to score the second mark as well.
(iii) Most candidates scored this mark.
(iv) Few candidates scored both marks here. A small proportion scored one mark for realising that the C–F bond is more polar than the C–C*l* bond.

(e) Most candidates gained some credit for their answer here. The best answers used technical language appropriately and structured their answers clearly. Many who gained low scores had missed details such as: where in the atmosphere the process they were describing happens, the type of radiation required and the exact nature of the particles involved.

(f) Nearly all candidates gained some credit here, with a good proportion gaining full marks. The most common reason for a candidate scoring only two out of three was not mentioning that the uv radiation was of high frequency or energy.

(g) Most candidates scored this mark. Those not gaining credit had often either drawn the oxygen with a full outer shell or had given the particle a negative charge.

(h) (i) Most candidates scored both marks here, with few gaining no credit. Those scoring one mark had usually forgotten to convert the energy to Joules.
(ii) The majority of candidates scored all the marks here.. Those who were unsure about how to do the calculation usually gained the mark for units.
(iii) The majority of candidates scored this mark.
(iv) Many candidates scored the mark here. Those not scoring generally gave answers that lacked appropriate detail.

Question 3

For many candidates, marks on this question were their best for the paper.

(a) Many candidates scored both marks here. Those scoring only one mark had often given incorrect state symbols or failed to include them at all.

(b) (i) Many candidates scored all three marks here, with very few gaining no credit. Those gaining some marks, but not all, had often left out a sign or put the sign after the number instead of writing it before the number.
(ii) A small proportion of candidates gained full credit here, although some did gain one out of two. Most incorrect answers gave the reducing agent as bromine.

(c) Most candidates scored here, with many gaining both marks. Those scoring only one mark often gave the precipitate the wrong colour.

(d) (i) Most candidates scored here. Those failing to gain credit had often not converted the volume to dm^3 by dividing the number by 1000.

(ii) Incorrect answers to this question were rare.

(iii) Most candidates gained at least one mark, with a good proportion going on to gain full credit. Those not gaining full marks often failed to give the answer to three significant figures.

Question 4

The quality of answers to this question was lower for most candidates than on the other questions.

(a) Most candidates scored at least one mark, with many gaining both. Most scoring just one mark had correctly commented on the comparative rates of the forward and backward reactions.

(b) Most candidates scored one mark here for knowing that the nanoparticles would provide a greater surface area.

(c) Most candidates gained some credit here, but only a small proportion gained both marks.

(d) (i) Most candidates scored at least one mark, with two out of three being the most common score.

(ii) Most candidates scored here, with the majority gaining at least two marks. Many answers were well worded and used technical terms associated with equilibrium reactions correctly. Those candidates gaining little credit often did not use the term ’(position of) equilibrium’ in their answer.

(iii) Most candidates scored here, with many gaining full marks. As with the previous part, those gaining low scores had often not included key technical terms.

(e) (i) Many candidates scored this mark. Those failing to score had often given an answer that is not an agricultural activity.

(ii) Most candidates scored here, but few gained both marks. Explanations of how methane works as a greenhouse gas often lacked the detail necessary to gain credit.

(iii) A large proportion of candidates scored both marks, with few gaining no credit.

Question 5

The quality of answers to this question was generally below those of the other questions, with answers suggesting that candidates had not used the article as well as they might have to help them to prepare for this question in advance of the exam.

(a) The most common outcome here was a mark of one out of three; in most cases for an appropriate example of an addition polymer from the article. Explanations of what the term ‘addition polymer’ means were often poorly worded and few candidates mentioned that the polymer is the only product.

(b) Many candidates scored here.

(c) (i) A high percentage of candidates incorrectly described mass spectrometry or atomic emission spectroscopy instead of infra-red spectroscopy. Those gaining credit often scored for knowing that different bonds absorb different frequencies of infra-red and that it makes their bonds vibrate. Only a few candidates scored for explaining how the spectrum would indicate that the compound was made only of carbon and hydrogen.

(ii) A good proportion of candidates scored both marks here.

(d) (i) Many candidates scored here.

(ii) Most candidates scored this mark.

(iii) The majority of candidates scored here. Those failing to score had often made a copying error.

(e) Most candidates gained credit here, with a good proportion gaining four or more out of seven. Descriptions of how the instantaneous dipole–induced dipole bonds form were often well worded and showed good use of technical terms; better than has been seen in similar questions in recent papers. Many answers also gave good explanations of how the strength of the bonds in the two polymers differed and the impact of this on the properties of the two materials.

F333 Chemistry in Practice

Organisation of work

Given that this is the fourth year of this assessment component, most Centres are now familiar with its general demands. However, before undertaking assessment of practical skills it is recommended that teachers familiarise themselves with the **Practical Skills Handbook**. This should help to avoid some of the mistakes that are still seen during the moderation process.

Candidates' work was usually well organised and labelled. Candidates may of course attempt more than one Task from each Skill with the best mark from each Skill being used to make up the overall mark. To help track candidate marks it is recommended that Centres use the interactive Marks Spreadsheet that is available on Interchange, from the GCE Chemistry B (Salters') page. If used, Centres should send a copy to the Moderator along with the Mark Sheet (MS1) and Centre Authentication Form (CCS160).

Centres should group the candidate's four best Tasks together loosely (e.g. with a treasury tag) when submitting work to the moderator and also include a copy of the Skill I Competence Record Card (also available on Interchange). It should be noted that **only** the four best Tasks should be submitted for moderation and **not** all of the work that has been completed. Similarly if a candidate achieves the same score on two or three Tasks for a given Skill, the Centre must choose which Task to submit for moderation and not simply submit all to the moderator. Where this does not happen the process of moderation is delayed.

Conduct of tasks

All Tasks used in the assessment of Skills II to V should be carried out under controlled conditions. Candidates are not allowed to modify or add to their answers after the Task has been handed in to their teacher. It should be rare, therefore, for candidates' work sent for moderation to include answers that have been crossed out and replaced.

Skill I

It is still the case that the expected documentation to support the award of marks for Skill I was not always included with the moderation sample. Centres should use the Competence Record Card available from OCR, or devise their own document, to show that the activities undertaken by candidates cover all of the six required types of practical work and to include marks or teacher comments noted during the year to help inform the award of marks for Skill I.

The mark for Skill I should be the best fit integer (whole number) when judged against the marking descriptors, so that when doubled a mark out of 12 is generated that is an even number. Some Centres are still giving a mark of say 5.5 and doubling this to give 11. This will give rise to a Clerical Error form being generated to the Centre. Such a situation then causes a delay in the process of moderation.

The marks awarded to candidates by most Centres for Skill I showed the expected good match with marks gained by candidates in Skill II and Skill IV tasks. This suggests that Centres are applying the descriptors for Skill I in an appropriate manner. This is of course to be expected since Skills I, II and IV all assess the ability of candidates to carry out practical work. However, some Centres are still giving what appear to be inflated marks for Skill I when compared with Skills II and IV.

Skills II – V

The marks awarded to candidates by centres for Skills II to V represented a generally accurate application of Mark Schemes to candidates' work. There were, however, a number of cases where candidate answers were marked as correct even though they did not match the expected answers given in the Mark Scheme.

In Skill II Tasks, there were few problems. The Mark Schemes give very precise guidance about what is required in tables of recorded data and the marks available for candidate results when compared to the value obtained by the teacher. Occasionally marks were awarded that were not consistent with this guidance. The main problems here occurred where subtractions had not been checked, for example of initial from final titres in titrations, or initial from final temperatures in thermochemical experiments. It is important that the Additional Guidance is carefully followed in such cases to see whether or not a mark may be awarded e.g. Tasks 2 and 3 (titrations), parts (d) – (h), and Task 1 (thermochemical), parts (d) – (g). Also when showing which readings have been used to calculate an average value for a titre, if requested a tick must be placed against the readings used if that mark is to be awarded.

In Skill III Tasks, the Mark Schemes allow for candidate errors made in one part of the task to be carried forward to subsequent parts to avoid penalising the candidate twice for the same error. Not all Centres applied this idea effectively. Again the Additional Guidance helps with the award of marks. It should also be noted that in Task 1, part (e)(ii) the second mark depends upon the first, so without a reference to the addition of the catalyst, the mark for the temperature rise cannot be obtained.

The Mark Schemes in Skill IV Tasks often include precise observations that are expected in order for candidates to be awarded marks. In some cases marks were awarded even though the expected observations were not included or were very vague. For example, if the Mark Scheme requires candidates to observe that a green precipitate is formed for 1 mark (Task 1, part (a)), then both colour and an indication of solid will be expected. Similarly, if the Mark Scheme requires both a dissolving of a precipitate (on warming) and a reappearing (on cooling) both must be clearly identified for the mark to be awarded (Task 2, part (f)(ii)). Again, if the Mark Scheme requires candidates to identify the formation of two layers in a test tube (Task 2, parts (b) and (c), and Task 3, part (a)) then when it is specified that an upper and lower layer need to be identified to gain any mark, an answer that does not do this, even if the correct colours are given, cannot score these marks. So an answer such as 'orange at the top, colourless below' is not sufficient since this may result from inefficient mixing. An explicit reference to two layers must be made, for example 'two layers are formed, the top one being orange and the lower one being colourless'. Again, it should be noted that 'clear' is not the same as 'colourless', and 'cloudy' is not usually an acceptable alternative to 'precipitate', unless specifically stated as such in the Mark Scheme. Where colours are required in an answer it is important to note the Additional Guidance of the Mark Scheme where the statement 'any combination of these colours but no other colours should be mentioned' is often stated.

It is important that the Centre carries out a trial run of the experiments in the Tasks before the Tasks are set to the candidates. This allows for any minor modifications (e.g. of solution concentrations) that may be necessary when using the chemicals in the Centre in order that candidates' may achieve the observations in the Mark Schemes. This is essential because credit should not be given for observations that are not in the Mark Schemes. If the expected results cannot be achieved, the Centre is required to contact OCR using the e-mail address GCEScienceTasks@ocr.org.uk giving details about the observations made by the teacher. A copy of the relevant communications should be included with the sample of work for the moderator.

In Skill V Tasks, candidates are sometimes asked to explain reactions in terms of redox behaviour. In such a case it is necessary for candidates to use terms associated with oxidation and reduction in their answers rather than general comments about reactivity or displacement. In Task 2, part (b) in particular, the important point here is that there is an explanation of the observations. Given this, an answer that does not include 'bromide' and 'bromine' should not score the mark. So answers such as 'chlorine removes electrons from bromide to form bromine' and 'chlorine changes the oxidation state of bromine from –1 to 0' would satisfy this requirement for explanation. Where structures of organic functional groups are required it is acceptable for candidates to include 'R' for alkyl groups or to use specific examples such as methyl or ethyl groups. Where equations are required together with state symbols, and separate marks are awarded for the equation and the state symbols, the mark for the state symbols can be awarded, if the states are correct, even if the equation itself is incorrect.

If, after using one of the Tasks, a Centre believes that an answer not included in the Mark Scheme should be marked as correct they should immediately check this with OCR using the e-mail address GCEScienceTasks@ocr.org.uk.

Clerical Errors

A number of Centres sent in marks that contained Clerical Errors. Sometimes this arose from transcription errors made in transferring candidate marks from their work to a spreadsheet. On other occasions it arose because a candidate had carried out more than one Task in the same Skill and the highest scoring task was not used to calculate the total mark. However, it also arose where Centres had awarded a non-integer mark out of 6 for Skill I. The mark for Skill I should be a the best fit whole number when judged against the marking descriptors so that when doubled to give a mark out of 12 it generates an even number. It is important that Centres check marks carefully in order to avoid such errors.

Security of Tasks

Distribution of the practical Tasks is limited to those candidates who are currently undertaking that task. Task sheets should be photocopied and issued to candidates at the start of the task. They must be counted out and in; numbering the documents may help to keep track of them. In no circumstances should practical Task assessment materials be posted to a website where they can be accessed by the public.

All unused tasks and candidates' scripts must be collected after the assessment and stored securely or destroyed.

All F333 tasks, Mark Schemes and Instructions are live assessment materials for the life of the specification. These should be kept secure at all times even if they are not valid for assessment this year as they may be reissued in subsequent years. Tasks must only be made available to candidates for them to complete under controlled conditions and the completed Tasks must be submitted to the teacher at the end of the lesson. Mark Schemes and Instructions must be kept securely and not made available to candidates.

Practice Tasks

In 2011, OCR made a Practice Task available for each Skill type. Practice Tasks are available to download from Interchange, and can be used in the same way as the Specimen Assessment Materials (SAMs) to prepare candidates for the Practical Skills assessment. New Practice Tasks will not be issued each year. The Practice Tasks are published to Interchange only to allow centres to use them as mocks if they so wish.

Availability of files on Interchange

Each year, Tasks (and Instructions for Teachers and Technicians) and Mark Schemes are available from 1 June, and are removed by 15 May in the following year.

Clarifications/modifications to Tasks and Mark Schemes

From time to time OCR may need to publish clarification for a task in light of centre queries. Centres should ensure that they check Interchange before using a Task for assessment to ensure that no modifications have been posted and that a check is made before final submission of marks to OCR by 15 May.

An e-mail alerts service is available. To be notified by e-mail when changes are made to GCE Chemistry B (Salters) pages Centres should e-mail GCEsciencetasks@ocr.org.uk including their Centre number, Centre name, a contact name and the subject line GCE Chemistry B (Salters). It is strongly recommended that all Centres register for this service.

Re-submitting Tasks in future years

Only OCR Tasks from Interchange clearly marked with the current assessment year, *i.e*. 1 June 2012 to 14 May 2013, can be used for practical assessment during that period.

However, if a candidate wishes to improve their mark they could re-submit their best 1 June 2011 to 14 May 2012 Task(s), along with a new (from the 1 June 2012 to 14 May 2013 selection on Interchange) Task from the other Skill(s). However, the marks confirmed by the Moderator when the Task was first submitted cannot be 'carried forward'. Teachers should re-mark the Task in light of any comments made by the original Moderator and it will be re-moderated when it is re-submitted. Up to four Tasks per student may be re-submitted. Where a candidate wishes to improve their mark, their Skill I mark can be re-submitted (their Competence Record Card will need to be re-submitted for moderation) or, where they have fulfilled the assessment criteria, their Skill I can be re-assessed and their new mark, along with a new Competence Record Card, submitted for moderation.

F334 Chemistry of Materials

General comments

General knowledge of the factual material covered in the unit was good, particularly regarding organic chemistry, polymer properties and transition metal chemistry. However, candidates of all abilities appeared to make more errors when dealing with formulae, equations and calculations. Responses were often confusing and contradictory through an inadequate reading of the question, whilst there was an unwillingness to use correct technical terms, relying instead on more descriptive jargon.

A couple of points raised in January still need improvement.
- The problem in the use of ‘appropriate significant figures’ remains. Fewer candidates than in January could get this correct (Question 3(f)).
- Use of the *Data Sheet* by many to identify infrared spectrum peaks was poor; often data quoted off the sheet was inadequate or wrong (Question 4(e)).

Comments on individual questions

Question 1

(a) Some confusion about identifying the monomers from a polymer chain continues, with many ‘carboxyl’ groups seen as opposed to ‘oxygen/carbonyl’, whilst many chose repeating units containing multiple ‘monomer’ units. The trick here is to use the ester linkage, which the vast majority identified correctly, to realise that an alcohol and a carboxyl group are used to form the linkage.

(b) Many recognised that the monomer should have an –OH and a carboxyl group but were either careless or confused in drawing the structural formula.
Many full structural formulae were drawn **without** the H on the α-carbon, whilst many skeletal formulae appeared with an H on the α-carbon; both losing the candidate the mark. There seems to be a creeping tendency by students to mix the two types of structures together. Centres should try to discourage this practice.

(c) The various explanations involving PLA formation were generally tackled successfully apart from the reason why the absence of water was important regarding yield. Candidates need to explain their answer in terms of the breakdown of the polymer rather than just stating ‘reacting’ as given in the stem.

(d) Many answers lacked precision with candidates stating ‘chiral’ atom/centre when they meant ‘carbon’, and restricting groups to ‘functional’ or the more general term ‘-R’ groups.

(e) The properties of polymers were clearly understood by most candidates. Candidates who organised their answer into the 3 parts described in the question generally scored well from detailed and relevant answers.
However many students missed out stating that a polymer above its T_m is a liquid; instead they wrote about increased flexibility or too much detail **explaining** the ideas of intermolecular forces behind T_m, usually ending up with ‘chains sliding’. This was not asked for here, only a **description**. They then missed out similar details later on in the question where the explanation was asked for. The most common missed mark was the idea that a polymer below its T_g will break if a force is applied. There was also a tendency to not clearly distinguish between covalent bonds within the chain and intermolecular bonds between the chains.

(f) Few recognised that this question was about materials from renewable resources as opposed to finite resources.

Question 2

(a) Oxidation numbers are clearly a weak area for a significant number of candidates. Many wrong answers were given where students could not work out which species had changed its oxidation state; often oxygen was involved. Simple ions as answers were common, especially for the chromium species, whilst a significant number of students omitted the chromium altogether. Some forgot to explain why oxidation had taken place but otherwise, this point was answered well.
Most failed to correctly name Na_2CrO_4 because they did not quote the oxidation state of the chromate ion, calling it chromite or even chromium oxide.

(b) Omitting water was the commonest error, although some candidates could not write the formula of sodium sulfate correctly whilst others considered that NaOH was a product.

(c) Few considered 'filtration' as a possibility, most used one of the following: a magnet, distillation, electrolysis, recrystallisation, elimination or a reaction with a reactive metal or oxygen.

(d) Most candidates found this testing and had to work hard for this 1 mark; only the best were able to reason it out. Many were unable to apply their knowledge to the information in the flow diagram. Some thought that the two oxides were equal in strength, whilst many thought Cr_2O_3 was more oxidising since 'Cr has a larger change in oxidation state'.

(e) Most managed to draw a cell, though a number omitted the salt bridge or voltmeter or stated an incorrect temperature. A few tried to label the hydrogen electrode but ignored the Cr electrode. Others did not make it clear that Cr^{3+} ions were in solution.
Many candidates gave correct equations, better than previously has been the case with ionic equations. However, it was fairly common to get the equation the wrong way round (poor understanding of E^o), when this happened it was also common to forget the state symbols. Many got the first mark but failed to balance the equation. Half-equations involving Cr alone were also frequently seen.
The third part was challenging, only the most able students were tackling this with any clear understanding. Electronegativity was often confused with electron affinity, and occasionally ionisation energy. In a large number of cases, there was a failure to restate the conclusion correctly. Interpretation of the data was not strong, and labelling the oxidising (or reducing) agent was inaccurate *e.g.* Cr^{3+} was stated as being a reducing agent. The misconception alluded to in the question was also shared by many candidates. A reasonable number of students just changed the words 'oxidizing agent' for 'reducing agent' without thinking it through.

(f) The candidates generally were able to identify the two species acting as acids but seldom scored the definition mark. Acids were defined as proton donors, but the definition of a base was omitted. The equilibrium was often described in terms of an acid reacting with a base to form a salt and water. References to conjugate acids and bases, instead of proton exchange, were common without any explanation what these are.

(g) All parts were well attempted. Commonest errors were missing numbers from the name and not stating the type of bond that is formed with the central atom.

(h) Drawing a three-dimensional diagram is always a challenge, and requires previous practice. Although many good examples were seen, some had little idea how to begin whilst trigonal-planar and tetrahedral designs were quite common. The argument for optical isomerism was frequently based on 'chiral carbons' or some phrase learned by rote such as 'it has a mirror image'.

Question 3

(a) Usually correct, though examples of all the terms given were selected.

(b) Generally good, but the usual suspects of conc. NaOH or H_2SO_4 were sometimes used. Most gained the $–NH_2$/–COOH mark but again the same errors abounded as seen in 1(b) regarding use of skeletal/structural formulae.

(c) Phenol chemistry was well known and the usual alternative to colorimetry was titration.

(d) There was some confusion over 'tertiary structure', often with 'secondary' with some applying it to alcohols or amines.
Again, candidates were rather loose with the use of the word 'bond' and do not appreciate that, in this case, pH changes will affect ionic and hydrogen bonds rather than all bonds. Many used the amine group as an example, although if a carboxyl was chosen they often suggested that the carboxylate ion would be formed.
Some candidates discussed very general effects such as 'protein denatures' rather than using chemical terms. This was also very common in part (e).

(e) In the first part it was clear that many had failed to absorb the context, discussing 'colour change' or even 'absorption of heat'.
Some candidates did not read the question concerning using the graph and so many answers were in terms of drawing a tangent and taking a gradient.
The ideas behind the graph shape were clearly understood, which was surprising as the majority of students were unable to describe how to read off the rate in the previous question. However, many marks were lost due to the inaccurate wording of correct ideas. Most linked rise in temperature to increase in energy of various chemicals (rather than particles) and gained the first mark, but few followed this through with the idea of the collisions exceeding E_a. The third mark was not often seen; most students mentioned the word 'denature' and thought that this covered all ground. A good number did go on to gain the final mark, which was generally well described.

(f) Many candidates recorded 0.308 for their final answer and were unsure about how to work out the number of significant figures that are appropriate. They clearly are able to work out the units in this situation though, so a majority gained 2 out of the 3 marks.

(g) Although generally answered well, a number of candidates thought that the order was 1 and gave elaborate explanations which did not fit the information provided.

Question 4

(a) Few recognised a problem with administration or what constituted a safe dose. Instead they concentrated on finding side-effects or overcoming skin problems.

(b) It was uncommon to award full marks for this question but many students gained 3 or even 4 marks. The first mark was commonly lost due to mentioning chromatography 'paper' or by missing out the pencil line. Also common was the failure to be clear about what exactly was spotted onto the line. The best students did this by labelling all four of the spots required on a diagram. Although it was only necessary to mention the mixture / cinnamon oil to get the mark, a number of students still failed to say what they were performing the experiment on. The second mark point was either clearly stated or was obvious from the diagram. The third mark point, for removing/drying the chromatographic plate when the solvent nears the top of the plate was omitted by many students, even though many did mention marking the level of the solvent front on the plate. The location of spots was mentioned by most with only a small number using ninhydrin or the less specific 'locating agent'. The use of R_f values and comparison with known values was well described. The best students also sketched a likely outcome of the plate which showed matching levels of the individual components within the mixture.

(c) Ester was often confused with ether, whilst some hedged their bets with 'esther'. Alcohol was often given instead of hydroxyl/phenol.

(d) The formation of a soluble salt for eugenol was not well expressed whilst linalool was mainly ignored.

(e) A significant number of candidates did not logically follow the evidence in the IR spectra and so arrived at the wrong conclusion. There was also a lot of incorrect reporting of the wavenumber ranges or failure to mention the key bond giving rise to the peak.

(f) This was well known.

(g) Very few candidates arrived at the correct answer. It is apparent that many are not confident in following through an unstructured titration question. This question was therefore a good differentiator for the most able; it really showed the importance of clear, stepwise working as 3 out of 5 marks could still be gained here even if 2 key steps were omitted. Almost all students who attempted the question got the first mark. The most common scenario was where a student had not been sure how to use the titre value of 10.8cm^3 and so had missed the second mark point, going straight onto the third point where the stoichiometry was applied and gaining this as a method mark with an error carried forward. The fourth mark point was rarely awarded as it was common to omit the scaling up to 1dm^3 and continue straight to the final mark for multiplying by the molar mass of the acid. Some students used a tabular style format for n, C, V etc. and lost out on method marks. This is not an advisable way to perform a titration calculation, since the examiner can only see a random array of numbers.

F335 Chemistry by Design

F335 Chemistry by Design

General comments

This paper performed in a very similar way to last June's F335 paper. At the top end there were some excellent scripts with candidates showing that they had gained a great deal from the Salters course and thereby acquired a real understanding of chemical concepts.

Many candidates demonstrated fundamental abilities such as writing chemical formulae and equations, naming organic compounds and describing common organic reactions. Their knowledge and understanding of IR spectroscopy was definitely better than nmr. Knowledge and understanding of entropy was not so good. There was real confusion between entropy and enthalpy among the weaker candidates. Some candidates coped well when faced with a question that required application of their knowledge into a new situation but others found this difficult.

There were some excellent answers to calculation questions but overall the standard was variable, especially on those involving pH. Few candidates realised that when one piece of data is given to one significant figure, the answer ought to be quoted to one significant figure.

Some candidates were able to give careful and cogent answers to long-answer questions which showed a logical understanding of the subject. Other answers were less well constructed and did not quite make the points that the writers intended.

Candidates who used the 'additional page' to extend their answers usually made it clear in the main body of the script that they intended to do so. Others must realise that it is not helpful for answers to be continued elsewhere on the double-page spread, except that questions can be continued to the bottom of a page if there is space there containing no further questions. Many candidates took a pride in their presentation and handwriting but there were others who made life difficult for the examiners and for themselves in scoring marks if they answered imprecisely or made copying errors.

There were no indications that candidates were short of time on this paper.

Comments on individual questions

Question 1

1(a) Most candidates were able to identify the correct oxidation numbers and give one of the acceptable names of NO_2 ('nitrogen (IV) dioxide' was accepted but the preferred answers were either 'nitrogen(IV) oxide' or 'nitrogen dioxide')

1(b) Many candidates knew that nitrogen dioxide was brown.

1(c) Most candidates knew about nitrogen compounds being used as fertilisers and that nitrogen dioxide gave rise to acid rain, though other answers were too vague to score.

1(d) Most candidates could calculate the concentration of nitrogen from the given value for oxygen, though the calculation verifying this given concentration was often missing or unclear. The equilibrium constant was nearly always correct. The calculation in part (iii) was achieved by many candidates, though some found handling the square and the square root difficult. Only a few realised that one significant figure was suitable, however. Parts (iv) and (v) showed a good understanding of the effect of conditions on equilibrium, though some failed to say that the equilibrium *position* moved to the right in part (iv).

1(e) Many scored on the equation, though some included an equilibrium sign. The calculation was often correct.

1(f) Part (i) was well done by many candidates who worked through the processes described and reached the correct answer. Part (ii) was often correct, though some incorrect oxidation states and some nitrogen compounds appeared. Some candidates realised that the answer to part (iii) was 'nitration'; 'diazotisation' and 'buffers' were the commonest incorrect answers.

Question 2

2(a) Just a very few candidates are to be congratulated on carefully working out the molecular formula of malic acid and deducing that carbon dioxide was formed. By far the commonest answer was methanoic acid. Many could name lactic acid in part (ii).

2(b) Diagrams were often good, the commonest error being not showing three-dimensional structures. There are certain criteria for drawing such diagrams and teachers are advised to consult the Mark Scheme if they need further information. Most deduced correctly that there was one chiral centre in malic acid.

2(c) Many candidates were able to spot that malic acid had two carboxylic acid groups which gave it two pK_a values. The commonest error was to relate the two values to there being two stereoisomers. Some could navigate their way through the argument that because lactic acid had a *higher* pK_a than one of the values for malic acid, it had a lower number of H^+ ions in solution.

2(d) The equation was often correct in part (i), though there were some arrows and some incorrect anion formulae. Part (ii) was often correctly done, as was part (iii). A proportion of candidates managed part (iv). The important thing to realise is that working shown in such calculations often allows partial credit to be given if the answer is wrong.

2(e) A few candidates produced the structure of the 'lactide', which fitted the formula given, the structure of lactic acid and the spectroscopic data. Others proposed cyclic compounds which did not match the data or would not form from lactic acid. Most candidates scored for stating that an ester C=O was present but no OH.

2(f) In order to score, candidates had to know the anhydride formula and also be able to negotiate the loss of another water molecule to form 'maleic anhydride'. Quite a number knew the former, and some could also manage the latter.

2(g) Most could name ethanal and many could draw the structure of the cyanohydrin. Part (iii) was often correct, also. A good few could deduce that ammonia was formed, though few spotted that this would be turned to an ammonium ion in the acid conditions. 'HCN' and 'NH_2' were common wrong answers.

2(h) The colour change and the structure were known by most candidates, just a few reversed the colour change or added extra oxygen atoms to the formula. In part (ii), most could say that the same colour change would be given by both substances but identifying lactic acid as having an alcohol group was not quite so common.

Question 3

3(a) Most candidates could name propane-1,2-diol, though quite a proportion benefited from the decision to allow 'propan-1,2-diol'.

3(b) A few candidates understood that a co-product is formed as an *additional* product in a *reaction*. Even fewer were able to describe a by-product as the product of a side reaction. Many answers focused too much on whether the products were useful. In part (ii) the correct answer 'hydrolysis' was frequently seen. The commonest wrong answer was 'condensation'.

3(c) In order to score here, candidates either had to describe water as the *only* product, or say that no *toxic* products were formed, or talk about renewable resources. Many used one of these routes.

3(d) A lot of candidates realised that pressure would not affect the equilibrium here and talked about the increase in the rate of the reaction being due to increased *frequency* of collisions.

3(e) Many candidates could draw the curly arrow correctly in part (i) and it was good to see that most drew an unambiguous line from one bond to another. Again, many candidates answered part (ii) correctly and most scored both marks on part (iii). The commonest error was to add 'alkane' which contradicted a correct answer.

3(e)(iv)Most started well, giving the bond and the absorption which distinguished acetol in the IR. Some went on to talk about similarities in the IR spectra which were not required by the question. A few negotiated a complex analysis of the nmr, relating peaks to proton environments, realising that acetol had no splitting in any of its peaks and giving the reason in terms of no hydrogen atoms on *adjacent carbon atoms.*

3(f) Most could work out the oxidation state of the chromium, though answers of '+6' were sometimes seen. In part (ii), many could say that catalysts had no effect on the equilibrium constant but that they speeded up the achievement of equilibrium. Just 'speeding up the reaction' was not good enough.

3(g) There were a lot of correct answers here, by far the commonest error being to work out the percentage yield by mass instead of by moles.

Question 4

4(a) Many candidates not only gave the correct structural formula of the product but also included the HCl produced as well. Many could name the reagent correctly and most named the reaction as electrophilic substitution.

4(b) Some candidates were able to select one of the products and give a possible contaminating effect. Many answers were too vague and did not mention a substance formed.

4(c) Part (i) was well answered with many candidates gaining full marks. Many candidates described weak ionic bonds in part (ii) that did not take much energy to break. However, too many used the term 'intermolecular bonding'.

4(d) Some candidates were able to select for part (i) one of the possible correct structures. The commonest error was a structure containing no chlorine atom. Most candidates were able to score some marks on part (ii). Some were able to set out a logical answer which showed that they understood how the electrons moved, the relation between energy *change* and frequency, the fact that dyes had smaller energy gaps than benzene because they had more delocalisation and the fact that uv radiation had a higher frequency than visible light. Some did not give a clear *comparison* between benzene and dyes and a small proportion still think that light is emitted when electrons drop down.

4(e) This question was well done with most candidates realising that it was the stability of benzene's delocalisation which caused it to undergo substitution to form bromobenzene rather than addition reactions. Those who drew a structure for the addition product often scored while those trying to name it found it more difficult.

Question 5

5(a) Most candidates answered this correctly.

5(b) In part (i), most candidates gave the correct equation, but only some were able to give the gaseous state symbols correctly. In part (ii), many candidates understood that the full d subshell was stable. Most candidates could give the formula of zinc sulfate, but there were a large number of variants among the incorrect answers.

5(c) Some candidates were able to give a correct equation with the 'basic salt' but many found this difficult.

5(d) Most candidates could name 'lattice enthalpy' and many could do the calculation in part (ii) correctly, though some forgot that two chloride ions were involved. Part (iii) was often well done with some forgetting that hydrogen bonds were broken in the water.

5(e) Many candidates correctly described entropy in terms of disorder or ways of arrangement of particles, but some talked about atoms or arranging 'a molecule'. Some candidates were able to describe carefully the change in disorder when a substance dissolved. A few showed that they understood that calcium ions were strongly hydrated and that this increased the order of *the water molecules.* There were many attempts to answer this in terms of strong bonds in the lattice or the insolubility of calcium compounds.

5(f) Some candidates gave a correct equation for ΔS_{tot} and correctly described ΔS_{surr} as getting *less negative* as temperature increased, thus ΔS_{tot} increased and the solubility increased. Some were confused about how to describe a negative number which was getting less negative and many answered this in terms of the effect of temperature on equilibrium, which only enabled them to score the first mark.

F336 Chemistry Individual Investigation

General comments

It was clear that the vast majority of centres put an enormous amount of time and effort into preparing candidates for the individual investigation. In most centres candidates undertook appropriate investigations that allowed them to demonstrate their chemical skills and knowledge. In some cases the work was of a quality that went well beyond that which might normally be expected of A level candidates. In a few cases candidates needed to spend more time on their investigations to allow their ideas to develop and to collect sufficient results.

A wide range of investigation topics was chosen by candidates. Chemical kinetics and analysis projects were again very popular but less common topics such as the Freundlich Isotherm, inorganic complexes, partition coefficients of organic acids and double salts were also seen.

A few candidates needed to choose more demanding topics to investigate. Investigations such as acid and thiosulfate and simple electrochemical cells do not allow candidates to develop their skills and understanding sufficiently. It appeared that some candidates treated their work as an extended experiment rather than an investigation. This led to formulaic reports that scored less well than might have been expected.

A few investigations were not appropriate. These included investigation of the effect of a solid on rate of reaction and a comparison of aspirin tablets bought at different suppliers or prices. Other candidates chose experimental methods that focussed too much on biology or physics and lacked the essential chemical component required by this assessment component.

A few candidates began their investigation report with a brief abstract. This seemed to help them structure the rest of the report and to have a clear focus on what they did and the outcomes they achieved.

Written evidence arising from direct teacher observation of candidates at work in the laboratory should be sent to the moderator to support the mark awarded in skill G. This often takes the form of an aide-memoire in which the teacher adds comments several times during the course of investigations. Centres should ensure that they think ahead about how they are going to collect this evidence and should send it to the moderator with candidates' work. In a small minority of cases investigation reports lacked cover sheets or candidate numbers.

Most candidates presented their investigation reports well with almost all work word processed. Most candidates seemed to benefit by dividing their report into distinct sections to cover theory, method, results, analysis and evaluation. Such a practice is highly recommended.

OCR provides a free Coursework Consultancy service, which allows teachers at the Centre to obtain guidance on their marking from the Principal Moderator before marks are submitted to OCR. Details are to be found on Coursework Enquiry forms, available from Interchange.

Comments on specific skill areas

Skill A

Many candidates carried out effective research to find the chemical theory required for this skill area. In the better examples all the theory was relevant to the investigation undertaken. In kinetics investigations candidates should explain how they intend to use the Arrhenius equation to draw a graph to determine the activation enthalpy rather than just quoting the equation and should ensure that they discuss in sufficient detail the reaction they are going to investigate.

Skill B

There were many examples of good practice in this skill area where candidates provided sufficient detail about experimental methods so that another student could have used the account as a set of instructions to repeat the experiments. This is a good guideline to the amount of fine detail required. In other less good cases candidates did not give details about experiments after the first of several different conditions had been investigated.

In a few cases candidates could have been more ambitious in the amount and range of experiments that they carried out which would have allowed them to develop their use of chemical techniques and related chemical ideas more fully. In some cases candidates needed to consider more carefully whether the experiments that they chose would help them achieve their stated aim, particularly where they needed to ensure that the experiments would lead to precise quantitative analytical data. For example, qualitative tests with iron(III) chloride, melting point measurements and thin layer chromatography do not allow candidates to determine the accurate purity of aspirin.

Lists of standard apparatus are not expected. Drawings or photographs of standard equipment such as a burette or stop watch do not add to the report and are also not required.

A few candidates who investigated kinetic ‘clock’ reactions changed the concentration of sodium thiosulfate. This is not an appropriate choice and suggests that more teacher guidance is needed.

Skill C

The marks awarded in this section were sometimes a little higher than was merited. Candidates need to take care to link their risk assessment with the concentration of solution used in the investigation. Photocopies of Hazcards reflect a lack of selectivity on the part of the candidate. Comments in the risk assessment about the dangers of broken glassware, Bunsen burners and long hair are not expected at this level.

Some references to electronic resources lacked sufficient detail. A short sentence describing their content works very well. A few candidates included many references to images rather than the more comprehensive sources they might have consulted.

Skill D

Whist many candidates produced sufficient high quality data some did not spend sufficient time in the laboratory to produce enough results. Others spent too much time on unnecessary repeats of experiments which limited the range of different experiments they were able to investigate.

In investigations involving titrations it is expected that candidates will change concentrations of solutions if they get very low titres, that they will record all burette reading not just titres and will record volumes to two decimal places.

Skill E

Many candidates were able to draw useful graphs and carry our relevant calculations. Drawing relevant conclusions based on recorded data and linked to theory described in Section A was less well done.

In kinetics investigations candidates should make clear links between the graphs they have drawn and the orders of reaction that may be inferred from them. Many candidates did not make clear the assumptions made in using the reciprocal of rate of reaction rather than the reciprocal of rate constant in an Arrhenius plot to determine the activation enthalpy. A few candidates used temperatures measured in degrees Celsius rather than Kelvin in an Arrhenius plot.

Skill F

When evaluating percentage errors it is expected that candidates will use the correct error for each particular piece of equipment, will calculate the percentage error for all types of measurement and will show their calculations clearly.

Comments on the limitations of experimental procedure can be quite brief and limited. Some candidates would benefit by developing this aspect of their report to ensure that key points relating to all of their experiments are included. Candidates seem to achieve this most easily by grouping all of their comments together rather than spreading them out in different parts of their report.

Skill G

It is expected that there will be a range of marks for this skill area submitted by centres to match the range of performance that is usually seen in marks for skill D. Many centres need to check that the range of marks for their candidates in this skill does cover an appropriate range since in some cases the award of maximum marks for the majority of candidates was clearly not appropriate.

Skill H

The award of marks in this section was more appropriate than in the past although there were still a number of centres where the marks awarded were too generous. As an example, a kinetics investigation in which the concentrations of reactants are changed in order to determine the orders of reaction and the temperature changed in order to determine the activation enthalpy via an Arrhenius plot should be awarded a mark of 3 out of 5.

Most centres appreciated that to be awarded maximum marks candidates need to show real flair in their ability to innovate and solve problems.

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