

**GCE**

**Chemistry B (Salters)**

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

**OCR Report to Centres June 2014**

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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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**Advanced Subsidiary GCE Chemistry B (Salters) (H035)**

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# F331 Chemistry for Life

## General Comments

This paper, once more, proved accessible to the majority of candidates, with fewer *very* low marks compared to recent sessions, but also fewer very high marks. One issue which centres need to remind their candidates of is the fact that the papers are scanned for marking. This year, possibly because there were several chemical structures which needed drawing as part of a response, there were more draft answers showing up on the scans than normal. This, in a few cases, made marking more difficult than it needed to be.

There was some evidence of key words triggering responses to questions which were not appropriate for the actual question being asked; candidates seemingly going on auto-pilot, and not considering the stem of the question carefully enough. Those questions requiring the application of knowledge and understanding were particularly susceptible to this key word/rote learning approach, almost inevitably leading to a loss of marks.

The longer-response answers discriminated well, with less able students' answers being very variable in their quality, occasionally lacking relevance to the question or using imprecise scientific language. Again this re-enforces the need to be able to apply knowledge in different contexts and not rely on rote learning

Time once more was not an issue with this paper and it was pleasing to see very few blank (No Response) answers.

## Comments on Individual Questions

### Question 1

This question was designed to give candidates a relatively comfortable start to the paper and most candidates, overall, coped well with the question.

#### 1(a)

A large majority of candidates scored this mark with the most common wrong answer being cracking instead of fractional distillation.

#### (b)(i)

Well answered generally, but there were issues with drafting marks showing up on the scans. Some candidates did not appear to realise that the prefix 'prop' means three carbon atoms.

#### (b)(ii)

Well answered.

#### (c)(i)

Well answered. Most common wrong answers arose from the use of the wrong formula for decane.

#### (c)(ii)

Well answered.

#### (c)(iii)

Well answered.

#### (c)(iv)

Well answered.

(c)(v)

Fewer candidates gave the correct answer (hydrogen), to this question than on the previous questions, with arenes or alkenes being the most common wrong answers.

(d)(i)

Well answered.

(d)(ii)

The most discriminating part of question 1. A wide range of answers were offered, including structures with more than 4 carbon atoms.

(e)

Another question where drafting marks occasionally became a problem. Wrong answers included structures with the wrong number of bonds to individual carbon atoms.

## Question 2

This question, overall, proved to be the most difficult on the paper.

2(a)

There were many completely correct equations but some candidates lost marks by using the wrong state symbol for sulphuric acid or adding superfluous atoms in order to balance the equation.

(b)

This question proved very difficult for the vast majority of candidates. In many cases it seems that the reference to calcium and sulphur acted as key words and candidates chose to answer the question in terms of loss and gain of electrons, as if the elements were reacting instead of a simple acid/base reaction between oxides.

(c)

The more able or better prepared candidates scored well on this question but some candidates, once more, lost unnecessary marks by the wrong use of the term 'pairs of electrons.' For example, a common error was to state that the central sulphur of  $\text{SO}_2$  had four pairs of electrons leading to the incorrect bond angle for the  $\text{SO}_2$  molecule. Good answers were those in which descriptions concentrated on areas of electron density or sets of electrons.

(d)

This question discriminated very successfully at the top end of candidate ability.

(e)

This question was set in the context of a comparison with fossil fuels and examiners were looking for the advantage that no (not 'less') carbon-based emissions were produced and the disadvantage that any waste was radioactive.

(f)

This bonding and structure question was reasonably well answered with most wrong answers not surprisingly being for sulfur. Metallic and ionic bonding types were, however, worrying responses.

*Numerical answer: 2(d) 199.7/200g*

Question 3

This question overall was the second most difficult question on the paper but had the narrowest mark range.

(a)

This question was correctly answered by most candidates.

(b)(i)

This question was correctly answered by most candidates.

(b)(ii)

Weaker candidates found this common question, usually asked as a calculation, difficult to explain in words.

(b)(iii)

This question was relatively well answered by most candidates, the relationship between mass and velocity being the most common mark missed.

(c)(i)

Generally well answered.

(c)(ii)

Generally well answered and, pleasingly, hardly any candidates are now putting the numbers on the wrong side.

(c)(iii)

The majority of candidates gained this mark.

(d)

Pleasingly answered by most, ionic structures were given credit. The most common error was an extra pair of electrons on the boron atom.

(e)(i)

Well answered.

(e)(ii)

This question required the application of knowledge and only the more able candidates scored. The need for a measurement of both uranium and lead in the sample was the main factor missed. Frequently "principles" was taken to mean "assumptions" - e.g. no loss or gain of uranium, or the half-life remains constant.

(e)(iii)

Candidates often answered this question in terms of the long half-life of U-235, explaining that not even one half-life would have passed. Unfortunately this would also be the case with very old rocks. The salient fact is there will have been so little decay in archaeological material that measurement would be very inaccurate.

(e)(iv)

Candidates are used to writing fusion equations but having to explain the process in words proved tricky. Examiners were looking for light/ heavy rather than small/large when comparing nuclei.

Question 4

This question discriminated well but there were some parts where candidates had clearly not thought about the stem of the question carefully enough.

(a)(i)

Generally well answered, the most common error being the use of 12g in the calculation, instead of 25g, for the mass of the solution.

(a)(ii)

Discriminating. The most common mark lost being the lack of any, or the wrong, sign for the enthalpy change. The latter being an example of candidates not reading the question carefully enough.

(a)(iii)

Disappointingly answered; this type of question has often been for an exothermic reaction and many candidates just rolled out their answer as a 'learned' response as if this was the case with this particular context.

(a)(iv)

Only the more able candidates scored these marks, with the common wrong answer  $72\text{dm}^3$  - i.e. simply multiplying the given  $24\text{dm}^3$  by 3.

(b)

This question threw up long-standing problems with this important idea. Many candidates answered in terms of endothermic and exothermic reactions. These were stock answers and showed no understanding of the question which had actually been asked.

(c)

Reasonably well answered; the fourth mark, where a greater understanding was required, was the mark most commonly missed. A significant minority of candidates are still failing to differentiate between entropy and enthalpy.

*Numerical answers:* 4(a)(i) 1672 (1670/1700); 4(a)(ii) +12; 4(a)(iv) 3.4

# F332 Chemistry of Natural Resources

## General Comments

A wide range of marks was achieved by candidates for the paper as a whole, with a good proportion of higher marks being recorded. 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 as well. Questions requiring candidates to choose and explain technical terms were also well answered, as were most of the questions involving organic chemistry when being asked about structures of products and functional groups. The marks for question 5 were often above those for other questions on the paper.

Questions on structure, bonding and intermolecular bonds were less well answered, with responses often lacking the details needed to gain credit. Some candidates, who found that answer spaces were not large enough to complete their work or who had crossed out their original response, continued their response at the bottom of the page (putting an asterisk by the answer space, or drawing an arrow down the side of the script) rather than using the extra pages provided at the back of the paper. This sometimes made it difficult for the Examiner to work out where the candidate had continued their response, particularly if the only indication that there was extra work was an asterisk. Some Centres gave additional answer booklets to candidates to use instead of encouraging them to use the extra pages provided as part of the script.

## Comments on Individual Questions

### Question 1

Most candidates found this question to be a good start to the paper, with many gaining one of their highest scores for the paper on this question.

(a) Most candidates gained credit here for numerical values and for recalling the need to put a sign for each value (except the '0' for the final oxidation state of iodine) in front of the number. In cases where a completely correct response was written, except that all signs had been positioned after the number, partial credit was given.

(b) Most candidates gained this mark for an equation with two electrons added on the right, although some gained credit by subtracting two electrons on the left. Those who did not score had often only given one electron or left electrons out altogether.

(c) A high proportion of candidates scored at least one mark here, for describing the reducing agent as the chemical whose oxidation state increases during the reaction. Those who did not go on to score both marks had often given iodine, rather than iodide ions, as the reducing agent.

(d) Most candidates scored the mark for grey or black solid. Those who did not gain credit had usually included another colour or described iodine solution, rather than iodine.

(e) Most candidates gained this mark, with a very wide variety of uses being given – the most common being antiseptic.

- (f)
- i) Most candidates scored this mark for the name of the reagent, with some also scoring for the formula  $\text{AgNO}_3$ . Those who did not gain credit often seemed to misunderstand the term 'reagent' and gave silver ions as their response, rather than the name of the compound, silver nitrate.
  - ii) Most candidates gained credit, with many gaining both marks. The identity of the white precipitate was usually given as silver chloride, but candidates also gained credit if given as the formula  $\text{AgCl}$ .
  - iii) Candidates gaining credit usually gave a good reason for an unexpected result, but did not always go on to score the second mark for explaining why their answer would not produce the expected white precipitate (for example, correctly stating that the solution may also contain iodide ions, but not explaining that this would mean that a yellow precipitate would form instead of a white one).
- (g)
- i) Most candidates scored this mark for a clearly written response that followed the convention for writing electron configurations with shell numbers on the line, lower case letters for sub-shells and superscripts for the number of electrons per sub-shell. Those who did not score had usually written subscript numbers where there should be superscript numbers.
  - ii) Many candidates scored this mark, giving the response  $5p^5$ . Those candidates who did not gain credit in the previous question, because they had written the numbers that should be superscript as subscript or on the line, were also given credit here on 'error carried forward' if they gave  $5p_5$  or  $5p_5$ .
  - iii) Most candidates scored this mark by describing a gain of electrons.
- (h)
- i) Most candidates scored this mark for an answer supported by clearly set out working. The most common reason for not gaining credit was a candidate who did not divide the value by 1000, so giving 5.68 as the answer, rather than  $5.68 \times 10^{-3}$ .
  - ii) Most candidates gained credit, either for giving  $2.84 \times 10^{-3}$ , or for dividing an incorrect response in the previous question by 2 and correctly evaluating it.
  - iii) Many candidates gained credit here. Those who did not score both marks had usually used the value for the relative atomic mass of iodine, rather than its relative molecular mass.

## Question 2

For many candidates, this question was their lowest-scoring one, often because it included the longer answer on intermolecular bonding.

- (a)
- (i) Most candidates gave the name as propan-2-ol and so scored the mark. Those who did not score this mark often gave propanol, without the number.
  - (ii) Many candidates scored this mark, naming the product as ethanal. Those who did not score often gave ethanoic acid or identified the product as an aldehyde, but did not name it.

- (iii) Most candidates gained some credit, usually for giving a wavenumber range or value at which they would expect to see a peak if ethanol were still present. Many also scored the second mark for identifying the O-H bond as being responsible for peaks at their chosen wavenumber. Those not scoring the second mark often gave OH group, rather than O-H bond.
- (b) Most candidates scored marks, often by quoting very precise details of the reagents and conditions.
- (c) Most candidates gained credit for identifying the strongest type of intermolecular bond between propanone and ethanol as hydrogen bonding and between hexane and methylbenzene as instantaneous dipole – induced dipole. The main difference in response seen was the level of detail that was given about how these intermolecular bonds form. There were many examples of very good explanations that focused on the characteristics of the molecules being discussed and how they lead to attractions between the molecules. In some cases, answers that were given were too general, and the ideas had not been applied to the specific example being asked about. For example, a description of a hydrogen bond forming when a hydrogen atom with a partial positive charge is being attracted to an atom with a lone pair of electrons, but not stating that the hydrogen is part of the -OH group in ethanol and the lone pair of electrons is on oxygen in propanone. Some candidates compared the strength of the two types of interaction, rather than explaining how they form.
- (d)
- (i) Most candidates scored both marks, usually by giving ‘in a closed system’ for the second mark, and many of those not gaining full credit scored one mark. Those not gaining full credit had often either missed out the word ‘rate’ in the first mark (giving ‘forward reaction equals backwards reaction’, rather than ‘rate of forward reaction equals rate of backwards reaction’) or had described the system as ‘concentrations of reactants and products are the same’ instead of ‘concentrations of reactants and products are constant’.
- (ii) Most candidates gained credit, with many scoring both marks. Answers often showed a clear understanding of the principles that needed to be applied and answers were very detailed. Those not gaining both marks had often described the reaction moving to the right, rather than the equilibrium moving to the right.

### Question 3

The majority of candidates scored their best marks on the early parts of this question and found the question more challenging towards the end.

- (a)
- i) Most candidates gained credit here, with chlorotrifluoromethane, trifluorochloromethane and both answers with a correct sequence of 1s all being accepted.
- ii) Many candidates scored both marks here, for a three-dimensional diagram and a bond angle in the range of 105-110°. Those who did not score both marks often gave an angle value that was outside of this range.
- iii) Most candidates scored this mark by indicating a partial positive charge on the carbon and partial negative charges on all the halogen atoms. Those who did not score often gave partial charges on the atoms of only one bond.
- iv) Most candidates gained some credit, with many scoring both marks. The most commonly given completely correct response was ‘fluorine and chlorine are both more electronegative than carbon’, although some also gained both marks for stating that

there was a difference in electronegativity of the atoms in the molecule and then explaining what this meant in terms of the ability of the atoms to attract the bonding electrons towards themselves. Some candidates did not spell the word 'electronegative' correctly and so did not score the first mark.

- v) Most candidates who gained credit here scored the mark for stating that fluorine is more electronegative than chlorine, or that the C-F bond is more polar than the C-Cl bond. Some candidates went on to link this to a valid reason for the molecule being polar.
- (b) Most candidates identified the C-Br bond as being the one most likely to break.
- (c)
- i) Most candidates gained some credit, usually for giving the type of bond breaking as homolytic. Many also went on to gain the second mark either for stating that the process resulted in two radicals forming, or for explaining how the bond breaks during the process.
- ii) The majority of candidates gained both marks by writing the expression for the calculation and correctly evaluating it.
- iii) Most candidates gained some credit, with many gaining all three marks by using their answer to the previous question correctly, even if their value for the energy from the previous question was incorrect. Candidates who did not know how to calculate the final answer to the question usually gained a mark for evaluating the expression they had derived and giving an answer that was correct to three significant figures.
- (d) Many candidates gained credit for describing the data collected from atmospheric studies as being overlooked because the value for the ozone concentration was considered to be too low to be correct. Some went on to give details of the discovery that chlorine radicals catalyse the breakdown of ozone and that spectroscopic measurements showed that ozone levels in the atmosphere were lower than expected.
- (e)
- i) Most candidates gained some credit, with many going on to score both marks – often by stating that as greenhouse gas concentration increases; more of the infrared radiation emitted by the Earth is absorbed. Candidates scoring one of the two marks had often stated that an increase in greenhouse gas concentration meant that more infrared would be absorbed, but did not score the first mark because they had not identified the Earth as the source of this radiation.
- ii) Candidates who gained credit for their response usually stated that as concentration of greenhouse gases increases, so do global temperatures. Those candidates who did not score this mark had often given answers that related the increase in greenhouse gas concentration to melting of ice at the poles or stated that more greenhouse gases meant more global warming.

#### Question 4

This was one of the higher-scoring questions for many candidates, with questions involving atmospheric issues and reactions often producing responses that were well-written and logically ordered.

- (a) Most candidates gave incomplete combustion as the process that causes carbon monoxide to be released from cars, but not all candidates who stated this gained the mark, as they did not identify the source as being a fossil fuel, hydrocarbon or named fuel – such as petrol.

- (b) Most candidates scored at least one mark, usually for stating that carbon monoxide is toxic, and many went on to score both marks.
- (c)
- i) The majority of candidates gained credit here. Those who did not score often stated that a radical is an unpaired electron rather than the required response of some sort of particle with an unpaired electron.
  - ii) Most candidates scored both marks for giving the name of the process as propagation and then explaining what this means. Those scoring one mark had often correctly chosen propagation, but then described this as a reaction that produces a radical, rather than describing a situation where there is a radical at both the start and the end of the process.
  - iii) Candidates gaining credit gave carefully worded answers that described the available radiation as being not of a high enough frequency to break the bond. Those candidates who did not score had usually described the radiation as not having enough energy.
  - iv) Candidates gained credit with a variety of answers that either linked the low reaction rate to low concentrations of the OH and/or CO or to the fact that there were few collisions of OH and CO particles.
- (d) Most candidates gained some credit, usually for describing carbon dioxide as simple molecular and/or describing silicon dioxide as forming a giant lattice. Some candidates scored the third mark for an appropriate comparison of the strength of the forces that need to be broken in order to change the chemicals' physical states. Those candidates who did not score the third mark were often comparing intermolecular forces in both compounds or gave answers that were not worded sufficiently clearly for Examiners to know if they were comparing intermolecular bonds or covalent bonds.
- (e)
- i) Candidates gaining credit gave responses that showed clear working and rounded their answer correctly, usually choosing three significant figures and so quoting a final answer of 26.7%. Those candidates who did not gain this mark had usually either rounded incorrectly (e.g.: giving 26.6%) or had calculated the increase in the percentage (so giving an answer of 0.008), rather than the percentage increase.
  - ii) Many candidates scored at least one mark for performing a comparison of the concentrations of carbon dioxide and carbon monoxide, even if they had not scored the first mark for converting both values to the same units.
- (f)
- i) The majority of candidates gained both marks, often giving detailed descriptions of the problems and benefits of ozone. The most common correct responses were that a problem of tropospheric ozone is its toxicity and the benefit of stratospheric ozone is its ability to absorb uv radiation.
  - ii) Most candidates gained some credit, with many scoring both marks. A wide variety of appropriate responses was given, often including more details than were necessary to gain the mark. The most frequently given correct response was the bonds in ozone molecules being broken when uv radiation is absorbed, producing an oxygen molecule and an oxygen radical. Candidates scoring one mark had often given an appropriate process but not identified the products.

- iii) Many candidates gained credit for succinct answers that followed the process in a logical way. Candidates scoring two marks out of three had often given water, ozone or another chemical as the source of the oxygen radicals, rather than oxygen molecules.

#### Question 5

There were a large number of very good answers to this question, which indicated that candidates had made good use of the article when preparing for this paper.

- (a) Candidates gaining credit usually named the product as ethanoic acid, although some gained credit by writing the formula  $\text{CH}_3\text{CO}_2\text{H}$ . Incorrect responses in most cases were the names of other acids taken from the article.
- (b)
  - i) Most candidates gained full credit for working out the formula  $\text{C}_8\text{H}_{14}\text{O}$ . Those not gaining full credit had often miscalculated the number of hydrogens in the formula.
  - ii) Many candidates gained both marks, with alkene and ketone being most often given, although credit was also given for 'carbon to carbon double bond' and 'carbonyl'. Candidates scoring one mark had often given aldehyde rather than ketone for the second answer.
  - iii) Credit was given to candidates identifying the process as 'redox' either by circling their choice or by underlining. Some candidates did not score this mark because they had chosen more than one response and it was unclear to the Examiner which response was their final choice.
  - iv) Many candidates gained credit here, giving ether or alkoxy as their answer. The most commonly seen incorrect response was ester.
- (c)
  - i) Most candidates scored at least one mark, with many gaining full credit, for diagrams which were drawn with care. Those candidates who scored one mark had often drawn the diagram in pencil, changing their mind about the final diagram during the process, and then gone over their structure in ink. This made the structure ambiguous, with single bonds often looking like double bonds and extra methyl groups showing, which the candidate may not have intended to have included (as rubbed out pencil lines can still show on the page). Candidates may find it helpful to draft their diagram first; possibly using the extra pages at the end of the paper, and then transfer their final structure to the answer space – crossing out the draft version so that it does not contradict their chosen response.
  - ii) Most candidates gave red or brown to colourless as the colour change and so gained the mark. Those not scoring had often included an additional colour.
  - iii) Most candidates scored at least one mark, with many gaining full credit for an equation showing 5 moles of bromine molecules being added to the organic reactant. Those scoring one mark had often given less than 5 moles of bromine molecules, but had realised that the reaction is addition and so only one product is formed, allowing them to score the second mark for 'error carried forward'.
  - iv) Most candidates scored two marks, with ascorbic acid and retinol being the most commonly given correct responses.

- (d) Most candidates gained some credit, with detailed descriptions of malolactic fermentation and how it causes the taste of the wine to be less acidic being the most common response gaining credit. Many of the candidates who wrote this description also went on to score marks for a description of the polymerisation of flavanols and how this makes the wine taste less bitter. Those candidates who scored one or two marks had often described the malolactic acid fermentation, but had also given details of the initial fermentation that produces the wine, rather than going on to consider the reaction of the flavanols.

## F333 Chemistry in Practice

### General Comments

#### Organisation of work

Given that this was the sixth 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, and **not** put the work in plastic document wallets, when submitting work to the moderator. 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 remains the case that a number of Centres sent in marks that contained Clerical Errors. Sometimes this arose from transcription errors made in transferring candidates' 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 in the future.

#### 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.

### **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](mailto: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 2014 to 14 May 2015, 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 2013 to 14 May 2014 Task(s), along with a new (from the 1 June 2014 to 14 May 2015 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 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 student may be re-submitted (for example a student may have performed well in their skills II, III and IV in June 2014 and re-submit them for moderation with a new Skill V Task in June 2015 – 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**

#### **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 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 2, Part (g), there must be a specific reference to the (ethanoic) acid and not simply the vinegar.

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 1, Part (d) (i)), 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), 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 1, Part (d)(ii)).

Again if the Mark Scheme requires candidates to identify the formation of two layers in a test tube (Task 1, 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 1, Part (b) such as 'orange at the top, colourless 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 orange and the lower one being colourless'. However, 'layers' may be

implied, for example by stating that 'mixture separates'. Also, when adding cyclohexane 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' (Task 1, Part (c) (ii)).

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. This point was frequently overlooked so that for example, in Task 1, Part (a) (i), an answer such as 'red/orange' was awarded a mark whereas the mention of orange should negate this mark even though the correct colour of red is also present.

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 (c), where very few Centres realised that name and both the starting and finishing colour were needed for the first marking point.

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](mailto:OCR.GCEScienceTasks@ocr.org.uk) giving details about the observations made by the teacher. If OCR endorses this change then the answers of all 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 1, Part (a) (iii), the oxidation must be linked to the chloride ion, and not simply 'chlorine is oxidised'. That said, it must also be noted that the second mark does depend on the first, so correctly identifying the chloride ion would not score if reference had been made to reduction rather than oxidation. Also in Task 1, it should be noted that in Part (b) (iii) and (iv), the Additional Guidance is particularly important in clarifying the role of cyclohexane.

In a Task that considers organic reactions, 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, for example Task 2, Part (d)(i).

It should also be noted that in Task 2, Part (h), the phrase 'at boiling point' was sometimes overlooked and the mark incorrectly awarded.

Where equations are required, formulae must be written in the conventional way. This means that in Task 3, Part (e), barium oxide written as Ba(O) should not score. Also where an equation is required together with state symbols, for example in Task 3, Part (g), 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 [OCR.GCEScienceTasks@ocr.org.uk](mailto:OCR.GCEScienceTasks@ocr.org.uk).

## F334 Chemistry of Materials

### General Comments

Teachers are to be congratulated on how well candidates of all abilities were prepared for this now annual examination. This is definitely a positive outcome as a result of there no longer being a January examination. Candidates were able to access all marks and time did not seem to be an issue.

There were continuing noticeable improvements in the presentation and logical construction of calculations making it easy for examiners to award marks when errors had been made. It was also pleasing that candidates had addressed the difficulties of previous sessions in using the appropriate IR information from the *Data Sheet* and linking it to actual spectral frequencies.

There was a marked improvement in selecting the relative data here, as there was in using standard electrode potentials in Q.4, though this latter concept remains a quite difficult issue for many.

Candidates' general chemical knowledge was good and many were able to select the appropriate details in formulating their answers to Q.1 (d) (i), 1 (e) (i), 3 (b) (iii) and Q4 (b) (iii). Many candidates were much less certain when dealing with the topic of rate of reaction (see Q.2 (c) and Q.2 (d) (i), (ii), (iii)). The difficulty was that these questions both needed selective descriptive knowledge and an understanding of theory and practical techniques. Candidates all too often gave responses involving rote learning without considering whether they were relevant.

Being asked to drawing 3-D structures highlighted the need for teachers and candidates to adopt the standard line-wedge-dashed line method used in the specification, examination papers and the published teaching materials. Many of the different methods used failed to define the molecular shape correctly. This also highlighted a problem with examination technique; rubbing out diagrams/formulae etc. is not to be recommended as the scanning process picks up the original diagram and so leads to confusion.

A further difficulty in reading all of a candidate's response was the increasing tendency to write answers outside the allocated space (including the margins of other questions). In this paper pages 18-19 were available for this purpose. Correct numbers to each additional answer should be given; this was not always the case.

### Comments on Individual Questions

#### Question 1

- (a) Many candidates achieved the marks for the oxidation of Fe and the ionic equation for the formation of 'green 'rust'. Far fewer were able to give the equation for the formation of  $\text{OH}^-$  ions and the recognition of the formation of  $\text{Fe}(\text{OH})_2$  was rare, commonest errors were addition or redox..
- (b) The position of the sign was sometimes at fault and others confused oxidation state with the formula of the ion. Similarly when explaining why further oxidation did not take place many got this correct; the most common mistake was to suggest that no oxygen was present
- (c) The salt was often named correctly but oxides, sulfides and hydroxides were common errors as well as no or incorrect oxidation state for iron. Interestingly the most able candidates also wrote sulfate(VI) with the oxidation state always correct.

- (d) Good skills here in selecting the relevant information to give precise definitions for the first 3 marking points. The language skills needed to explain 'polydentate' proved much more difficult ; candidates seemed to confuse 'more than two' with 'two or more', few managing to use the correct version.
- (e) What was oxidised was identified correctly more often than what was reduced. Frequently O, OH<sup>-</sup> or H<sup>+</sup> was given as being reduced. Explanations were generally good though some forgot to include the actual oxidation states. The calculation involving gases proved more difficult than the one involving solutions in 2 (b). Most worked out the moles correctly but were not sure whether to divide or multiply by 3, and the same with 24. (Answer to calculation: 2.91)
- (f) As mentioned previously, diagrams were often confusing and even when correct names were also given the structures given did not always show the correct molecular geometry. It was common for candidates to give the mirror image of the tetrahedral complex for the second 'shape', believing the two structures to be enantiomers.

## Question 2

- (a) The ability to name compounds accurately was excellent. A few used hydroxyl or hydroxo, whilst pentanoic acid was occasionally seen.
- (b) The calculation was clearly structured by many leading to high marks. Others lost their way in trying to find the concentration of the acid rather than the number of moles. The wrong number of significant figures was responsible for a small proportion failing to gain the final mark and a few miscalculated the molar mass of the acid. (Answer to calculation: 48.4)
- (c) Many candidates were able to gain the final 3 marking points. Most of these failed to realise that it was vital for the first mark to consider the information given about the solutions provided for the experiment. Consequently no details were given for the preparation of the reacting mixture.
- (d) The answers to the 3 parts of this section were often muddled with candidates trying to remember procedures and techniques learned.
  - In (d) (i) few realised that it was necessary to prepare a series of solutions of **B** by diluting the one given. Most measured the absorbance of some solutions but often there was a reluctance to explain what is meant by a 'calibration curve'. Some candidates saw this part as requiring looking at graphs and calculating half-lives rather than experimental design.
  - In (d) (ii) most were able to deduce that the order was 1, but then gave an explanation linking concentration to rate rather than data from the graph such as initial gradient or reaction time.
  - The idea of varying the concentration of **B** in (d) (iii) was usually given but the need to keep the NaOH concentration constant was not always recognised.
- (e) A big improvement with this type of question enabled most to make at least 2 of the 3 marking points. Sometimes the nature of the bond, -OH or C=O, was missing whilst only a few failed to identify the peak at 1742 cm<sup>-1</sup>, instead quoting a range. Most knew the test for a phenol.
- (f) Most identified that optical isomerism existed because of the presence of a 'chiral C atom' but some missed the idea of 'mirror images' and quite a number used a second 'i' in 'superimposable' so failed to gain the QWC mark.
- (g) Most got ester as the functional group in the polymer. Explanations for polymerisation involving the two functional groups were often vague - e.g. 'the two -OH groups react together' was fairly common. Many suggested 'biodegradable' or 'from a renewable source' but few got both. Often suggestions were made based on properties candidates thought the polymer might have rather than using the information given in the question.
- (h) Rather well done, with only a few protonating one -NH<sub>2</sub> group in acid solution and some copying the structures given incorrectly.

Question 3

- (a) Usually correctly identified, the commonest errors being ester, aldehyde and carboxyl.
- (b) Although many knew water was eliminated, far too many wrote  $\text{H}_2\text{O}$  as the name despite 'name' being in bold in the question. In general candidates need to take special care when reading text which is emboldened in the question stem.  
Most identified condensation with only a few guessing addition.  
Many thought it was enough to state that  $T_g$  is the glass transition temperature. Of those that described it, the majority correctly had brittleness occurring 'below' rather than 'at'  $T_g$ .  
The next two marking points were generally more accessible though some thought a polymer became brittle above its  $T_g$ . The final two marking points were much more difficult to achieve, with candidates fixating on intermolecular forces rather than the mobility of polymer chains. As a result this usually resulted in PEEK having a higher  $T_g$  than PPO and thus a CON.
- (c) Very well answered with the commonest errors being use of several monomer units, 1,4 ring substitution and links to incorrect atoms e.g. H and O. The majority correctly identified acylation though the alternatives all had their following.
- (d) Only a few peptide linkages with the more able identifying the amide as secondary. Most made the connection between closer packed chains and stronger intermolecular bonds. Some thought there were different types of bond involved in the two polymers whilst others focused on there being *more* bonds present.

Question 4

- (a) Most candidates recognised the implications of the positions of P and As in the periodic table. A few tried to explain in terms of displacement or As being more reactive, presumably comparing group 5 to groups 1 and 2.  
Many excellent *dot-and-cross* diagrams; the commonest error was not to address the additional electron but leave only 7 electrons on the O.  
Many well-developed explanations for molecular shape and bond angles were seen. Those with a formulaic approach sometimes forgot to include the double bond as a single region of electron density. Others treated the bond angle as a separate question and argued for  $120^\circ$  or  $180^\circ$ .  
In part (iv) the vast majority correctly identified the reaction as condensation. This undoubtedly helped in drawing the structure in part (v) correctly. Some chose a primary alcohol or forgot the charge on the  $-\text{O}^-$ .
- (b) A few forfeited the first mark for use of AS rather than As. Many gave  $\text{AsO}_4^{3-}$  an incorrect or no charge or failed to balance the equation. With ecf operating most correctly identified the proton acceptors.
- (c) An improving area of understanding, far less sloppy language is now employed. There is some confusion between standard electrode potential and cell potential which led to a variety of errors. Some contradicted their answer with statements such as ' $\text{SO}_2$  is reduced'.  
Many candidates successfully added the two equations and cancelled the electrons but not any other species.
- (d) Most candidates finished the paper in style with the majority realising the assumption made regarding molecular size.

## F335 Chemistry by Design

### General Comments

There were many good answers seen, showing that candidates had benefited from their study of the subject in context. They were able to demonstrate their knowledge and understanding of the fundamentals and apply these to new situations.

Many candidates did well on numerical calculations and assigned units and significant figures correctly. Some found manipulating powers of ten difficult. Some understood the concept of a limiting reagent while others found this more difficult.

Candidates were often able to write well-organised responses to long-answer questions, especially where the subject matter was familiar, for example dye colour or the action of buffer solutions. Unfamiliar areas, such as the colourfastness of dyes or the properties of water, were found more demanding.

Some candidates were at their ease writing formulae in a conventional style and balancing equations, but many showed that these basic skills are still a challenge, even at A2 level.

Candidates must be reminded to cross out wrong answers, rather than attempting to modify them, and not to write outside the lined area of the question. Answers continued on the Additional pages should bear the correct question numbers. Many candidates showed good handwriting but just a few samples verged on the illegible. Invigilators should be encouraged not to hand out extra answer booklets until candidates have used the Additional Pages at the back of the paper.

The paper seemed of appropriate length as virtually no candidates appeared to have problems in finishing it. On the whole there were few parts left entirely blank, which is a credit to Salters' candidates who are trying their hardest.

### Comments on Individual Questions

#### Question 1

1(a) This was a nice gentle start. Most candidates realised that temperature increased the yield and that pressure had no effect and were able to explain these in terms of the endothermic reaction and the same number of moles on each side.

1(b) Most candidates knew that a catalyst had no effect on  $K_c$  and some were able to extend their knowledge that catalysts speed up reactions to say that equilibrium would be reached faster.

1(c) This calculation was often done well, especially if candidates wrote out their method carefully. The main error was halving the product of the  $H_2O$  and  $CO$  concentrations, rather than taking the square root.

1(d)(i) Some candidates were able to envisage the situation on Mars and suggest the Sun, rather than burning fossil fuels, the commonest wrong answer.

1(d)(ii) Again, some candidates realised that oxygen was also produced, though many talked about hydrogen removing carbon dioxide.

1(e)(i) Most candidates correctly gave +42 as the answer and the commonest error was omitting the plus sign.

1(e)(ii) There was a good success rate on this question and most candidates realised that the enthalpy change was in kJ.

1(e)(iii) Only a few realised that the equilibrium was exactly balanced at this point.

*Answers to calculations:*

1(c)  $[H_2O] = [CO] = 1.64 \times 10^{-6} \text{ mol dm}^{-3}$

1(e)(i) +42 J mol<sup>-1</sup>K<sup>-1</sup> 1(e)(ii) 950 K

## Question 2

2(a) Most candidates could give the formula of one of the possible groups and name its interaction with water molecules.

2(b)(i) A large number could name the amine group correctly

2(b)(ii) Fewer candidates could name benzene diazonium chloride or a significant part of this name.

2(b)(iii) The name 'coupling' was known by most candidates.

2(b)(iv) Relatively few candidates understood that they had to describe the reaction of acids with carbonates to form carbon dioxide. A large number answered in terms of delocalisation of the anion.

2c(i) Many candidates could draw the correct structure and very few omitted HCl as a product. Many of the errors were careless - for example poor copying of the dye structure, or omission of the hydrogen atoms on the lower N atoms.

2c(ii) This was a test of accurate expression of ideas which some candidates passed well. Candidates had to say that the dye would not 'wash out' (not 'fade') because water (not 'washing') would not break covalent bonds. Water could form hydrogen bonds with the dye that linked to wool by these bonds. Errors of expression included hydrogen bonds making hydrogen bonds with water or water hydrogen bonding with wool.

2(d) By contrast, this much more familiar question was answered well. Many candidates could describe the origins of colour in dyes and link the difference in  $\Delta E$  to the size of the chromophore. There was still a minority who think the colour comes from the electrons dropping, so presumably they would expect dyes to glow in the dark.

2(e)(i) This question was well-answered, with many candidates scoring all the marks. Common errors were just one bromine atom on the right-hand structure or 1,3,5-tribromocyclohexane.

2(e)(ii) Most candidates stated that the bond lengths would be different and almost all said that double bonds were shorter than single bonds.

2(f)(i) Many candidates could write a correct equation and give the formula of a suitable catalyst, usually AlCl<sub>3</sub>. Some did not realise that HCl was also formed.

2(f)(ii) The answer 'sodium hydroxide' (or its formula) was given by many candidates. Some thought that water was a powerful enough nucleophile to undertake this reaction.

Question 3

3(a)(i) The name 'ethanol' was given by most candidates, though some described it as 'ethan-1-ol', which was not accepted.

3(a)(ii) Again, many candidates knew 'propane – 1,2,3 – triol', though many benefited from the lack of insistence on the 'e'.

3(b) Most candidates could work out that there were two double bonds in  $C_7H_{11}$ .

3(c)(i) Most candidates could name permanent dipole – permanent dipole bonds, though many took advantage of latitude on the spelling. The common wrong answer was 'hydrogen bonds'.

3(c)(ii) Many candidates could name the weaker intermolecular bonds in ester **G** and say why they were weaker. Almost every candidate scored for stating that weaker bonds take less energy to break (or the reverse argument). Some candidates tried to explain the differences in terms of packing of the molecules which was not relevant here.

3(d)(i) Some candidates scored more than one mark by realising that the intermediate was an anion with the negative charge on the oxygen. Only a few were able to draw all the curly arrows correctly.

3(e)(i) Most candidates could write this equation, with a correct equilibrium sign. The commonest errors were the omission of the equilibrium sign and the omission of water as a product.

3(e)(ii) Most knew that the sulfuric acid was a catalyst but only a few seemed aware of its function of absorbing water and moving the position of equilibrium to the right.

3(f)(i) Many candidates could draw the structure of the acid and, of those, almost all correctly circled the chiral centre.

3(f)(ii) Most candidates could give one of two answers 'no peak at 1700 – 1725' or 'no broad peak at 2500 – 3200' and gave them in the required detail to score the mark for the absence of an acid. They could usually also write that there was a peak between 1735 and 1750 that was given by the  $C=O$  of an ester.

3(f)(iii) Some candidates scored well here, giving the correct ester, describing why a doublet was formed and giving two other relevant reasons. Other candidates got the right answer but failed to back it up with good reasoning, which had to be expressed in recognised chemical terms. For example, candidates were better at describing splitting in terms of the 'number of protons on the adjacent carbon' but vaguer statements such as 'one proton in the neighbouring environment' did not score. Some credit was given for the ester 'the wrong way round', though the 3H at 2.0 gave the clue that it was an ester of ethanoic acid, not methyl propanoic acid. A counting exercise on the atoms would have revealed that there was no  $C=C$  bond. Some candidates thought that the 6H peak was caused by two  $CH_3$  groups on different parts of the molecule.

Question 4

4(a)(i) Most could name the amide group. Some wrongly named it 'secondary amide' or 'peptide'

4(a)(ii) Many could write the equation for the formation of ammonium sulfate and the carboxylic acid and balance it.

- 4(a)(iii) Most chose the correct answer, 'hydrolysis', though a few chose 'substitution'.
- 4(b)(i) Many could draw this diagram correctly and name 'ion-dipole' bonds. There were some omissions in labelling the water molecules and some did not know the name of the bonds.
- 4(b)(ii) This was a test of understanding, which many had, and also of careful attention to detail. Some were able to label the lines correctly, to describe the enthalpy change of hydration of both ions and label an endothermic enthalpy change of solution. There were many pitfalls; just talking about 'hydration enthalpy' was the most common, but omitting the '2' before the sign in  $\text{SO}_4^{2-}$  or failing to show two ammonium ions were also quite common.
- 4(c)(i) Most candidates had no trouble here but there were some who labelled the  $\text{H}^+$  as the acid.
- 4(c)(ii) Most candidates were correct here.
- 4(c)(iii) Again, most could do this, though some had trouble with the powers of ten.
- 4(c)(iv) This was a harder question but some managed to realise the relationship between  $K_a$ ,  $K_b$  and  $K_w$  and solve the problem.
- 4(d) This is a frequently-asked question, so accuracy of expression was required to score the marks. Most managed to state that adding acid meant more  $\text{H}^+$  ions, which moved the *position* of equilibrium to the left. The large concentration of  $\text{A}^-$  meant that the pH was hardly affected. Most scored the last part and each of the first three marks were lost about equally.
- 4(e) This was another tough question that was tackled well by many candidates. Most realised that lactic acid had both an acidic and an alcohol group and many could also draw the cyclic ester correctly. Relatively few ignored the molecular formula and drew an internal ester of lactic acid.

*Answers to calculations:*

4(c)(iii)  $5.5 \times 10^{-10} \text{ mol dm}^{-3}$ ; 4(c)(iv)  $1.8 \times 10^{-5} \text{ mol dm}^{-3}$

## Question 5

- 5(a)(i) Most could draw the dot and cross diagram for sulfur dioxide, the commonest error being to place two lone pairs on the sulfur.
- 5(a)(ii) Again, most could answer this fairly familiar question, though some lost marks because they talked about pairs of electrons rather than 'areas of electron density'.
- 5(a)(iii) Some candidates spotted that a dative bond would solve the problem and then produced a correct structure, though some of these were let down by a failure to count electrons.
- 5(a)(iv) A few candidates wrote a correct equation, forming either  $\text{SO}_3^{2-}$  or  $\text{HSO}_3^-$ . A number of equations had an unbalanced  $\text{SO}_3^-$  formed and many tried to form sulfate without realising they could never balance the equation without involving oxygen molecules – for which a correctly balanced equation would have been perfectly acceptable.
- 5(b)(i) Most candidates scored full marks here, though several got one of the oxidation states wrong.

5(b)(ii) Some candidates worked out the moles of  $\text{SO}_2$  and  $\text{H}_2\text{S}$ , realised that there was excess  $\text{SO}_2$ , said so and then calculated the mass of sulfur from the mass of  $\text{H}_2\text{S}$ . This was a case where explanation was necessary, hence the clue 'Show your working' in the question. Others scored one mark for working out the mass of sulfur using the moles of  $\text{SO}_2$ .

5(b)(iii) Some candidates identified lack of conductivity and low melting point and gave reasons for these. Credit was not given for those who said sulfur was a gas, partly because it had been described as a solid earlier in the question.

5(c)(i) Most candidates identified a Group 6 *element* (rather than atom) and made it clear it had formed a compound with hydrogen (rather than 'attached to hydrogen').

5(c)(ii) Many candidates said that oxygen was more electronegative and scored the first mark. Some then went on to score the second in a variety of ways. Those that went down the route of comparing the intermolecular bonds in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{S}$  sometimes failed to score by comparing the elements rather than the hydrides or by saying that  $\text{H}_2\text{S}$  had instantaneous dipole – induced dipole bonds, rather than permanent dipole – permanent dipole bonds.

5(c)(iii) Some candidates could express themselves clearly enough to write that ice had lower density than water because the molecules were further apart. This was because hydrogen bonds held the molecules in an ordered structure. Other answers omitted mentioning molecules or hydrogen bonds or an ordered structure.

5(d)(i) Only half the candidates scored here. Most of the others wrote the configuration of the  $\text{S}^{2+}$  ion, while some gave the configuration of a sulfur atom.

5(d)(ii) Many candidates could write the correct formula for sodium sulfide and then could go on to write and balance an equation forming the sulfide and 'ammonium hydroxide' or ammonia and water. Candidates must be aware that chemists have definite conventions for writing formulae and that use of extraneous brackets, such as  $(\text{Na})_2\text{S}$  and  $(\text{NH}_4)\text{OH}$  are not acceptable.

*Answers to calculations:*

5(b)(ii) 62.6 g

# 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. They were well supported by their teachers and will have gained a great deal from the process.

A range of investigation topics was chosen by candidates but unusual topics were less frequently seen this year. As usual, the work from some centres was limited to kinetics which is a pity since it reduces the opportunity for some candidates to choose and carry out an investigation of a topic that matches their own interests. On the other hand there were centres where candidates had been given a free rein in choosing their investigation and the marks achieved were just as varied. Candidates may, however, have gained a lot more from the assessment activity.

The extent to which candidates' work had been annotated varied between centres. Most centres accurately applied the marking criteria and wrote annotations on candidates' scripts. Some centres, however, merely lifted phrases from the marking criteria and wrote them on candidates' work without clearly explaining how they applied in each individual case. This resulted in them giving impersonal, generic comments which, in some cases, were duplicated over several scripts. The most helpful comments clearly identified shortcomings in candidates' work and explained how the centre arrived at the mark awarded.

Many centres did not supply the required documentation to support the award of a mark in skill area G. Written evidence arising from direct teacher observation of candidates at work in the laboratory should be sent to the moderator with candidates work. 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. In a small minority of cases investigation reports lacked cover sheets or candidate numbers.

Some centres failed to complete candidate cover sheets making the marking of work difficult as candidate numbers were not provided. Work is best sent to moderators held together securely by, for example, a treasury tag. A few centres sent candidates' work in large ring binders or with each skill area in a separate plastic envelope which made the mechanics of moderating samples much more difficult.

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

Most candidates produced a reasonable range of relevant background theory. Some candidates, however, still give a large amount of irrelevant historical or biological content which does not contribute to the mark. Some kinetics investigations lacked basic order theory.

The theory included in this section should be relevant to the actual experiments carried out. Examples of inappropriate content include the inclusion of theory of the effect of pressure or radiation when this is not varied, including the effect of a catalyst when this is not used or including details about homogeneous and heterogeneous catalysis when only one type of catalyst is used.

### **Skill Area B**

Sometimes the content for skill A was mixed up with content for skill B. This made it more difficult to unpick the investigation and award appropriate marks. It is more helpful to candidates if the two skill areas are kept separate. In most cases the marks awarded for this section were appropriate but in a small number of cases high marks were awarded when the proposed method was unworkable. Sometimes compounds were chosen as potential catalysts when a little research would have revealed that they would not work.

### **Skill Area C**

The risk assessments were better this year with the requirements being clearly understood in most cases. The only real issue here concerns candidates who do not include the concentration of the solutions they are using and those who simply copy out Hazcards instead of applying the information to their own situation. References were less good. The main error made by candidates was to cite web addresses as just a string of urls. Web addresses should be followed by a brief description of what the site contains.

### **Skill Area D**

Most candidates produced clear, well tabulated results. Where a data logger is used, candidates should summarise the results obtained from the graphs they generate.

### **Skill Area E**

Graphs were usually well drawn and calculations carried out correctly. Where candidates find that a plot of concentration against rate of reaction produces a curve they should plot another graph of rate against the square of the concentration to confirm that the reaction is second order.

The ability to draw appropriate conclusions, however, 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 work of candidates in this skill area was much improved this year. Most candidates clearly understand what is expected in terms of percentage errors and comments on the limitations of experimental procedures.

### **Skill Area G**

Too many centres failed to include sufficient detail to justify the marks awarded in this skill area. In examples of best practice some centres included detailed working documents giving details of candidates' competence in specific skills. There was often an insufficient range of marks given to candidates in centres.

## **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.

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.

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