

GCE

Chemistry B (Salters)

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

OCR Report to Centres June 2015

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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 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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CONTENTS

Advanced GCE Chemistry B (Salters) (H435)

Advanced Subsidiary GCE Chemistry B (Salters) (H035)

OCR REPORT TO CENTRES

Content	Page
F331 Chemistry for Life	4
F332 Chemistry of Natural Resources	7
F333 Chemistry in Practice	13
F334 Chemistry of Materials	18
F335 Chemistry by Design	22
F336 Chemistry Individual Investigation (Coursework)	26

F331 Chemistry for Life

General Comments:

The paper proved accessible to all candidates, with the very low number of 'no responses' confirming this accessibility.

Marks ranged from 1 to 59 and time did not seem an issue.

Some candidates lost marks on this paper because of a lack of clarity and/or precision in their answers. (See comments on specific questions below) This was unfortunate because in many cases the candidate had the right idea but the wrong choice of word or technical term meant the mark was lost. Examiners also commented that the legibility of responses seemed worse than usual this year.

Calculations were of variable standard and in some cases it was difficult for examiners to follow working, precluding the possibility of ecf marks.

Overall, however, the majority candidates were able to demonstrate their chemical knowledge and understanding and had clearly been well-prepared by centres.

Comments on Individual Questions:

Question No.1

This question proved the most straightforward of the four questions on the paper.

Q1(a), This gentle starter question was correctly answered by the vast majority of students.

Q1(b)(i), Correctly answered by most candidates.

Q1(b)(ii) The first marking point required the detail that positive ions or cations were formed. The mark was not awarded for just 'ions' formed. The second and third marking points were usually scored although there were still a small, but bemusing, number of students talking in terms of magnetic deflection.

Q1(b)(iii) This calculation was well-answered.

Q1(b)(iv) A well-answered question.

Q1(b)(v) It was pleasing to see that well over half the candidates were able to write correct nuclear equations for this slightly different decay process. The main errors were sub/superscripts being placed on the wrong side and wrongly working out the proton number of the product.

Q1(c)(i) This was well-answered.

Q1(c)(ii) Candidates were not comfortable with writing an overall electron configuration, in terms of principal electron shells.

Q1(d) This question required a clarity of thought and a logical answer. Examiners were looking for the idea that the properties of the known elements only matched with others in the group if a gap was left. A common mistake was to mention Mendeleev ordered the known elements in order of atomic number.

Q1(e) Phrasing was key to scoring the first mark here. Candidates needed to say that the number of occupied principal shells/energy levels indicated the Period. The very common, vague answer, of simply 'the number of electron shells' did not score the mark.

Numerical answer 1(b)(ii) 72.7

Question 2

Q2(a)(i) Common errors on this calculation were subtracting enthalpies of formation of reactants from products, leading to the wrong sign, and failing to double the values, as represented in the equation.

Q2(a)(ii) The vast majority of candidates did not seem to realise that enthalpy of formation is for 1 mole of compound formed, and doubled the equation. The state symbol mark was, however, usually gained.

Q2(a)(iii) Candidates often scored the mark for a gas being produced but their terminology prevented scoring the second mark (more moles of products or more molecules formed), often writing just in terms of more products.

Q2(b) This question discriminated well. However some candidates missed out on the possibility of ecf marks because of the haphazard nature of their working.

Q2(c)(i) Mostly correctly answered, but a common error was to write in terms of aliphatic compounds containing no 'rings.'

Q2(c)(ii) Generally well-answered.

Q2(c)(iii) Generally well-answered.

Q2(c)(iv) Mainly answered correctly. The most common error was a description of molecular sieves.

Q2(d) Well-answered; however some candidates did not seem to realise the answer was in terms of what was not produced, rather than what was.

Numerical answer. 2(a)(i) -196 2(a)(iii) 280 (any number of sig.figs. allowed)

Question 3

This question was the most discriminating of all the questions on this paper.

Q3(a)(i) Most candidates could draw an appropriate skeletal formula but a small minority considered the molecule to be an alcohol, instead of an ether.

Q3(a)(ii) A significant minority of candidates put a separate OH group on the end of their formula.

Q3(a)(iii) Well-answered.

Q3(b) Well-answered by a large majority of candidates.

Q3(c) Generally well-answered.

Q3(d)(i) The most common wrong answers were to identify the other product as water or ethane; however, a significant majority of students answered correctly

Q3(d)(ii) One of the most discriminating questions on the paper. The most common error was to suggest only two 'sets' of electrons were around the C atoms in cyclopropane, leading to a wrong predicted angle. It seemed that many candidates did not recognise this as a skeletal formula with bonds to H atoms therefore not shown. 120° was often the quoted C-C-C bond angle.

Q3(d)(iii) Not well-answered. Most candidates did not realise that average bond enthalpies are for the breaking/forming of 1 mole of bond. The second marking point was also rarely scored, usually this time by a less than precise phrasing; for example 'different molecules' rather than 'different compounds'.

Question 4

Overall this question proved the most difficult on the paper.

Q4(a)(i) Well answered.

Q4(a)(ii) A significant minority number of covalent structures were offered for this Group 2 compound.

Q4(a)(iii) This 5 mark question, perhaps not surprisingly, was the most discriminating question on the paper. The first marking point for the absorption of heat energy being the cause of the initial promotion of electrons was commonly missed or incorrectly attributed to the absorption of photons.

Other marking points were more regularly scored but lack of precise terminology, again, occasionally got in the way of examiners being able to award marks. For example, the nature of an emission spectrum and the explanation for such a spectrum sometimes became confused.

Q4(b)(i) The most common error was to suggest the mass of carbonate should be kept constant, rather the amount (moles).

Q4(b)(ii) Often candidates did not seem to appreciate that the experiment was being used as a comparison between carbonates and lost the second mark for the observation that the lime water would go cloudy quicker with calcium carbonate.

Q4(c) This question was the most difficult on the paper for three-quarters of candidates; however the most able candidates often achieved full marks. Some candidates did not write the formula of an ion as their answer and others failed to realise the question was asking about group properties in terms of formulae of compounds.

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 was no indication that candidates lacked time in the examination, with answer spaces that were left blank being rare and resulting from a lack of knowledge or understanding of the question, rather than an inadequate amount of time.

Good attempts were made at questions involving the greenhouse effect, bonding and intermolecular bonds. Many of the calculation questions were well answered, with candidates setting out their answers sufficiently clearly to be able to see what was being calculated at each stage. This allowed credit to be given towards the end of a calculation, under the 'error carried forward' rules, if a mistake had been made at the start of the response. Questions requiring a chemical equation to be written were also well-answered.

With the exception of the response involving the greenhouse effect, answers to the longer questions tended to produce lower marks. Many candidates were not sufficiently careful about the use of technical language in their explanations, in particular using the word 'molecule' when meaning 'atom'. Questions on organic chemistry that required an understanding of molecular formulae and full structural formulae were less well answered, as were those requiring an explanation of organic reactions. Answers requiring an explanation of information given in the question also tended to produce lower marks. In questions requiring a diagram to be drawn, some candidates had drawn a second attempt at the answer over an existing drawing, rather than crossing out the first attempt and starting again, and this made it unclear as to whether or not credit should be awarded.

Comments on Individual Questions:

Question No. 1

Candidates gaining high scores on this question gave carefully worded answers that showed good use of technical terms and included a great level of detail.

- There was a variety of answers that gained credit here, with 'breathing equipment because carbon monoxide is toxic' being the most common correct response. Those not gaining credit had often given an answer that did not include a sufficiently detailed reason for the use of the protective equipment they had named.
- Many candidates gained a mark for explaining that the rate of forward and backward reactions are equal at equilibrium. Some candidates went on to gain the second mark for including the fact that the concentrations of reactants and products does not change.
- Some candidates scored both marks for stating that there are fewer moles of gas on the right-hand side and that the forward reaction is exothermic. Those not gaining full credit had often given answers that lacked detail, such as describing the reaction as exothermic, but not stating that it was the forward process that was being considered.
- Some candidates gave detailed answers that explained the reasons for high pressures being expensive to use and went on to state that the reaction would be too slow at low temperatures. Those candidates who did not gain full credit had often given brief responses that simply stated that high pressures and temperatures are expensive.
- Most candidates gained some credit here, usually for drawing two suitable curves to show the enthalpy profile for the reaction with and without a catalyst and labelling them. Some candidates went on to gain further marks for labelling the products line and drawing an appropriate downwards arrow for the enthalpy change and for drawing two upwards pointing

arrows to the maxima of the curves labelled as E_a and E_c . The most common reason for a candidate gaining only one mark here was using double-headed arrows, instead of single-headed ones showing the correct direction of the energy change.

- f) Most candidates gained credit here for explaining that there would be a larger surface area of the catalyst available to the reactants. Some also gained credit for stating that, by using a thin layer of the catalyst, less of the catalyst would be needed.
- g) Most candidates identified the strongest intermolecular bonds as being hydrogen bonds. Many went on to gain a second mark for describing the role of a lone pair of electrons from the oxygen atom in the formation of these hydrogen bonds. Some candidates gained full credit by describing the attraction between this lone pair of electrons and a partially positive hydrogen atom from another methanol molecule. Those gaining two of the marks had often not made it clear that it needed to be an oxygen atom from one molecule and a hydrogen atom from another. Credit was given here for the lone pair of electrons and the partially positive hydrogen being shown in a diagram.
- h)
- i) Most candidates gained the mark by giving a range from $3200 - 3600 \text{ cm}^{-1}$ and stating that it was for an O-H bond. Some also scored the mark by quoting a suitable wavenumber range for a C-H or C-O bond.
- ii) Most candidates gained this mark by explaining that the fingerprint region can be used to identify a compound by comparing the fingerprint region of its spectrum to a database of spectra of known compounds.

Question No. 2

For most candidates, this question was one of their lower scoring responses overall.

- a) Most candidates scored the mark for stating that the functional group is that of an alkene. Those not gaining credit often gave ketone as their answer.
- b) Many candidates gained some credit here, for describing how the process ensures that no chemicals are lost from the system. In most cases those scoring only one mark did not state that the reaction mixture needed to be boiled.
- c)
- i) Many candidates gained both marks for writing an equation showing two moles of bromine reacting with the carvone in an addition reaction. Those gaining one mark had often only shown the carvone reacting with one mole of bromine molecules or had included two moles of bromine molecules but had not shown the reaction producing only one product.
- ii) Most candidates gained some credit here, with some going on to score all the marks for carefully drawn diagrams showing a high level of detail. Those gaining only some of the marks had usually given the correct partial charges on the bromine molecule and the correct structure for the intermediate that forms.
- d) Some candidates gained full credit here, usually for stating that it would be necessary to use phosphoric acid and steam (or water at 300°C). Some gaining full credit had quoted the alternative of concentrated sulfuric acid followed by water. Those gaining only partial credit had often left out the water, or had given the concentrated sulfuric acid and water response, but with incorrect temperature conditions.

- e) Some candidates gained full credit for two carefully and clearly drawn structures. Many candidates who did not gain credit had redrawn the diagram of compound A given in the paper, but with the –OH group shown on the left-hand side of the structure rotated to another position.
- f)
- i) Some candidates gained credit here, usually for stating that the reaction mixture does not change colour. Some went on to score the second mark by giving the reason that, because the alcohol groups are tertiary, they are not oxidised. Those not gaining full credit had often given a partial answer, either stating that there was ‘no change’ or that the alcohol groups are tertiary, but not also stating that they therefore do not react.
 - ii) Many candidates gained one mark for describing the reaction as taking one reactant and forming two products. Some went on to score the second mark for describing the organic product as being unsaturated.
 - iii) Most candidates gained credit here for giving a suitable drying agent (often anhydrous sodium sulfate) or for stating that distillation would be a suitable method for separating the carvone and compound A.

Question No. 3

For many candidates, this was one of their higher scoring questions.

- a)
- i) Many candidates gained this mark, either by writing the configuration in full, or by showing it as $[\text{Ne}]3s^23p^6$. Those not gaining credit had often given the configuration for a calcium atom, rather than the ion.
 - ii) Many candidates gained full credit for an equation showing the correct ions reacting and including the state symbols. Those gaining partial credit had often left out the state symbols.
 - iii) Most candidates gained some credit here, often for drawing at least one more of the large circles in a correct position. Some candidates went on to gain further credit for showing four large circles around a small one and for identifying the large circles as sulphide ions and the small ones as calcium ions.
- b)
- i) Most candidates scored here. Those who did not gain credit had often not converted the volume to dm^3 .
 - ii) Most candidates gained this mark, with some benefitting from the ‘error carried forward’ rules from their previous incorrect answer.
 - iii) Full marks on this answer were achieved by many of the candidates. Some candidates carried out an incorrect calculation but gained one mark for giving their answer to three significant figures.
- c)
- i) Some candidates gained this mark by writing the equation with lithium ions and an electron as the products and including appropriate state symbols. A few scored the

mark for an equation showing minus an electron on the left-hand side. Those not gaining credit had often left out the state symbols.

- ii) Most candidates gained some credit here, usually for stating that the electron being removed has a stronger attraction to the nucleus in a lithium atom than in other Group I atoms. Some went on to gain full credit by stating that the outer electron in lithium is closer to the nucleus than in other Group I atoms. Those gaining only partial credit had often not been sufficiently clear in their response that it was the outer shell electron that was being removed.
- d) Most candidates gained full credit here for calculating that the calcium ion is 42.5 times more concentrated in the hydrothermal vent seawater than in average ocean water. Those candidates gaining partial credit had usually made an error in converting the data to common units, but had then calculated the value for the correct quotient from their data.
- e) Most candidates gained partial credit here, with some going on to gain full marks. Those gaining partial credit had often stated that the water would be at a higher temperature and so reacting particles had more kinetic energy. The mark that was gained less often was for explaining that this would result in more frequent successful collisions.

Answers to numerical parts: (b)(i) 0.0003925; (b)(ii) 0.0003925; (b)(iii) 0.00981; (d) 42.5

Question No. 4

For many candidates, marks on this question were their highest within the paper.

- a) Many candidates gained full credit here, for the name 1,1,2-trichloro-1,2,2-trifluoroethane. Some candidates gained one mark for the name with the chloro- and fluoro- the other way round. Those who did not gain credit had often tried to name the compound carbon by carbon, with the response 1,1,1-chlorodifluoro – 2,2,2 – dichlorofluoroethane being given.
- b)
 - i) Most candidates correctly identified the C-Br bond and so scored the mark.
 - ii) Many candidates scored the mark here, by stating ultraviolet radiation.
 - iii) Many candidates gained full credit here, having given a clearly set out calculation, accompanied by a concise explanation of why the bond would not break. The method used to gain credit varied, with some calculating the maximum bond enthalpy for the bond that the radiation in the atmosphere would be able to break and then comparing that to the bond enthalpy of the weakest bond in the molecule. Others calculated the minimum frequency of radiation required to break the weakest bond in the molecule and then compared that to the frequency of the radiation in the atmosphere. Nearly all candidates showed some understanding of what was required in the response to this question and so gained some credit.
- c) Most candidates scored at least one mark here. Those gaining only one mark had usually stated that CFC-113 has a greater ozone depletion potential because its molecules have more C-Cl bonds. Some candidates went on to gain full credit by describing the formation of chlorine radicals from both compounds and stating that the chlorine radicals are catalysts for ozone depletion.
- d) Most candidates scored at least one mark here, either for stating that chlorine is toxic or for identifying methane as a greenhouse gas.

- e) Most candidates gained credit here, with the most common reason for not scoring being diagrams that did not have lone pairs of electrons on the chlorine atoms.
- f) Many candidates gained both marks here, for a diagram showing the tetrahedral shape of the molecule and a bond angle of 109° .
- g) Most candidates gained some credit here. The marks that were awarded most often were for describing bonds in the trichloromethane molecule vibrating and that this vibrational energy is transferred to kinetic energy. Some candidates gained full credit, having written an account of the processes that occur that was well structured and gave the key points in an appropriate sequence.
- h)
 - i) Some candidates gained a mark for describing the collection of data for the concentrations of greenhouse gases (usually by some method involving spectroscopy) and temperatures from the atmosphere. A few explained how data on concentrations of greenhouse gases and temperature of a model of the atmosphere could be obtained either in the laboratory (from a dome model of the atmosphere) or from a computer model of the atmosphere. Those who did not score, had often described collection of concentration of greenhouse gases from the atmosphere, but had not mentioned the collection of temperature data.
 - ii) Some candidates scored this mark by stating that as the concentration of greenhouse gases in the atmosphere increases, so does the temperature of the atmosphere. Those who did not gain credit had often given a response that lacked key terms, such as stating that there is a correlation between concentration of greenhouse gases in the atmosphere and the atmosphere's temperature, but did not say that it was a positive correlation.
- i) Many candidates gained some credit here. The most common responses were an advantage of breaking down in the troposphere and a disadvantage of being more expensive to manufacture. Some candidates who did not score had not made it clear whether the response they had given was considered advantageous or not.

Answers to numerical questions: (b)(iii) Energy to break one bond = 4.817×10^{-19} J, Minimum frequency to break bond = 7.266×10^{14} Hz, Energy of one photon = 3.514×10^{-19} J, Energy of one mole of photons = $211.5 \text{ kJ mol}^{-1}$

Question No. 5

The quality of answers to this question was generally below those of the other questions, with answers suggesting that some candidates had not used the article to full effect to help them to prepare for this question in advance of the exam.

- a)
 - i) Most candidates gained credit here, by drawing a clear diagram of the full structural formula of the molecule.
 - ii) Most candidates gave ketone as the name of the functional group and so scored the mark.
- b) Some candidates scored this mark by identifying the mechanism as electrophilic addition. Those who did not gain credit had often given addition, without the term 'electrophilic'.

- c)
- i) Many candidates scored this mark for stating that the organic ion is a carbocation.
 - ii) Most candidates gave 100% as the value for the atom economy and so scored the mark.
- d) Most candidates gained some credit, with many scoring both marks. The most common response gaining full credit was 'high temperature and pressure' along with platinum as the alternative catalyst. Those candidates not gaining the conditions mark had often quoted a value for the temperature or pressure that was too high.
- e) Most candidates gained some credit here, most often for stating that the two methods use different catalysts or that one method uses a homogeneous catalyst and the other a heterogeneous one. Responses that did not gain credit often gave no comparison or were comparing the two stages of one method rather than comparing the two methods.
- f) Most candidates gained the mark here by identifying the polymer as poly(phenylethene), with those not scoring often naming the monomer rather than the polymer.
- g)
- i) Many candidates gained credit for explaining that radicals form by the homolytic breaking of a bond.
 - ii) Some candidates gave an appropriate equation and gained the mark. Many who did not gain credit here had given an equation from the article rather than adapting it for the production of poly(propene).
- h) Most candidates gained credit here. The most common points that were raised for which marks were awarded were the identification of instantaneous dipole – induced dipole as the type of intermolecular bond in both forms of poly(propene), a property for atactic and isotactic poly(propene) and a comparison of the strength of the intermolecular bonds in each. Some candidates also described the difference in the closeness of the packing of the polymers and the consequent difference in the amount of energy needed to break the intermolecular bonds. The mark that was gained least often was for describing the isotactic as having all its methyl groups in the same orientation.

F333 Chemistry in Practice

General Comments:

Organisation of work

Given that 2015 was the seventh and final year of this assessment component, most centres are now familiar with its' general demands. However, there may be some centres that submit in 2016 under legacy arrangements, therefore 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. However, it is disappointing that a small number of centres do submit all work, leaving the moderator to sort it out, or work without candidate numbers, both of which inevitably slows up the process of moderation. 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, and **not** put the work in plastic document wallets, when submitting work to the moderator. These plastic wallets are still seen far too often. Attaching the Coursework Cover Sheet to the front of the candidates' four tasks also greatly assists the process of moderation. Centres should 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.

Clerical Errors

It still remains the case that 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 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, as this again delays the process of moderation.

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.

Availability of files on Interchange

Each year, tasks (and Instructions for Teachers and Technicians) are available from 1 June while the mark schemes are available from 1 December. The same are removed by 15 May in the following year. However, 2016 will be the last year when these tasks will be available for legacy candidates.

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 2015 to 14 May 2016, 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 2014 to 14 May 2015 task(s), along with a new task from the other skill(s) (from the 1 June 2015 to 14 May 2016 selection on Interchange). However, the marks confirmed by the Moderator when the task was first submitted cannot be 'carried forward'. Teachers will be able to 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 three skills tasks per candidate may be re-submitted (for example a candidate may have performed well in their skills II, III and IV in June 2015 and re-submit them for moderation with a new skill V Task in June 2016 – chosen from the Skill V Tasks available for assessment in the June 2015 session).

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.

Comments on Individual Questions:

Question No.

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. A small number of centres are still giving a mark of 5.5 for example, 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 generally 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. Rarely is the mark for Skill I less than that scored in Skill II and Skill IV.

Skills II-V

Whilst the marks awarded to candidates by a small number of centres for Skills II to V represented a very accurate application of mark schemes to candidates' work, the majority of centres showed varying degrees of deviation in their marking from the published mark schemes. Also there were a small, but not insignificant number of centres where the marking was deemed to represent an inappropriate application of the mark schemes.

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 1 and 2 (titrations), Parts (d)-(h), and Task 3 (thermochemical), Parts (d)-(g). The additional guidance for Task 3, Part (h) also requires very careful reading. Furthermore, 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 be noted that in Task 1, Part (i)(ii), concentration, that is amount per unit volume, is required and not just amount, whilst in Task 2, Part (g), there must be a specific reference to the (ethanoic) acid and not simply the vinegar. In Task 3, Part (e)(ii), the additional

guidance is particularly important as it emphasises allowable alternatives to ‘catalyst’ of which ‘reactant’ is not one, and also that the second mark can only be awarded if the first mark has already been credited.

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 yellow precipitate is formed for 1 mark (Task 2, Part (f) (i)), then both colour and an indication of solid will be expected. So, ‘yellow mixture with precipitate’ does not score this mark. Similarly, if the mark scheme requires both a dissolving of a precipitate (on warming) and a reappearing (on cooling), with the second mark depending upon the first, then ‘solid after cooling’ does not score if the dissolving of the solid has not first been described (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, Part (b)), then both marks cannot be scored if two layers are not mentioned even if the colours of the two layers are correctly stated. So an answer to Task 2, Part (b) such as ‘pink at the top, yellow below’ is not sufficient for both marks 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 pink and the lower one being yellow’. However, ‘layers’ may be implied, for example by stating that ‘mixture separates’. Also, when adding cyclohexane, as in Task 2, Part (b), it is possible that a candidate may mistakenly identify the mixture as having three layers since the interface between the two layers can appear like this, but still correctly identify the colours in the upper and lower layers. In such cases the marks should be awarded, ignoring reference to the interface ‘layer’.

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. However, the word ‘transparent’ is acceptable in place of ‘clear’.

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.

On occasion several statements have to be made in order to obtain a particular marking point and this can sometimes be missed. A very good example of this is in Task 3, Part (e)(i), where very few centres realised that the ‘intermediate colour’ had to be included to get the first mark.

It should also be noted that correct terminology is important. For example, in Task 1, Part (f), the second marking point can only be awarded if the idea of the blue solution becoming paler is clearly indicated, so ‘pale blue solution’ does not score whereas ‘solution is a paler blue’ does score. In the same part the third mark cannot be awarded for ‘brown precipitate’ because although the colour is correct the solid is not a precipitate since a precipitate is formed when two solutions react to form an insoluble product and not when zinc reacts to form copper.

As has been stated before, it remains particularly important in Skill IV 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 of say solution concentrations that may be necessary when using the chemicals in the centre in order that candidates may achieve the correct observations. This is essential because credit should not be given for observations that are not in the mark schemes. It is not acceptable to say ‘my candidates saw X and so did I so I am awarding the mark’ even though the mark scheme expected an observation of Y. In such cases the centre is required to contact OCR using the e-mail address OCR.GCEScienceTasks@ocr.org.uk giving details about the observations made by the teacher. If OCR endorses this change then all of the answers of the candidate (or the relevant group of candidates, if appropriate) may be marked according to the centre observations only. A copy of the relevant communications must then 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 link the type of behaviour to the correct species. For example in Task 2, Part (b) (ii), the oxidation must be linked to 'chlorine being better than iodine', and not 'iodide'. In Task 1, Part (f) it should be noted that the first mark requires reference to both absorbing and releasing energy while the second mark requires reference to a difference between energy levels. These points were often missed.

In a task that considers organic reactions, where structures of organic functional groups are required, the functional group must be attached in an unambiguous way, that is to say it is the oxygen atom of the hydroxyl group that is attached to the carbon atom (Task 3, Part (b)). In this same task, Part (f)(i) requires careful checking of the bullet points before a mark can be awarded for a diagram that 'looks about right'. Part (f)(ii) also requires very careful reading.

Indeed a general point is that as the detail in the mark schemes has increased over time, especially the content of the additional guidance, centres must read the answers of candidates in full and not simply award marks for key words if either the full meaning is not conveyed or that contradictory statements are made.

Where equations are required, formulae must be written in the conventional way. This means that in Task 1, Part (a), copper oxide written as Cu(O) should not score. Also where an equation is required together with state symbols, for example in Task 1, Part (d), 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. However, careful checking is essential.

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 OCR.GCEScienceTasks@ocr.org.uk.

F334 Chemistry of Materials

General Comments:

For most of the questions many good answers were seen, showing that many candidates had understood the contextual nature of the course and had a good range of background knowledge. In general, apart from one notable case involving the oxidation of iron(II) ions (see below), they were able to demonstrate their knowledge and understanding of the basic chemistry involved and apply these to a variety of new situations. The candidates' lack of experience with IR spectra showed in their inability to understand variability in regard to some peak intensities resulting in few marks being gained in this area.

The mathematical aspects were tackled very well indeed in most cases, with an increasing number of candidates (of all abilities regarding descriptive and theoretical chemistry) impressive with their logical thinking, resulting in clear responses. Significant figures were less of a challenge this session.

Responses to long-answer questions were well organised and showed a good understanding of the demands of the question. However, with the DNA based question, those with a biology background often found themselves floundering in a sea of inappropriate detail, often using a full extra page to do so. As ever, candidates need to realise that the answer space given on the paper indicates the length of response required.

Writing formulae of all types is still a major hurdle for many, particularly full-structural, where skeletal parts were often incorporated in their answers. The examination situation seems to make equation balancing an extreme procedure; many, of all abilities, would do well to check their final effort by counting atoms and charges.

Some candidates unnecessarily used extra page booklets, inadvertently given by invigilators unaware of the extra-page 20, included at the end of the question paper. Whilst many did not alert examiners to the fact that some of their answers were continued elsewhere, sometimes beneath or even on a different page (a problem for on-line marking).

There were several reports of an increase in the illegibility of responses, which was often worse than those candidates who used a word processor to make their answers more examiner-friendly. Such candidates should be encouraged to use the available technology too, or indeed a scribe when OCR regulations allow.

Rubbing out seemed to be on the increase, this is not at all helpful, as the scanning showed up unreadable formulae as well as confused cell diagrams.

The paper seemed of appropriate length as very few candidates appeared to have problems in completing it. Generally there seemed to be fewer blank answer spaces, even with the more difficult questions, with many attempting some sort of response even when it was clear they had not a clue, some even politely informed the examiner of this situation including a 'sorry'!

Comments on Individual Questions:

Question No.1

- (a) (i) A good number failed to use a reagent containing nitrogen, often choosing concentrated hydrochloric or sulfuric acid instead. Surprisingly in (ii) many failed to specify that it was the nitrogen that had the lone pair whilst a few donated protons.
- (b) (i) This was answered poorly with very few managing to pick both words. Many had elimination but usually paired it with neutralisation or substitution. Part (ii) was almost uniformly well-done although it was often complicated by drawing the whole structure. Perhaps the common error was to miss the bond between the N and H atoms.
- (c) Diagrams were well drawn for the most part, though a few overcomplicated matters with multiple hydrogen bonds and some drew bonds from C to either H or O. There were also a few HO₂ molecules, a hazard of examination nerves.
- (d) This was well-done, the majority qualifying hydrogen bonds with 'more' as well as often including a correct reason.

Question No.2

- (a) Parts (i) and (ii) were well answered, though some circled the primary alcohol or just the C to which a secondary hydroxyl was attached.

Many gave the skeletal formula in (iii) rather than full structural, whilst those who attempted the full structure omitted one or more H atoms from the ring and usually drew -OH instead of -O-H.

- (b) (i) The 'choking vapours' were identified correctly by many. However an equal number suggested they were an oxide of carbon, not realising they do not cause choking, just death if in sufficient amounts. Part (ii) was not well answered; many had hydrogen bonding involved in at least one of the compounds with some sloppiness with abbreviations being used; 'instantaneous-induced dipoles' was frequently seen. The difficulty in (iii) was in relating, *for example*, length of polymer chain with number of intermolecular bonds. Many used ideas of crystallinity and side-chains without making any real headway.
- (c) Generally, the cause of a polymer's brittleness was well known. Some did not make it clear that it was the polymer **chains** which were breaking under load.
- (d) A few students answered this perfectly, recognising the difference in structure of the two compounds and therefore identifying the correct one from the correct peak signifying the OH group.

However, the vast majority of students said there was no peak at 3500-3600 cm⁻¹. Some, including able candidates, even marked it on the diagram and then denied it was there. Somehow the words 'broad' and 'strong' seem to have been picked up by candidates as all-important, so they then decided to ignore any smaller peaks. The fact that the wavenumber scale is not linear and peaks with similar widths at different ends means that in reality they are anything but. Many argued on the basis of C=O absorptions suggesting that the high intensity of the peak indicated three ethanoate groups.

Question No.3

- (a) Most got full marks here, but some used dichromate or sodium hydroxide for the acid in the test for D. Some confused the terms observation and conclusion, stating that CO_2 was given off.
- (b) (i) Generally poorly done with many not realising this was an hydrolysis reaction which resulted in a variety of ethanoylated products being drawn. More candidates correctly drew the 2-hydroxybenzoic acid than the amine, which was usually left unprotonated.
- (ii) The students who had worked hard on their revision did very well here with many gaining full marks. Some ninhydrins but not many, some used chromatography paper, others only spotted the mixture on to the plate and a few lost the last mark for not measuring and comparing Rf values.
- (c) (i) This discriminated well, with many just not using the data or trying some random calculations to conclude that the half-life is constant. However those who keyed into the relevant data provided excellent explanations.
- (ii) There were some strange ways of calculating an average rate, many showed no working, while quite a few got the wrong answer but correct working. Perhaps, this was one for those candidates with a modicum of mathematical knowledge outside of the usual 'moles' remit, which many did not appear to have.

Answer: 1.25×10^{-5}

- (iii) The majority got the units correct and could calculate the rate constant.

Answer: $1.0 \times 10^{-6} \text{ s}^{-1}$

- (d) Both (i) and (ii) rewarded those who had revised their knowledge carefully. However there were many strange interpretations of combinatorial chemistry, indicating this was a 'new' concept. Those who knew that many compounds could be synthesised sometimes failed to include the fact they will be similar compounds.

Question No.4

- (a) (i) If the gas was correctly recognised the mark was often lost for giving the formula instead of the name. Unlike (i), part (ii) was very well done; the main error being that the vanadium in VS_4 was often given an oxidation state of +8. A few also had +32 for the vanadium in $\text{Na}_2\text{V}_6\text{O}_{16}$.
- (iii) Well-answered with the majority clearly stating the change in oxidation number.
- (iv) Many gained both marks eventually, but candidates wanted to explain d orbital splitting and electron promotion. This sometimes resulted in them arguing that energy is emitted when electrons fall back to the ground state, or omitting to mention the terms frequency or wavelength.
- (v) Very variable responses; a concerning number seem to think that vanadium is diatomic or that calcium oxide might be CaO_5 or Ca_2O_5 .
- (b) (i) Again the careful reviser candidates knew this but many wrong answers too; most commonly discussion of landfill, controlling the constituents of the steel, and saving energy linked usually to vanadium extraction.

- (c) (i) Some very weak responses with apparatus drawn correctly but with ions used as electrodes and no liquids in the beakers! Many were correct, but only a very few got the last mark for having H^+ in the correct beaker.
- (ii) Usually correct. Answer: $E_{\text{cell}} = 1.26 \text{ V}$
- (iii) Too many just stated that the experiment was not done under standard conditions without any clarification.
- (iv) Very well-done with very few reversing the reaction.
- (v) Candidates had to work hard for both marks and many did well, comparing the correct standard electrode potentials and also balancing the equation, although others had some difficulty with the balancing aspect.
- (d) (i) Many correct answers with all marks scored, a few lost the *significant figure* mark but on the whole this was well-done. Answer: 97.1%
- (ii) Most realised that Fe^{2+} was being oxidised, but often the oxidising agent was omitted and the $NaHCO_3$, H_2SO_4 and even $Cr_2O_7^{2-}$ (not present at this stage) were equal contenders for the role. This was the only mark most candidates scored. Despite the fact that in question 3(a), many had actually used $NaHCO_3$ to test for an acid, they did not recognise its function here. Instead many thought that $NaHCO_3$ offered some form of sacrificial protection. Few appreciated the full significance of the non-return valve concentrating on preventing O_2 entering ignoring allowing gas/ CO_2 to escape.
- (e) This was answered much better than in the past, although a number of colourless/clear solutions and brown precipitates cropped up regularly. The equation was good too, with only a handful adding $NaOH$.

Question No.5

- (a) Some good responses here; the second marking point was usually achieved but many talked about rights and personal liberty for the third point and about clearing yourself from a crime as a reason for storing DNA.
- (b) Nucleotide was well known in (i) but in drawing the structural formulae in (ii) the phosphate was often joined to the wrong hydroxyl group with other hydroxyl groups added to the ribose structure.
- (c) A number of the best candidates gained full marks here and were able to produce clear concise well thought out answers. However, some had rote-learned and produced a response without really thinking about whether it answered the question. This was particularly so if they had a biological background where the role of *m*-RNA was often discussed at length.
- (d) Generally fine, but some strange curves and many did not label the optimum pH or just indicated pH7.
- (e) Drawing the protein chain caused many problems; candidates often giving the same answer as in question 1b(ii) or linking to the wrong side chain and/or using an ester linkage.

In the last part, many did not appear to understand the phrase 'increasing the pH' and went on to discuss protonation of the amino group. A significant number just gave generalisations about ionisation within the molecule.

F335 Chemistry by Design

General Comments:

This paper gave candidates the chance to show what they had learned and how they could apply this over a range of Chemistry. There were few blanks and no evidence that candidates did not have time to finish the paper. There were some testing questions on which few candidates scored and some other parts where most candidates scored, showing their grasp of the course. Candidates showed good understanding of entropy calculations, energy level diagrams, shapes of molecules, enzyme kinetics, the effect of conditions on equilibrium, atom economy, drawing organic structures and benzene reactions. Some had difficulty with general chemistry, the effect of a chromophore on colour, addition polymerisation, some aspects of nmr, intermolecular bonds in dissolving processes and some aspects of radical reactions.

Simple calculations were often correct but, when errors were made in more complex ones, it was usually hard to unravel the working to give intermediate credit. Long answers were of a reasonable standard but candidates would still benefit from a few moments spent planning before embarking on their answers. The quality and logic of such responses will become more crucial as 'level of response' mark-schemes appear in AS next year and A-level the year after.

Comments on Individual Questions:

Question No. 1

This provided a fairly easy start for most candidates, even though it contained an entropy calculation.

In part (a), most knew that the bonding was covalent in CO_2 and ionic in CaO . Fewer realised that the crucial term for the structure of CaO was 'giant'.

The calculations in part (b) were often correct. The need to convert from kJ to Joules was usually understood. Some still have difficulty realising that signs are needed for positive entropy values. There were many good comments on the significance of the temperature where ΔS_{tot} is zero.

Part (c) tested some basic Chemistry. Many could name calcium hydrogencarbonate and knew that CO_2 came from the air. In part (iii) relatively few realised that CO_2 would be released from the solution on boiling. Some failed to say that the position of equilibrium moved.

Part (d) was often well done with relatively few technical errors. The commonest mistake in the calculation was to use the wrong sign for the enthalpy change of solution.

Answers to numerical parts: (b)(i) +161; (b)(ii) -443; (b)(iii) 1118; (d) -1162

Question No.2

This, the easiest question, began in a fairly straightforward manner but finished with some extended response parts.

In part (a) most could work out the molecular formula, though some tripped over the number of hydrogen atoms. There was high scoring on the question concerning the bond angle around nitrogen, though some forgot the lone pair and said there were only three areas of electron density around the nitrogen atom.

Part (b) was usually well-done with just a few curtailing the side-chain by one carbon.

Part (c) was similar to other questions of its type but did focus on *reactions*. Those who talked about bond lengths still usually scored the marks in the end, though some candidates did not mention addition and substitution at all.

In part (d) many scored the mark for the structure of the aldehyde and even more for deducing that ammonia was the other product. The commonest error was failure to copy correctly the unchanged part of the serotonin structure, which was a shame.

Part (e) was usually well done with most using their chemical comprehension to realise that serotonin was the substrate and to explain why moclobemide was an inhibitor. The last part required understanding of enzyme kinetics and equilibrium to realise that the rate would increase with the substrate concentration.

Much of part (f) was familiar territory and many scored the first three marking points, which dealt with the general origins of colour in organic compounds. Some failed to tie together the idea of the energy gap being *proportional* to the frequency of light absorbed. The number talking about electrons emitting light when falling was smaller this year. The last two marking points required understanding of the fact that uv radiation had a higher frequency than light and that phenelzine had a smaller chromophore, and thus the energy gap was bigger.

Question No 3

This showed a good understanding of organic chemistry with a little physical at the start.

In part (a), most named the compound correctly as propene and many could compare the reaction with a normal Friedel Crafts reaction.

Part (b) was the physical part and many scored full marks. Errors in part (b)(i) included a failure to say which *was* the side with fewer moles, that the concentration of the particles was greater and that the *frequency* of collisions was greater. In part (b)(ii) most scored the marks. Part (b)(iii) showed a good understanding of atom economy. The rare error was to hedge bets by saying 'less waste', rather than 'no waste'.

Many scored most of the marks in the first sub-parts of part (c). The name 'cyanohydrin' was accepted in part (c)(i) though many, to their credit, had a stab at the systematic name. In part (c)(ii), a few confused amides and amines. Part (c)(iv) caused more problems. Of the many who identified the type of polymerisation as addition, quite a proportion failed to state that it was the *carbon-carbon* double bonds that caused it. The structure was often erroneously connected through parts of the ester and some who got the structure correct failed to display the ester link.

Part (d) was usually well-done. The commonest errors were to write $C_6H_4OHC/$ for the molecular formula and identify 5 isomers (forgetting the symmetry).

Part (e) showed a reasonable understanding of nmr spectroscopy. Almost all got part (e)(i) correct but then fewer were able to identify the correct isomer in part (e)(ii). Of those who did, some then failed to point out *both* the protons causing peaks E and F. In part (e)(iv) some candidates correctly described the protons responsible for the peaks as being on a carbon with an adjacent carbon with one hydrogen. The commonest error was to say 'they' instead of 'protons' which did not quite answer the question, referring to the peaks rather than the protons.

Part (f) required thoughtful understanding of electrophilic substitution and was well done in many cases, with candidates showing one isomer of iodophenol, discussing the polarity of ICl_3 in terms of electronegativity and then saying that iodine acted as an electrophile.

Question No 4

This question was synoptic with physical, inorganic and organic parts.

Parts (a) and (b)(i) required understanding of inorganic chemistry that was possessed by some candidates. Many gave oxygen as a possible product in part (a) which candidates should have realised would not form in the presence of hot carbon. Part (b)(ii) was better, with more candidates suggesting that CaO and CO₂ would be formed, though CaCO₃ was the more likely product.

In part (b)(ii) many candidates correctly suggested a triple (or strong) bond between the nitrogen atoms and some went on to say that nitrogen compounds were needed for plant growth in part (b)(iii). Lack of the word 'compounds' caused some loss of the mark.

Part (b)(iv) involved a simple mole calculation, which most got right. Realisation that atomic mass data is to three significant figures was slightly more complicated.

Part (c) had two easy parts to start with and few faltered here. Part (c)(iii), on the other hand, was only scored by a handful of candidates. Part (c)(iv) was high-scoring again, though some failed to say it was oxygen that oxidised the NO to NO₂ and others did not mention that the latter was brown.

There were many correct answers to part (d)(i), though some of the curved lines attempting to show the bond angle did not start and finish on bonds. The next two parts were often well done.

Some managed Ca₃P₂ in part (e)(i) but many attempts involved an H atom as well. Part (e)(ii) had a high rate of scoring.

Part (e)(iii) was an area where planning would have paid dividends. Some candidates sailed through the first three marks but others tripped up by saying either that nitrogen (rather than ammonia) formed hydrogen bonds with water or that ammonia was more electronegative than phosphane. For the fourth mark a clear statement about the relative strength of bonds or the amount of energy released in breaking bonds and use in making bonds was needed. Some achieved this but others failed to express themselves clearly, particularly not saying that the hydrogen bonds they were talking about were in water.

Answers to numerical parts: (b)(iv) 35.0; (c)(i) -3 and +2; (c)(iii) 40

Question No.5

This question was about butanoic acid and was, by a small margin, the hardest question on the paper.

Part (a) Many candidates correctly named the isomer of butanoic acid.

In part (b), many candidates could draw the triester correctly, the main error being the careless omission of one or more hydrogen atoms. In part (b)(ii) there were a lot of correct answers but the double bonds had to be described as between carbon atoms.

In part (c)(i) there were again a lot of correct answers but the commonest error was to omit the state symbols (needed to 'complete the equation' since a state symbol was given for the acid).

Part (c)(ii) was usually correct but part (c)(iii) caused more problems and the crucial idea of lack of H⁺ ions was often missing. In part (c)(iv) candidates had to realise that the question was slightly different from previous buffer questions in that the *particles* involved needed to be discussed. Hence the movement of the equilibrium alone was insufficient to score and expressions like 'added H⁺ moves the equilibrium to the left and forms the acid' were required. Many candidates mentioned that a large concentration of salt was required but fewer mentioned

a large concentration of acid also being necessary. Almost all scored for saying that the pH did not change much when small amounts of acid or alkali were added.

Part (d)(i) was usually correct but part (d)(ii) was seldom so. Candidates had to realise that much of the OH^- was used up *and it was also diluted*. Marks were given for error carried forward wherever possible, but the layout of many answers made it impossible to see where the mistakes had been made.

5(e) was well done with most candidates being able to draw the structures in parts (e)(i) and (e)(ii) and many to predict boiling points in terms of intermolecular bonds in part (e)(iv). Many candidates realised that the intermolecular bonds in the ester were permanent dipole – permanent dipole and instantaneous dipole – induced dipole but several lost marks through wrong spelling of these terms. In some cases the spelling was hard to decipher and candidates with poor handwriting should at least try to do better in questions where the spelling of technical terms is a requirement.

In 5(f) most could draw a hydroxyl radical. The use of ‘double half arrows’ to indicate electron movement was less well known, however. Most could name ‘homolytic fission’ in part (f)(iii) and classify the types of radical reaction in part (f)(iv). In part (f)(v), many added the same extra molecule on each side and some got it right but left off one of the right-hand bonds, again a copying error. Part (f)(vi) might well have come as a welcome relief and most got it right.

Answers to numerical parts: (d)(i) 3.26; (d)(ii) 11.3

F336 Chemistry Individual Investigation (Coursework)

General Comments

It was clear from the work seen during moderation that the vast majority of candidates made good use of the opportunity provided by this assessment component to demonstrate their skills in planning, carrying out and evaluating their own investigation. Many candidates had devoted a large amount of time and effort to their individual investigation. Centres also spent a great deal of time in preparing candidates for this assessment and in marking and annotating the investigation reports.

A range of investigation topics were chosen by candidates but investigations of chemical kinetics continue to be by far the most popular. Fewer candidates were awarded maximum marks than had been the case in previous years. This may well be because of a more realistic appreciation of the evidence required to achieve maximum marks in skill H.

Candidates' work was often comprehensively annotated but sometimes the candidate summary sheets were sometimes filled with stock phrases taken from the marking criteria such as 'describes comprehensive range of chemical knowledge'. This resulted in them giving impersonal, generic comments, which in some cases, were duplicated over several scripts. In examples of best practice, centres highlighted not only the good points in an investigation report but also explained why higher marks had not been given,

Many centres did not supply the required documentation to support the award of a mark in skill area G. Written evidence arising from direct centre observation of candidates at work in the laboratory should be sent to the moderator with candidates work.

A few centres sent candidates work in large ring binders or with each skill area in a separate plastic pocket which made the mechanics of moderating samples much more difficult. Occasionally the candidate name and centre number was missing from the investigation report.

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. In centres where there is a wide difference between the marks awarded by the centre and the marks achieved after moderation the use of the service is highly recommended. Details are to be found on Coursework Enquiry forms, available from Interchange.

Skill Area A

In most cases the marking criteria had been accurately applied. In a small number of cases some centres gave very high marks for very limited amounts of work whereas others did not award full marks even when there was nothing else candidates could have realistically added.

Skill Area B

This skill area was also generally well-marked with centres applying the marking criteria in an appropriate manner.

Skill Area C

The standard of marking of the skill area varied between centres. Some candidates did not include concentrations of materials in their risk assessment or explain the content of the resources that they had used but the marks awarded did not reflect these omissions.

Skill Area D

Most candidates produced clear, well-tabulated results. In a few cases the amount of data recorded was significantly less than that expected from 18 hours spent in the laboratory.

Skill Area E

Graphs were usually well-drawn and calculations carried out correctly. Some candidates used small, computer generated graphs in kinetics based investigations when a larger, hand drawn graph would have been more accurate.

The ability to draw appropriate conclusions discriminated between candidates. Better candidates used the theory they had described in skill A to explain what they could find out from their experimental results, linking rates to a mechanism in a kinetics investigation for example. Other candidates tended to simply describe their results rather than attempting to draw conclusions from them.

Skill Area F

The marks awarded in this section were reasonably accurate. Many candidates were able to identify relevant limitations in their experimental procedure although in some cases this part of the report was quite brief. Some candidates did not appreciate that they should calculate the percentage error in every type of measurement they had taken.

Skill Area G

Too many centres failed to include the expected documentation to justify the marks awarded in this skill area. In some cases, the high marks awarded in this skill area were surprising in view of the poor quality of data recorded in skill D.

Skill Area H

There were still a number of centres where the marks awarded were too generous in this skill area. 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. Where greater breadth is required because the effect of a catalyst on the activation enthalpy is also explored the mark awarded should be increased to 4.

Most centres appreciated that to be awarded maximum marks candidates need to show real flair in their ability to innovate and solve problems. This mark should not be awarded simply because the candidate has chosen to study a topic that is not in the specification or where they have not yet reached the topic in their studies.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Facsimile: 01223 552553

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