

Chemistry B (Salters)

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

Report on the Units

June 2010

HX35/R/10

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

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

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

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

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Chief Examiner's Report

This year sees the first candidates completing the new Specification and we can be pleased with the outcome. The reports on each unit indicate that many candidates did well and produced answers of high quality. Even more importantly, others did their best, and showed that they were trying hard by attempting almost every part of every question.

There are still some issues reported with setting out calculations and, even more so, with candidates expressing themselves fluently in chemical language. Significant figures also still prove a weak area, in both the papers and the AS coursework.

Candidates should also note the advice given in the F334 and F335 reports about how they should proceed if they run out of space.

The F333 coursework moderators were pleased with the marking standards of most centres, aided by the detailed mark-schemes. The grade boundaries emerged as the same as last year's, though this may not always be the case, since these boundaries are awarded by judgement of the work, and the tasks vary from year to year. Once again clerical errors made the moderators' work more taxing. Centres are urged to take care over their administration.

The new marking arrangements for F336, the Individual Investigation, certainly made moderation easier and we suspect that teachers found applying the new criteria easier too. The Individual Investigation may be harder to administer and to mark than other forms of coursework, but there is no doubt that many candidates are inspired by what they do, and some excellent work was seen.

Note regarding Stretch & Challenge (A*) for June 2010

June 2010 sees the first award of the A* grade for new GCEs (see page 49 of the specification). To achieve an A* grade in their Advanced GCE, candidates must achieve 480 *uniform* marks (UMS) in their Advanced GCE, *ie* grade A, and also gain at least 270 *uniform* marks in their three A2 units. Two candidates with 480 UMS could have different grades depending on their AS and A2 performance, for example:

Candidate 1 – 211 UMS at AS, 269 UMS at A2, 480 UMS overall, grade A

Candidate 2 – 210 UMS at AS, 270 UMS at A2, 480 UMS overall, grade A*

A good explanation is given in the open letter to centres from OfQual, see www.ofqual.gov.uk/files/2010-02-11-open-letter-a-star-grade.pdf and also see www.ocr.org.uk/qualifications/type/gce/stretch_challenge/

Upcoming INSET events in 2010/2011

OCR AS/A Level Chemistry B (Salters) (H035/H435): *Get ahead – raising standards through exam feedback* (Course code OSCM601 / OSCM602)

This **full day** course will:

- Consider post-summer results documentation, such as question papers, reports and mark schemes
- Consider the step up from AS to A2
- Discuss approaches for preparing candidates for the external examination
- Demonstrate standards for the internal assessment of coursework and externally assessed components
- Allow delegates to share good practice and ideas on new approaches.

Course dates – Friday 12 November 2010 (London), Wednesday 24 November 2010 (Birmingham). We would also like to run this course in Leeds if there is sufficient interest from customers. Please visit EventBooker or e-mail training@ocr.org.uk to register your interest. We will contact you with details as soon as we confirm a date and location.

Fee – £182 including refreshments, lunch and course materials. £215 if you book within 7 days of the course date.

OCR AS/A Level Chemistry B (Salters) (H035/H435): *Get ahead – improving delivery and assessment of Unit F336* (Course code OSCM501/OSCM502)

This **full day** course will:

- Demonstrate standards for the internal assessment of coursework and externally assessed components
- Advise on resources and offer guidance on the use of teacher support materials
- Examine other useful resources and provision of support
- Review exemplar candidate work
- Allow delegates to share good practice and ideas on new approaches.

Course dates – Thursday 4 November 2010 (London), Tuesday 16 November 2010 (Birmingham).

Fee – £182 including refreshments, lunch and course materials. £215 if you book within 7 days of the course date.

OCR AS/A Level Chemistry B Salters (H035/H435): Get Started – guidance for first delivery (Course code OSCM401)

This **full day course** will:

- Answer questions from teachers linked to the teaching of the standards
- Review the support and resources we offer
- Explain the administration procedures
- Enable delegates to network and share ideas for best practice.

Course dates – We would like to run this course if there is sufficient interest from customers. Please visit EventBooker or e-mail training@ocr.org.uk to register your interest. We will contact you with details as soon as we confirm a date and location.

To book a course

Online: you can view and book your training event online (or to register your interest for events at other locations) by visiting our new EventBooker service at www.ocr.org.uk/eventbooker

By e-mail: use the booking form on www.ocr.org.uk and e-mail it to: training@ocr.org.uk

By fax: please complete and return the booking form to: 024 7649 6399

By post: please complete and return the booking form to: OCR Training, Progress House, Westwood Way, Coventry CV4 8JQ

Please note: we cannot take telephone or provisional bookings.

Please note: training programmes are correct at time of going to print. Please visit EventBooker at www.ocr.org.uk/eventbooker to search for the most up-to-date event details.

F331: Chemistry for Life

General comments

The paper proved very accessible to all candidates, giving the opportunity for more able candidates to score highly, yet providing weaker candidates with material that they could achieve success on.

Marks ranged from single figures to full marks.

Time was not an issue in this paper. There was encouraging evidence of candidates more logically setting out their answers and numerical questions were, in the main, well attempted. It was pleasing to mark so many candidates' work where there was evidence of understanding of the ideas, and work had clearly been done to revise those ideas thoroughly.

Comments on individual questions

Question 1

Q.1 (a) (i) Despite irrelevant references to incomplete combustion this question was generally well-answered. Q.1 (a) (ii) caused a number of candidates to trip up when they referred to the toxic nature of nitrogen oxide rather than a polluting effect. In Q.1 (a) (iii) the correct answer of nitrogen was missed by a sizeable minority of students. A surprising number said 'nitrogen dioxide'.

Q.1 (a) (iv) had many very good answers with candidates remembering the phrasing in the text book; the main error once more being the statement that bonds between molecules break in Stage 2. The number of candidates' correctly using the term adsorption has increased considerably over the last few sessions which is pleasing.

Q.1 (b) had many correct answers but some candidates still forget to put the sign and in this specific example a significant minority failed to realise that the enthalpy value given needed to be doubled.

Numerical answer Q.1 (b) -164

Question 2

Q.2 (a) was well-answered. Q.2 (b) produced a range of answers. Q.2(b)(i) was correctly answered by many candidates but Q.2(b)(ii) was less well-known and 'magnetic field' was given often enough as an answer to wonder if some centres have missed the move to 'time-of-flight' mass spectroscopy.

Part Q.2 (b) (iii) was generally answered correctly.

In Q.2(c) (i) many candidates missed out the peak height or 208 isotope or 1950 from the answer and failed to score. Q.2(c) (ii) was well-answered.

Q.2 (d) (i) caused few problems and Q.2 (d) (ii) had more candidates getting it completely correct than in recent sessions. In Q.2 (d) (iii) a problem was with singulars and plurals. "The time taken for an atom/nucleus to decay" was wrong while 'atoms/nuclei' were right. "The time taken for isotopes to decay" was wrong, while 'isotope to decay' was right.

The majority of candidates successfully negotiated parts Q.2(e)(i) and (ii), although the requirement to recognise four pairs or groups of electrons was still missed by some candidates and the actual shape of the molecule was sometimes confused with the orientation of the electron pairs leading to answers such as 'bent tetrahedral' for the shape of the water molecule.

Question 3

Q.3 (a) (i) was reasonably well attempted by most candidates with the most common errors being BaCl as the formula of barium chloride and (l) as its state symbol.

Q.3 (a) (ii) was based on an important experimental activity within this unit however candidate answers, and consequently marks, varied widely. Some answers started with "Mix the carbonate with the lime water". Some otherwise good answers lost marks because of a poor description of the experimental set-up or did not mention the order of cloudiness, or said use the same mass, rather than moles of carbonate.

The calculation in Q.3 (b) frequently yielded the maximum three marks for the more able candidate.

In Q.3(c) a number of candidates stated the number of outer shell electrons or number of electron shells without relating this to the period and more got the group than the period (quite a few thought it was period 5, not 6).

Numerical answer Q.3 (b) $9.43/9.44 \times 10^{-7}$

Question 4

Q.4 (a) was well-answered. In Q.4 (b) a common wrong answer was to name another isomer as butan-3-ol then draw butan-2-ol backwards.

Tip for Centres

The drawing of structural formulae can be sloppy and risk losing marks. Make sure candidates are taught to draw bonds clearly to the atoms joined by the covalent bond and not to the side of atoms or indeed to the wrong atom.

In Q.4(c)(i) a sizeable minority of candidates failed to realise that they first needed to calculate the number of moles of butan-1-ol in 1000g (the 1 kg given in the question) in order to answer the question. Many multiplied the values rather than dividing and some missed out the 1000 giving an answer of 36.

Q.4(c) (ii) threw up the same problems as in previous sessions when this type of question has been set, namely the need for clarity of thought, which in turn leads to clarity of explanation. Predictably, some weaker candidates said bond breaking was exothermic, however other common incorrect statements included 'It takes more energy to break bonds than it does to make them' which is partially right and many candidates still think that more bonds can be made in a chemical reaction than broken, and of course, this is only true for termination reactions.

In Q.4(c) (iii) a large number of candidates wrongly said there were more molecules when mixed.

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Q.4(d)(i) was correctly answered by the majority and many answered Q.4(d)(ii) correctly by referring to the chain length of the hydrocarbon, although those candidates trying to answer in terms of the stoichiometry of the equation often unfortunately 'shot themselves in the foot' by not stating the ratio 'per mole' for each hydrocarbon.

Q.4 (e) (i) and (ii) produced several vague and therefore non scoring answers, typically 'less pollution' for a benefit of biofuels in (i).

Numerical answer Q.4(c) (i) 36,153

F332: Chemistry of Natural Resources

General Comments

Candidates' scores covered almost the whole mark range, from single figures to the high nineties. A good proportion of candidates scored satisfactorily overall and in line with performances on previous papers. There was no indication that candidates had a problem with the length of the paper, with answer spaces that were left blank being uncommon and tending to indicate a lack of knowledge and understanding rather than time constraints.

Calculation questions were generally less well done than in previous sessions and candidates did not set out their answers as clearly to show what was being calculated at each stage. Many candidates still gained credit, even if they had made a mistake, because they were given marks under the 'error carried forward' rules. Answers to the questions on organic chemistry were, on the whole, good – and much better than on similar questions on previous papers. Literacy skills were generally good, with marks for the long answer questions being in line with those on previous papers and candidates showing a sound grasp of most technical vocabulary.

Marks were generally much lower on questions that required candidates to write descriptions or explanations of chemical phenomena.

Comments on Individual Questions

Question 1

This was a high scoring question for many candidates, with the majority scoring well over half marks.

- (a) Many candidates scored well here. For those failing to score full marks, the lack of signs in front of the number value was the major issue.
- (b)
 - (i) Many candidates gained this mark, with the most common incorrect answer being hydrogen.
 - (ii) Marks on this question were generally good. Those failing to score both marks had often not written their answer to two significant figures, as had been asked for in the question.
 - (iii) Fewer candidates scored both marks here. Many gained one mark for showing 6 hydrogen ions, but many left the second answer space empty.
- (c)
 - (i) The majority of candidates scored both marks here, with the most common error being an incorrect colour for the precipitate (often given as white).
 - (ii) The majority of candidates scored at least one mark here and many scored both. Candidates writing an incorrect equation could still score for appropriate state symbols.
- (d) Scores on this question were very low, with few candidates scoring two or more marks. This was often caused by poorly worded explanations that were not sufficiently detailed to show a good understanding of the phenomenon being described.

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- (e) (i) Marks on this question were very high, with the vast majority of candidates gaining both marks. Those failing to gain full credit often scored one mark for including the correct number of electrons in their configuration.
- (ii) This was another high scoring question, showing a generally good grasp of the concept being tested.
- (iii) Nearly all candidates scored here, even if they had failed to gain credit on the previous two parts of this question.
- (iv) Although many candidates gained some credit here, few gained both marks. This was caused, as in other questions requiring an explanation, by answers that lacked descriptive depth.

Question 2

Although marks were not generally as high on this question as they were on Q.1, many candidates scored quite well on this question overall.

- (a) Many candidates gained both marks here, although a surprisingly large minority did not seem to understand what the question wanted and either wrote a shortened structural formula for the compound or tried to write its systematic name.
- (b) Marks on this question were high, with few candidates failing to score at all and many gaining both the available marks.
- (c) Again, marks were high for this question, with the vast majority of candidates gaining full credit for their answer.
- (d) (i) The majority of candidates gained some credit here, usually for naming an appropriate acid. Many also scored the second mark for a suitable oxidising agent.
- (ii) Fewer candidates gained good marks here, even if they gained full credit in (d) (i). Many gave the correct colours for their chosen oxidising agent, but got the colours the wrong way round.
- (iii) Only the most able candidates scored this mark, with the most common incorrect answer here being aldehyde.
- (iv) A few candidates failed to gain the mark here because they did not draw a full structural formula. Those who incorrectly gave the answer of aldehyde in the previous question were given error carried forward for a correct drawing of the full structural formula of an aldehyde group here.
- (e) Many candidates failed to score here and showed a lack of understanding of the type of isomerism being tested. Those who did gain credit generally scored both marks.
- (f) Few candidates gained this mark. Many answers were too vague to gain credit or were referring to lack of rotation about the C=C instead of the impact of the two identical groups on the carbon at one end of the double bond.
- (g) (i) Most candidates gained some credit here, although full marks were seen quite rarely. As in other questions asking for descriptions, many answers were too vague, making it difficult to tell which chemicals candidates were referring to in their answer.

Report on the units taken in June 2010

- (ii) Two marks were only gained by the highest achieving candidates, although many scored one. In most cases the first mark was not awarded, as candidates wrote about differences in reaction rate for the two organic compounds, rather than the difference in volume of bromine water they would react with.
- (iii) Few candidates gained both marks here. The most common incorrect answer had candidates substituting a Br for the OH of the molecule.
- (iv) Many candidates scored both the available marks for this question.

Question 3

As with Q.1, this was a high scoring question for many candidates, with the majority scoring well over half marks.

- (a) The majority of candidates scored a mark here. Those not scoring generally gave an answer that was not a human activity.
- (b)
 - (i) The majority of candidates scored this mark.
 - (ii) Most candidates scored here. Many of those failing to gain credit gave answers referring to a lone or free electron, rather than an unpaired electron.
 - (iii) The majority of candidates scored this mark.
- (c)
 - (i) Very few candidates gained credit here. Many answers referred simply to radicals being very reactive, rather than dealing with the fact that no bonds need to be broken during this reaction.
 - (ii) Many candidates scored here for a clearly worded answer. Most of those candidates who failed to score gave answers that were too vague or did not make use of the information given in the question.
 - (iii) Marks were generally good, with many candidates scoring three or more out of five. Common errors from candidates who gained low marks here were stating that increasing the temperature lowers the activation enthalpy of the reaction and failing to state that increasing the temperature increases the reaction rate, or vice versa.
- (d)
 - (i) Only the most able candidates scored this mark, with the most common incorrect answer being an equation that still showed the nitrogen oxides.
 - (ii) The majority of candidates scored this mark.
 - (iii) Many candidates scored this mark, giving a clear definition in the required context.
 - (iv) Most candidates scored at least one mark here for a correct statement about activation enthalpy. Fewer went on to gain the second mark for writing about the alternative pathway provided by the catalyst for the reaction.
- (e)
 - (i) Most candidates gained some credit here, with many scoring two or three marks.
 - (ii) Most candidates scored the mark here. Those failing to score often gave vague answers about ozone such as 'it is harmful'.

Question 4

This was the lowest scoring question for a lot of candidates, with many scoring less than half marks.

- (a) (i) Many candidates failed to score at all here and very few gained both marks. Common incorrect answers that gained partial credit included 1,1,1-trifluoro-2-fluoroethane and 1,1,1,2-tetrafluoroethane (both of which scored one mark for the numbers).
- (ii) Answers here were very high, with almost every candidate gaining some credit and the vast majority scoring both marks.
- (iii) Most candidates scored this mark.
- (b) (i) Most candidates scored this mark.
- (ii) Many candidates gained full credit here, although it was sometimes difficult to follow the logic that had been applied in arriving at the final answer.
- (iii) This mark was not often awarded. Many candidates divided their answer from (b) (ii) by 100 and multiplied by 45, instead of dividing by 45 and multiplying by 100.
- (c) (i) Marks awarded to most parts of questions (c) and (d) were low, and answers suggested that candidates had not had experience of carrying out this experiment for themselves. Few candidates gained credit here.
- (ii) A sizable minority of candidates had no idea of what heating under reflux meant and gave answers that illustrated this clearly. Those who did know often worded their answers in a way that made it impossible to give credit.
- (d) (i) A small majority of candidates gained no credit here. Those who did usually knew that a separating funnel was required, but few could then describe how this helped with separation of the layers.
- (ii) A small majority of candidates gained credit here.
- (iii) Most candidates scored this mark

Question 5

Marks on this question were disappointing and, on the whole, candidates scored one of their lowest marks for this question. Answers generally indicated a low level of understanding of the article and suggested that candidates had not prepared sufficiently carefully for this question or read the article thoroughly.

- (a) Most candidates gained credit here, although few scored all four marks. Many did not include an example or gave heterolytic as the type of bond fission instead of homolytic.
- (b) Marks on this question were very low, with the vast majority of candidates failing to gain any credit. Many candidates did not know the percentage of nitrogen in Earth's atmosphere. Those who did give an acceptable value often incorrectly divided this value by the value for Venus, instead of the other way round. Very few candidates appreciated the significance of the difference in atmospheric pressure between the two planets.

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- (c) Marks here were very low, with most candidates failing to gain any credit. This question is a good example of the importance of extra research being carried out by candidates once they have the article. Here, they needed to have found out what is meant by 'outgassing'.
- (d) Most candidates gained some credit here, with the failure to score marks often being as a result of stating that the molecule vibrates more, rather than the bonds. This seems to be a common error on papers that include a test of this concept.
- (e) Most candidates scored here. A common reason for not gaining credit was the quotation of an inappropriate wavenumber range.
- (f) Most candidates gained one mark here, but few went on to score the second. A common error was to convert from percentage to ppm by multiplying by 1,000,000, but forgetting to divide by 100.
- (g) Marks on this question were generally quite good and better worded than many of the other questions on the paper that asked for descriptions or explanations. Most candidates scored four marks or more out of six and few failed to score at all. Lower marks often resulted from a failure to compare Earth with Mars. Many gained the mark for quality of written communication by linking the atmospheric composition with the greenhouse effect.

F333: Chemistry in Practice

Organisation of work

Given that this was the second 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**.

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).

Centres should group the candidate's four best Tasks together loosely (eg with a treasury tag) when submitting work to the moderator and also include a copy of the Skill I Competence Record Card (also available on Interchange).

Conduct of Tasks

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

Skill I

Although an improvement upon last year it was noted 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.

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.

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 of initial from final titres had not been checked in titrations. Also when showing which readings have been used to calculate an average value for a titre, if requested, a tick must be placed against the readings used if that mark is to be awarded.

In Skill III Tasks, the Mark Schemes allow for candidate errors made in one part of the task to be carried forward to subsequent parts to avoid penalising the candidate twice for the same error. Not all centres applied this idea effectively. In enthalpy change calculations if the answer is positive, the positive sign cannot be inferred – it must be included.

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 precipitate dissolves then an answer that says that '*...the solid sinks to the bottom of the test-tube...*' should not be awarded a mark. Similarly if the Mark Scheme requires candidates to identify the formation of two layers in a test-tube then this should be made explicit in the candidates' answer to gain a mark. Here an answer such as '*...orange at the top, colourless below...*' is not sufficient since this may result from inefficient mixing. An explicit reference to two layers must be made. Again, it should be noted that 'clear' is not the same as 'colourless', and 'cloudy' is not usually an acceptable alternative to 'precipitate', unless specifically stated as such in the Mark Scheme. Where colours are required in an answer it is important to note the Additional Guidance of the Mark Scheme where the statement '*...any combination of these colours but no other colours should be mentioned...*' is often stated.

It is particularly important in Skill IV that the centre carry 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. Credit should not be given for observations that are not in the Mark Schemes.

In Skill V Tasks, candidates were sometimes asked to explain reactions in terms of acid–base or redox behaviour. In these cases it is necessary for candidates to use terms associated with acid and bases or oxidation and reduction in their answers rather than general comments about reactivity or displacement. 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.

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

Clerical Errors

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

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 lifetime 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, Instructions for Teachers and Technicians, and Mark Schemes are available from 1 June. They are removed by 15 May in the following year, with an archive file of Mark Schemes available.

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, *ie* 1 June 2010 to 14 May 2011, 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 2009 to 14 May 2010 Task(s), along with a new (from the 1 June 2010 to 14 May 2011 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 2010 and re-submit them for moderation with a new Skill V Task in June 2011 – chosen from the Skill V Tasks available for assessment in the June 2011 session).

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Where a candidate wishes to improve their mark, their Skill I mark can be re-submitted (their Competence Record Card will need to be re-submitted for moderation) or, where they have fulfilled the assessment criteria, their Skill I can be re-assessed and their new mark, along with a new Competence Record Card, submitted for moderation.

F334: Chemistry of Materials

General Comments

The paper seemed to work well, with most questions providing a reasonable range of responses. The candidates overall gave a pleasing performance, with many showing an excellent understanding and knowledge of chemistry at this level. There was a similar spread of marks to the January paper, although the expected improvement in examination awareness did not materialise; the extended writing responses were both long-winded and often contained much irrelevant detail, a result of a superficial reading of the question and lack of planning culminating in the use of additional pages. Students also need to be encouraged to alert examiners each time they continue their answers elsewhere. The writing of molecular and structural formulae was often imprecise and this also impacted on the construction of chemical equations. Ionic equations were tackled rather well but those of the normal stoichiometric type, describing organic reactions and those of metals proved much more difficult than expected. Calculations were generally tackled most effectively; the main problem seemed to be in deciding an 'appropriate' number of significant figures.

High level candidates produced many exemplary scripts showing excellent use of English and they were able to incorporate technical terms and ideas correctly and fluently in their responses. However, elsewhere legibility and basic use of spelling and grammar were sometimes poor.

Candidates at all levels showed good understanding in discussing the properties of polymers, reasons for clinical trials, enzyme kinetics, and describing iron chemistry.

The question involving mass spectrometry provided the most difficult hurdle; unfortunately very few candidates had heard of high-resolution mass spectrometry. This part of the question was designed to examine part of the learning objective **WM** (q) '*...explain how the molecular formula can be worked out from the high-resolution value of the M^+ peak...*', The relevant theory is covered in a 'green box' section in *A2 Storylines* (page 7).

The questions involving the experimental techniques, recrystallisation and colorimetry, caught many candidates out; they produced what they had learned by rote rather than attempting to apply their knowledge to the situations described.

Comments on individual questions

Question 1

Q.1 (a) Generally fine, but some focused on the R group and suggested an amine, cyanide or amide.

Common errors: *phenol* and *arene*

Q.1 (b) There was a good awareness of chirality and the nature of enantiomers. Although some candidates wrote about what made a carbon atom chiral, several discussed *E* and *Z* isomers rather than enantiomers and those who discussed enantiomers often used the phrase 'mirror images' without 'non-superimposable'.

Common error: just stating that *the compounds have different properties*.

Q.1(c) Answers to the first part usually discussed use of fragmentation patterns (see *General Comments* above). Very few gained both marks for the formulae, often charges, both negative and positive were used randomly or not all. Some mis-read the question and gave the formula of the fragment which resulted in the peak at 332.

Student tip: **peaks** are due to **positive ions**, whereas **fragment peaks are formed** by loss of **neutral molecules**.

Q.1 (d) Some mis-read the important term **full structural formula** and, for example, drew a skeletal formula. In the second part many candidates liked to hedge their bets and use the term 'moderately concentrated' for the inorganic acid.

Common errors: drawing the ester group with the C=O bonded to the ring system and using *ethanol* rather than *ethanoic acid* as the organic reactant.

Q.1 (e) The equation proved quite difficult for all but the very best. Many did not recognise it as an addition reaction but treated it as a substitution, missed the second alkene group or used HBr instead of bromine.

Q.1 (f) Many candidates ignored the *suitable solvent* information given in the question and used up a lot of space describing how the solute should be soluble at high temperatures and insoluble at low temperatures, or suggesting a particular solvent, often unsuitable. The main steps were generally well described but not many were clear on exactly how the steps removed the two types of impurity; *eg* impurities were often stated *to evaporate away*. Many missed out the hot filtration step altogether.

The 'Quality of Written Communication' (QWC) mark for describing how the process worked to remove impurities was not often gained; many just launched into describing what they had learned about recrystallisation without addressing the QWC instruction.

Q.1 (g) The use of clinical trials was well known and clearly described by most candidates.

Question 2

Q.2 (a) Very few recognised this as a metal and acid reaction. Many tried unsuccessfully to write an ionic equation.

Common errors: H_2O or H^+ as a product, Fe^{2+} as the formula for iron, unbalanced charges in the formula of the salt.

Q.2 (b) Most were able to give the correct electronic structure for Fe and were aware of the extra stability of a half-filled set of d-orbitals.

Common error: retention of the $4s^2$ electrons for Fe^{2+}/Fe^{3+} ions.

Q.2(c) The ability to construct an ionic equation was much improved; fewer missed out the state symbols, inserted electrons or gave a full stoichiometric equation.

Although asked to give the name of the red-brown precipitate many gave a formula, they were not penalised, but candidates do need to be reminded to focus on the 'command' words used in each question.

Common errors: *rust* as the name of the precipitate, *formed by reaction of iron with air*, resulting in no marks.

Q.2 (d) Both the writing of the formula and the subsequent calculation were often correct across a wide spectrum of ability.

Q.2 (e) Many did not give the answer to the calculation to 2 significant figures, thus missing out on the second mark.

Infrared spectroscopy data was usually effectively used, a few candidates giving the absorbance at 3150 cm^{-1} as due to the C–H stretch in alkanes. A worrying number gave the **location** of the bonds as *at the end of the molecule*.

Although most gained the mark for identifying the carboxyl group, few were able to discuss solubility of salts. Most chose to use ideas gained from F335 to describe a variety of interactions, usually with much confusion. Candidates should be aware that although this paper was sat later than F335 it does not require the new chemistry from that unit to gain the marks awarded.

Q.2(f) Although there were some very good answers showing that the candidates fully understood the process described, many used all of the available space in describing how to set the colorimeter up to obtain a *calibration curve*. Clearly they had not read the question carefully enough and had missed the point that they had been given the calibration curve. This certainly proved a good question for discriminating between candidates.

Common errors: *describing inappropriate graphs, taking gradients of or finding half-lives from the calibration curve, unbalanced charges in the formula of the salt*.

Again the QWC mark was elusive for many, since the term absorbance was neither widely known nor could be spelt correctly.

Question 3

Q.3 (a) Most candidates were aware of the requirement for two charged groups in the zwitterion but many could not draw the ring structure accurately for both marks or included an NH_3^+ instead of an NH_2^+ group.

Q.3 (b) In discussing the effects of temperature and pH on enzyme activity, enzymes were often described as if they were living organisms rather than chemical structures. The term *denatured* was then invoked as if it was a sufficient explanation in itself. If *bonds* were referred to they were invariably *intermolecular* rather than *intramolecular* that were being broken; another example of lack of precision in an answer. The effect of pH was less well answered, few realising that groups within the active sites either lost or gained protons.

Q.3(c) Although most were able to construct the rate equation, some carelessly missed out 'rate =' or even '='. The ability to work out the correct units was much improved.

In discussing the first part of enzyme kinetics most understood the principles but were unable to express themselves clearly.

Common errors: failure to refer to *active sites*; stating that *first order* meant *rate increased with concentration*, without any further qualification.

In the last part, zero order was well known and explained more clearly than with first order.

Q.3 (d) Some good responses but a large number believed enzymes are specific and so seek out the correct substrate, meaning that mixtures of substrates can be used as a feedstock. Yield was also confused with rate.

Question 4

Q.4 (a) Naming amines was generally fine but with some misreading the skeletal formula leading to *1,6-diaminohexane* and others referring to *1,4-butylamine*.

Q.4(b) Most were able to form at least one end $-\text{NH}_3^+$ group but few protonated the central $-\text{NH}$.

Q.4(c) There were too many unforced errors in drawing the repeating structure; too many or too few $-\text{CH}_2-$ groups in the chains and H atoms missing from the N groups.

The only problem in the final part was referring to the product as hydrochloric acid rather than HCl, sometimes both were given.

Q.4 (d) **Common errors:** failure to state that water was produced from hexanedioic acid and that chlorine would be given off.

Q.4 (e) The correct intermolecular forces were often identified although permanent dipole-permanent dipole was often seen for either polythene or *Stanyl*.

Most gained the first two marks for explaining softening but only the better candidates mentioned anything about chain movement. Too many still insisted on discussing crystallinity or chain branching in their explanations.

Common errors: COOH and/or NH_3^+ groups, the wrong number of carbons in the chain or using *spermidine* instead of *putrescine* as the monomer.

Student tip: do not omit H atoms joined to the C atoms in a carbon chain when drawing structural formulae *or* use skeletal formulae for drawing repeating units.

Question 5

Q.5 (a) Only the more able could gain both marks, many scored zero. Very few referred to electrode potential data.

Common errors: many involved Zn in their answers; long confused explanations with no explicit statement of the direction of electron flow; referring to E° values in terms of high and low; referring to electronegativity values; discussed only the relative reactivity of the metals.

Student tip: E° values are given for half-cells, do not refer to them as E°_{cell} values.

In the last part the most common error was to forget to double the Ag and Ag^+ .

Q.5 (b) As expected it was only the most able candidates who were able to gain maximum marks. Few recognised that the oxidising agent came from the acid or if they did the commonest answer was chloride ion. Explanations were usually given in terms of the relative reactivity of Zn and Cu, with Cu being less reactive in acid so Zn was a sort of sacrificial metal.

The calculation was done well by a pleasing number of candidates; most were able to start off correctly but were then unsure how to use the moles of Cu^{2+} to calculate the Cu%.

The reaction of EDTA with copper (II) also caught a lot of candidates out. It was not common to score the mark for the formula of the complex with lots of confusion over the charges of the ions (whether to include them or not) and the overall charge of the complex. Scoring marks for the shape and the coordination number fared better but the commonest answers were tetrahedral with a coordination number of 4, seemingly the 'tetra' in EDTA loomed large at the end of the paper.

F335: Chemistry by Design

General Comments

This was the first F335 paper and candidates attempted it well. Candidates were almost invariably trying their hardest to show what they knew, understood and could do. Some, however, were let down by their lack of ability to write accurately in chemical language - this is commented on in the detail below.

The standard of calculations was usually respectable, with most giving some decipherable working so that 'ecf' marks could be awarded if they made mistakes early on.

If candidates have to continue an answer on the back of the paper (or an additional sheet, if such back pages are not available) they should clearly indicate that they are doing so (eg 'see page 23') and then, on the Additional Page, they should indicate clearly which question and part they are answering. All common sense, of course, but it can be forgotten in the heat of an examination. Crossing out of all erroneous material and re-writing is recommended, even if it makes the page look less neat.

Comments on individual questions

Question 1

Q.1 This question was found the easiest overall.

Q.1 (a) Most could answer part (i) correctly, using one of the several possible acceptable answers. Part (ii) was more difficult, with some thinking the dative pair came from the oxygen. The shape was marked consequentially from the diagram. Some did not describe the shape as 'linear' even though they had no lone pairs on the central nitrogen.

Q.1 (b) Part (i) was often correct but part (ii) was not, with the number of electrons often wrong. In part (iii), marks were lost for not stating that it was the oxidation state of nitrogen that changed or for saying that some species other than nitrogen or nitrate had gained electrons. 'Loss of oxygen' was ignored. Most scored on part (iv).

Q.1(c) was quite well done, with sufficient working shown to score two marks. The bare answer was not allowed full credit, since it could be guessed, but it was allowed one mark, since it was a sensible chemical guess. However, virtually no candidates approached by this route.

Q.1 (d) (i) was often correct, but part (ii) was not. The mark-scheme shows that there are a variety of ways of approaching this, the commonest wrong answer being to consider hydrogen bonding between nitrous oxide and the triglyceride.

Q.1 (e) (i) was well answered, the weakest part being hexanedioic acid. In Q.1 (e) (ii) there were a lot of correct answers, though some candidates did not take the hints in the question as to which were the 'useful' products.

Numerical Answer: Q.1 (e) (ii) 84.1%

Question 2

Q.2 This was the second most difficult question.

Q.2 (a) was mixed. Most got the skeletal formula correct, but quite a lot of candidates could not name it correctly – 'trimethyl methanol' being seen quite often. The naming of organic compounds clearly needs revisiting at A2.

Q.2 (b) (i) was well answered and it was good to see very few examples of 'it is connected to three other carbon atoms'. Part (ii) depended on recalled knowledge for the first two parts, but it was reasonably done.

Q.2(c) was trickier than recent hydrogen bonding diagrams. Relatively few used a wrong hydrogen atom (which scored zero out of three). Some got the alcohol formulae wrong, some did not ensure that O-H-O was straight, some did not point the lone pair down the bond and some (relatively few) did not put the 'delta minus' signs on both oxygen atoms involved.

Q.2 (d) was more tricky, though many realised that it was instantaneous dipole - induced dipole bonds which varied in strength (not number) and produced good answers in terms of these.

Q.2 (e) Candidates do need to practise drawing curly arrows, particularly being careful about where they start and finish. For example the arrow in the HCl molecule often started dangerously near the hydrogen atom.

Q.2 (f) A small proportion of candidates left this question out altogether, rather a concern as it was worth six marks. Most of those who attempted it scored some marks, though many found it difficult. For the IR, it was necessary to realise that the only relevant evidence was the absence of an O-H group as virtually all the isomers would have a C-O. Many got the mark for the two different NMR environments, though not all were able to relate these to the structure (ethoxyethane). The splitting of the peaks is a new specification concept and candidates need to practise writing about this. It was necessary to say 'a triplet has two hydrogen atoms on the adjacent carbon' to score, for example, not just 'a triplet has a two hydrogen environment'.

Question 3

Q.3 This was one of the easier questions.

Q.3 (a) (i) was usually well done, though the insistence on seeing 'equilibrium position moves' rather than just 'equilibrium moves' at least once, lost many candidates one mark. Part (ii) was usually correct.

Q.3 (b) (i) was a high-scoring mark, as was part (ii).

Q.3(c) (i) was also often correct, with the omission of the positive sign being rarely seen. Part (ii) was not so well done. Fewer omitted the kJ/J factor, but quite a few struggled and some omitted the unit. A small proportion of candidates left out this part.

Q.3 (d) (i) was only answered correctly by about half the candidates, showing that, even at the end of their A2 course, many are not fluent with formulae and equations. A lot gave hydrogen as a product. Part (ii) was often incorrect. 'Precipitation' was not allowed as there was no reference to aqueous solutions in the stem, and this was the commonest incorrect answer. In part (iii) few realised that it was the large amounts of reactant needed or product formed that gave the greatest disadvantage. A small proportion of candidates left out this part.

Numerical answers: Q.3 (b) (ii) $4 \times 10^{-20} \text{ mol dm}^{-3}$; Q3(c) (i) +172; Q.3(c) (ii) 3290 K

Question 4

Q.4 was the most difficult question.

Q.4 (a) (i) Many candidates seemed confused over whether to use CH or the molecular formula for benzene. Of course, both gave the right answer if it was realised that the latter formed six moles of carbon dioxide. In part (ii), many lost the mark by saying 'the highest peak' as opposed to 'the peak of highest mass'.

Q.4 (b) (i) was better, with most candidates being able to draw the structural formula. There were quite a few wrong attempts at the 120 angle, but most got the 180 one. However, some candidates marked this as going from one carbon to the next, instead of one bond to the next. In part (ii), the mark was sometimes lost by confusing HBr with bromine or by referring to 'the structure in (a) (i)' without mentioning the double or the triple bond.

Q.4(c) was intended to test 'how science works'. Most candidates were able to say that Kekule's structure would not give all bond lengths equal, though not all gave the reason (double bonds shorter than single bonds). Some thought that this irregular hexagon would not have equal angles but many deduced that it would and some gave the reason in terms of areas of electron density round the carbon atoms.

Q.4 (d) (i) resembles several similar questions in the legacy 2854 but candidates are still not expressing themselves clearly enough to score all the marks. The word 'delocalised' was nearly always mentioned, and the fact that each carbon contributed one electron. However, descriptions of 'the arrangement of the electrons involved' were often not precise enough. What was required was 'two rings, above and below the plane of the carbon atoms', but usually either 'rings' or 'carbon' was omitted, sometimes both.

Q.4 (d) (ii) has also had many antecedents in 2854 papers. The slightly different wording upset some candidates who did not set out their answers clearly, thereby losing marks, particularly the one for 'more delocalisation causes a smaller energy gap'. The 'Quality of Written Communication' mark was given for relating the excitation energy of the electrons to the frequency absorbed, using words, not just a formula. Quite a proportion failed to score this. A small proportion of candidates made no response at all. Candidates should be encouraged to 'have a go' at such questions as there are often one or two fairly easy marks.

Q.4 (e) was not answered as well as expected. Candidates might never have considered the number of hydrogen environments in the benzene structure, but quite a few also fell at the hurdle of reading the correct range from the Data Sheet.

Q.4 (f) (i) was fairly high-scoring but 'bromohexane' appeared occasionally. In part (ii), those who used the skeletal formula of benzene were particularly prone to failing to realise that a hydrogen had been substituted and therefore the product was HBr. Explanations of 'electrophile' were much better than in legacy papers. However, some were unable to compose a sentence which explained the electrophilic action of bromine in good chemical language. Both the polarisation of the molecule and the attack on benzene by the 'positive end' were required for the third mark.

Numerical answers: Q.4 (a) (i) 3.38 g

Question 5

Q.5 provided a slightly easier finish to a demanding paper but there was evidence to suggest that candidates perhaps need to keep an eye on the clock.

Q.5 (a) was answered well in all three parts, with just a few 'ketones' in part (ii). Just a few mis-identified the chiral centre but a significant proportion omitted this. Candidates need to be reminded to work carefully down the question and not just answer where there are large gaps between the printing.

Q.5 (b) was one of the most successful parts on the paper, which shows that candidates have a good understanding of skeletal structures.

Q.5(c) sometimes revealed an inability to write in accurate chemical language. The idea of 'fit' into the active site was needed, and then the idea of 'blocking'. The last mark was for a definite chemical comparison of the structures and some were led astray by the Kekule representation of the fused ring into thinking there was an alkene bond present.

Q.5 (d) required accurate recall and was often well done.

Q.5 (e) (i) was well done but there were mistakes, particularly the omission of the equilibrium sign. Part (ii) caught some candidates out, possibly because it is a new addition to the specification. Part (iii) was well done but again there were errors, occasional '+' signs or the lack of square brackets. In part (iv), some candidates were clearly unaware of the meaning of pKa, and a significant proportion left it out, though most who attempted it got it right. A slightly smaller proportion left out part (v) which is a very familiar question. Part (vi) was on new material in the specification and was intended to 'stretch and challenge' which it duly did. Quite a proportion realised that it was the 'initial [HA] = equilibrium [HA]' approximation that was most important here, but most did not even begin to analyse the numbers to justify this. In general, of course, this is the less accurate approximation for a strongish weak acid, whereas the '[H+] = [A-]' approximation is the less accurate for a very weak acid.

Q.5 (f) Many candidates clearly could not relate this to their work on buffer solution calculations. One mark was awarded for the calculation of [H+] from the pH, so it was worth making a start on this part.

Q.5 (g) (i) is recall, but it has been asked before and a definite proportion got it wrong. Part (ii) is also recall but it required accurate chemical expression. The idea of the equilibrium position moving to the left and then back again was sometimes seen. The hardest mark is the crux of the buffering action - the large concentration of hydrogen carbonate ions.

Q.5 (h) (i) should have been another old friend, so the small proportion leaving it out showed that certain candidates were having time problems by now. Candidates are to be congratulated that very few HO₂ molecules were seen. In part (ii), 'ionic dipole' was not accepted, which cost several candidates the mark. Part (iii) was well done. Some little slips like leaving charges off ions, or using '(aq)' instead of '(g)' cost marks, as well as expressions like 'enthalpy of lattice' which chemists do not use.

Numerical answers: Q.5 (e) (iv) 2.3; Q.5 (e) (v) 1.65; Q.5 (f) 1.3 x 10⁵;

F336: Chemistry Individual Investigation

General Comments

Many centres tackled the new investigation assessment component with enthusiasm and commendable accuracy in the application of the coursework marking descriptors. A few centres were rather generous in awarding marks and over eight different skill areas this could add up to a significant impact on the overall mark. The marks awarded ranged from below 10 to a maximum of 45. A number of outstanding investigation reports were seen in those awarded marks of over 40.

Kinetics studies still remain the dominant choice in many centres with an increasing number of candidates exploring the effect on reaction rate of changing concentration, temperature and catalyst. The provision by OCR of a list of 20 'starter sheets' did seem to widen the range of topic investigated. As in previous years, it is how a particular topic is approached rather than the topic itself that determines the mark achieved.

A small number of centres did not include the candidate numbers on cover sheets or made clerical errors when adding the marks from separate skill areas to calculate the overall mark to be awarded.

OCR provides INSET days on all aspects of the individual investigation during the Autumn Term. These events will provide teachers with guidance and help on any issues that have been identified during the moderation of the F336 coursework in this session.

Comments on specific skill areas

Skill Area A

This section of the investigation report was generally marked quite accurately by most centres. The key issue for candidates is to include sufficient range of relevant chemical ideas. In a typical kinetics study, for example, they might expect to include a section on the reaction studied, including how the reaction is followed, a section on the rate equation including an explanation of order of reaction and rate/concentration graphs for different orders, a section on the Arrhenius equation and how it can be used to find a value for the activation enthalpy and a section on catalysts.

Some candidates included a lot of background information to establish the context of the investigation such as the historical development of aspirin or the daily needs of different people for vitamin C. Such passages do not help meet any of the marking criteria and so do not help the candidate gain marks in this section.

Skill Area B

This section was sometimes over marked by centres. The key issue for candidates is to include sufficient relevant fine detail about experimental procedures. This should include how solutions are made up, how they are diluted to produce solutions of different concentrations and how different temperatures are achieved.

Report on the units taken in June 2010

In some investigations candidates chose inappropriate techniques and this reduced the mark awarded. Examples include the use of thin layer chromatography and melting point to determine the purity of samples of aspirin. The inclusion of appropriate aims and choices are important but serve to modify the mark that is largely determined by the description of the experimental techniques.

Skill Area C

The risk assessment, references and clarity and accuracy of the written account are three aspects of equal importance in this section. The mark awarded represents, therefore, the average performance of the candidate in these areas. Some centres were a little harsh in awarding marks here because they did not adopt such an averaging approach.

The most often seen error in risk assessments was where candidates had not listed the concentration of the solution whose hazard they described. References should include detail such as page number for written material and a brief description of content for web sites. References need to be linked to specific sections of text in order to achieve maximum marks. A minimum of 2 relevant references are required to achieve a mark of 1, 5 to achieve a mark of 3 and 8 references to achieve a mark of 5.

Skill Area D

The key issue for candidates in this section is that the amount of data recorded should be that expected from about 18 hours spent in the laboratory. If less time is devoted to the investigation the mark achieved can be significantly affected in this skill area. The other main weakness seen in some investigations was poor quality data. This included very low titres in titrations and very big differences between the results of repeated experiments.

Skill Area E

The manipulation of data and drawing conclusions contribute equally in this section so that the mark awarded represents an average performance by the candidate. The manipulation of data was often well done although in some cases small, unlabelled or untidy graphs did not score well.

Conclusions, however, were often the weakest part of this section and significantly reduced the overall mark awarded. Often conclusions were simply a re-statement of the outcomes of the investigation and candidates did not attempt to explain using ideas described earlier in the report how their recorded data led to the conclusions they described.

In a typical kinetics study, for example, a candidate might explain how the shapes of appropriate graphs enabled the orders of reaction to be established and how this information allowed them to speculate about the mechanism of the reaction. They might additionally comment on the values of the rate constant and activation enthalpy that they have calculated from their recorded data and explain the role of the catalyst in their reaction.

Skill Area F

The mark for this section takes into account the calculation of percentage errors associated with measurements and evaluation of errors arising from limitations of practical procedures. Some candidates included excellent error calculations but their account of the limitations of practical procedures was very basic and included rather trivial features. This tended to significantly reduce the overall mark awarded for this section.

Skill Area G

The mark awarded for this section is awarded by teachers as a result of direct observation of candidates carrying out their investigations. Only a minority of centres included with the moderation sample written evidence on which they based their marks. This is required from all centres. A simple sheet for each candidate will suffice on which the teacher writes down brief, dated, comments at intervals through the investigation period.

The marks awarded by some centres were surprisingly high for candidates who were given low marks in other skill areas, particularly in skill D. It is expected that there will normally be a clear range of marks within the centre for this section representing the range of ability to carry out experimental work effectively and safely normally seen in centres.

Skill Area H

The marks awarded in this section tended to be a little higher than would be expected for the demand of investigations undertaken by candidates which suggests that this is one area where centres need more training.

One of the 5 marks in this section should only be awarded where the candidate has clearly shown innovation in their approach to project design and/or has clearly solved emerging problems during their investigation. Relatively few candidates demonstrated the necessary achievement to gain this mark.

In a typical kinetics study, a candidate who changes concentrations of reactants so as to find the order of reaction and changes temperature so as to find the activation enthalpy using an Arrhenius plot should be awarded a mark of 3 for this skill area.

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