RECOGNISING ACHIEVEMENT

GCE

Chemistry B (Salters)

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

Report on the Units

January 2010

HX35/MS/R/10J

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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.

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REPORT ON THE UNITS

Chief Examiner's Report

This was the third time unit F331 had been taken. Candidates found this paper harder than those in previous sessions and this was taken into account at the award. There were issues in this paper, as in the summer, of candidates not paying careful attention to ‘command words’, particularly the difference between ‘describe’ and ‘explain’.

Candidates found unit F332 more to their liking than in June. There was the usual lack of high-fliers in this retake paper but some good work was seen. Candidates have learned to lay out their numerical answers so that ‘error carried forward’ can be given if necessary. Candidates could also express themselves in chemical language, especially when describing the greenhouse effect, which has been a stumbling-block in the past. The question on the Advance Notice article was dealt with well. Candidates, however, found the organic questions in this paper more testing, particularly when they involved reagents and conditions and molecular structures.

This was the first time unit F334 had been set. Candidates responded to it well and showed that they had made a good start to their A2 course. Once again, calculations usually allowed the steps to be followed and ‘error carried forward’ applied if necessary. Descriptions of colorimetry were particularly effective. However, candidates need to take care to give enough detail when giving the evidence for organic structures. There were several questions on material that was new to the specification. That on ‘Rate determining steps’ was found quite hard, while ‘atom economy’ was found much easier. The question on DNA was well done on the whole, though the detail of how the monomers interact was not always known.

There was virtually no evidence of candidates being unable to finish any of the papers.

The stage is now set for the first F335 unit in June, accompanied by the overall A-level aggregation, including the first A* grades.

F331 Chemistry for Life

General Comments

Candidates found this paper more difficult than those in recent sessions and this was reflected in the mean score on the paper being lower than usual. This was taken into account when the grade boundaries were set. Nevertheless, marks once more ranged from single figure to almost full marks.

There were no reported problems with candidates failing to complete the paper.
This paper is set on the smallest section of the specification and, as usual, aims to set questions in a context. However, some candidates experienced difficulty interpreting the context of some of the questions and did not appreciate the relatively straightforward chemistry being asked. Questions 1c(i) and 4b(ii) exemplify this problem.

Command terms were once again a problem. A good example being question 2c(iii) where candidates were asked to 'describe' the features of a mass spectrum, yet many explained the workings of a time-of-flight mass spectrometer, scoring zero.

Comments on Individual Questions:

Question 1
Parts a(i), a(iii) and c(ii) were well-answered. In part a(ii) often candidates identified the pentane stem but were unable to label the branching.

Part b(i) produced a range of marks with higher scoring candidates being more logical and systematic in their approach to the answer. Part b(ii) generally scored one mark for heat loss to the surroundings with the second mark proving more elusive.

Part c(i) was misinterpreted by some candidates, many of whom merely tried to rearrange the enthalpy values instead of recognising that all that was being asked was the name of the various enthalpy changes represented.

Numerical answer: 1c(ii) -248 kJ mol^{-1}

Question 2
Part a(i) produced a surprising range of marks. Common errors included vague statements such as 'medium' or 'neutral' for deflection by an electric field. Parts b(i) and (ii) were well-answered. c(i), a high level mark, was only answered correctly by a small minority of candidates. Examiners were looking for the 'consequence' of a long half life when trying to date a relatively young rock. In other words were looking for the idea that so little decay had taken place it would be impossible to calculate the age with any confidence.

Parts c(ii) to (iv) proved very discriminating. c(ii) was answered well by most candidates. In part c(iii), as has already been mentioned, some candidates failed to realise that they should be describing the features of the spectrum which allow recognition of the three isotopes and their relative abundance.

Candidates answering part c(iv) usually scored the two straightforward marks (electrons dropping down levels and a line spectrum being the result) but gaining the last two marks proved more difficult, particularly the idea that the electronic energy gaps between the same levels in different elements are themselves unique.

Question 3
A common wrong answer in a(i) was to suggest that an aliphatic compound does not contain 'rings' and an alarming number of candidates did not realise that the correct answer to a(ii) was fractional

Parts b(i) and (ii) were variously answered, with a wide range of suggestions.
Most candidates answered c(i) correctly but as usual c(ii) the shapes / bond angle question proved trickier. The best candidates however produced almost text book answers. c(iii) was well-answered and in general c(iv) also.

Question 4
Part (a) proved straightforward, and the majority of candidates had little problem with part b(i). Part b(ii) however proved more difficult with some candidates not realising that the percentage of Be atoms in the alloy would be the same as the percentage of moles of Be in the alloy. The unnecessary multiplication by the Avogadro constant caused some arithmetical errors, however examiners looked carefully for 'error carried forward marks'

Parts (c) and (d) were well answered by the better candidates but common errors by weaker candidates included the labelling of metal cations in part (c) as 'protons' or 'nucleus' and ionic structures being drawn for beryllium chloride.

Part (e) addressed a new part of the specification, namely the recognition of the broad characteristic properties of ionic compounds compared to simple covalent. The question was reasonably answered although a comment that ionic compounds were generally more soluble without qualification did not score.

Numerical answers: 4b(i) 0.19 and 1.55 4b(ii) 11

F332 Chemistry of Natural Resources

General Comments

Candidates' marks covered a wide range, from single figures to the early nineties. A good proportion of candidates scored satisfactorily overall, with the paper's mean mark being 57. 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.

Good attempts were made at most of the calculation questions, where candidates generally set out their answers clearly and it was evident what was being calculated at each stage. This meant that candidates gained credit even if they had made a mistake, because they were given marks under the 'error carried forward' rules. Answers to the question on greenhouse gases and global warming 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 much higher than some recent papers and candidates showing a sound grasp of technical vocabulary.

Marks were generally much lower on questions that required candidates to write about organic chemistry (particularly reaction reagents and conditions and molecules' structures), and explaining physical properties of chemicals.

Comments on Individual Questions

Question 1

This was a high scoring question for many candidates, with the majority scoring well over half marks. It was pleasing to see many completely correct answers to the calculations in part (c).

a) Many candidates scored marks on this question, although a significant minority gave an answer that was too vague to score the second mark (e.g.: stating incomplete combustion of the fuel, without indicating that the fuel must contain carbon).

b) Most candidates scored one mark here, although few went on to score the second. Many candidates incorrectly identified carbon monoxide as a greenhouse gas in the second part of their answer.

c)

i) The majority of candidates failed to score this mark, with a common incorrect answer being photochemical dissociation.

ii) The majority of candidates scored both marks here and few failed to score at all. Many candidates who gained one mark had forgotten to convert the energy value to joules.

iii) The vast majority of candidates scored three marks here and very few failed to score at all. As has been seen in previous papers, there is a misunderstanding amongst some candidates about what is meant by three significant figures and so again some lost a mark for giving answers to three decimal places instead.

d)

i) About half of all candidates scored a mark here. Of those who did not, the most common answers were 'a particle with a free / lone electron'.

ii) Many candidates scored both marks for a clear, well-drawn diagram, and few failed to score at all. Of those scoring just one mark, many gave the oxygen a full outer shell, but scored for the bonding electrons.

iii) Answers on this question were quite varied. Many scoring both marks gave carefully worded explanations for their choice of propagation. A number of candidates incorrectly thought that the process was termination, stating that no radicals were formed in the reaction. Some candidates clearly did not understand what was required from them and gave explanations that had no bearing on the topic.

e) Many candidates found this the most demanding part of question 1, and only the most able scored well here. The very best candidates gave clear, well-worded explanations of the differences between the structures of silicon dioxide and carbon dioxide and a comparison of their forces. Many candidates, however, confused bonding and structure and gave answers that referred to breaking bonds in carbon dioxide and intermolecular bonds in silicon dioxide.

f)

i) Only a few candidates gained this mark. The most common mistake was to calculate the percentage increase in carbon dioxide from 1900, rather than the increase in the percentage of carbon dioxide.

ii) Answers to this question were good, with most candidates scoring over half marks. A few candidates gave a good explanation of the source of the infrared radiation, but then forgot to complete the second part of the answer by commenting on the possible link between rising carbon dioxide concentrations and global warming.

g)

i) Most candidates scored a mark here for correctly identifying that the compound was an aldehyde.

ii) Answers to this question were generally sound. Many candidates scored two marks. Those gaining one mark had either given a correct formula for ethene or correctly identified hydrogen as the additional reagent.

iii) A large majority of candidates gained this mark. Many of those who failed to score drew in the hydrogen and oxygen atoms with the correct bonds, but forgot to draw in the extra carbon atom first.

Question 2

Many candidates scored well on this question, with about half of all candidates gaining over half of the available marks.

a) Very few candidates failed to score this mark.

b)

i) Most candidates scored both marks here. A few gained only one mark because they incorrectly gave hydrogen as the second product instead of water.

ii) Few candidates failed to score at all here, with the majority gaining both marks. Those scoring one mark often incorrectly gave electrophilic instead of nucleophilic.

c)

i) This was not well known and just over half of all candidates failed to score the mark.

ii) Less than half of candidates scored here, even if they had correctly identified the product as an amine in part (i).

d) Most candidates scored this mark.

e) About two thirds of all candidates scored both marks for this part question. Of the remainder of candidates, many scored one mark for an appropriate diagram, but gave a bond angle that was too great to score the second mark.

f) Marks of 4 or 5 were only gained by the very able candidates on this question. A surprisingly high proportion of candidates scored well on the first part of the question, but failed to address the second part at all and so limited their overall scoring potential. It would be helpful if centres explained to candidates that the longer answer questions often require them to answer on two or three related topics, as this is not the only longer part question in which this was observed.

g) Few candidates scored the mark here, as answers were generally rather vague in their wording.

Question 3

The quality of answers to this question was generally sound, with an average score being just over half marks for the whole question.

a)

i) It was surprising to see that only about two thirds of candidates scored this mark, with many giving co-polymerisation as an incorrect answer.

ii) Over half of all candidates failed to score at all here, incorrectly identifying a much more complicated monomer than propene and then not being able to name what they had drawn. Many who did score gained both marks for a correct structure and name.

b)

i) Many candidates scored this mark.

ii) Most candidates gained at least one mark. Those who failed to score had, however, often made the same mistake as was seen last summer by getting the two colours the wrong way round.

c) Most candidates scored both marks here, with diagrams clearly showing the differences in the two structures. Those gaining only one mark scored for a correct structure for but-2-ene.

d) About two thirds of candidates scored this mark. Those not scoring often gave permanent dipole – permanent dipole as an incorrect answer.

e)

i) Only about half of candidates scored here, with many incorrect answers being rather vague comments like tough or strong, or properties that were not relevant to the context of the question.

ii) Only about a third of candidates scored this mark, with uses often being given that were not relevant to the fact that they were asked for a use for a film.

Question 4

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

a)

i) Many candidates scored 3 marks here but few gained full credit. It was pleasing to see most candidates remembering to include a partial charge on both ends of both polar bonds.

ii) Answers to this question were good, with few candidates failing to score and many gaining full marks. A few gave an incorrect type of intermolecular bond in propene, but scored the rest of the marks for comparing the relative strengths of the intermolecular bonds and linking this to the energy needed to break them.

b) A majority of candidates scored the mark here.

c) About half of all candidates failed to score any marks on this question. Many mistakenly gave answers that would have been appropriate for the oxidation of the propan-1-ol to propanoic acid. Some gained one or two marks for a concentrated acid but did not give appropriate reaction conditions.

d) Most candidates gained some credit here, but only about a third scored both marks. In most cases, candidates scored the first marking point, but did not explain that the concentrations of the reactants and products remain constant or that the process needs to be in a closed system.

e)

i) Most candidates gained at least one mark here, but only about a third scored both. Many candidates scored for correctly explaining what happened to the position of equilibrium, but then failed to answer the second part of the question by saying that the amount of propene decreases.

ii) The situation here was almost the same as in part (i), with many only answering half of the question.

f) The majority of candidates gained some credit here, with over half scoring two or more. Those not scoring often gave answers that were still connected to the position of equilibrium that they had been writing about in the previous question.

g)

i) Most candidates scored this mark. The most common incorrect answers had a structure with the wrong number of carbon atoms.

ii) As in part (i), most scored here.

f) This was not well known, and less than half of candidates scored this mark. Many incorrect answers gave nickel rather than platinum.

Question 5

Marks on this question were encouraging and, on the whole, candidates scored higher marks than were seen on the equivalent question last summer. Answers generally indicated a better understanding of the article and suggested that candidates had prepared more carefully for this question.

a) Most candidates scored some marks here, with answers for the definition in general being better than those for the explanation.

b) This question was not well answered, with the majority of candidates failing to score at all. The most common answer that gained no credit was a copy of the whole equation as given in the article, with no attempt being made to limit the answer to one showing the formation of the precipitate.

c) Marks here were good, with the vast majority of candidates gaining all three marks.

d) About a third of candidates failed to score here because their answers were not sufficiently clear in their wording for credit to be given. Some incorrectly wrote about the relative reactivity of calcium and sodium.

e) Most candidates scored something here, with the mark for calculating the number of moles of calcium ions being the one scored most often. Few gained all the marks, as many forgot to double the moles of calcium ions to get the moles of sodium ions, so ended up with a mass of sodium ions of half the correct value.

f) Marks on this answer were very good, with a large number of candidates scoring at least four out of the five marks available. Candidates gave clear answers, in their own words, which showed a good understanding of the relevant section of the article.

F334 Chemistry of Materials

General Comments
For the first examination of the new specification for this unit, teachers and candidates have clearly got to grips with both the new material and the synoptic aspects of AS included here. Fewer candidates achieved really low marks, though able candidates failed to reach really high scores; the A* requirement has certainly toughened up the top end, whilst candidates of all abilities lost marks through poor awareness of good examination technique. This was prevalent in the lack of precision shown in addressing the question and poor expression of knowledge and thought processes rather than any lack of knowledge and understanding. These skills are usually much better honed in June.

Candidates should take care when answering questions, with some candidate responses proving very difficult to read. Enlargement does very little to enhance the readability of such responses, only a more careful approach to the use of proper sentence construction will do that.

Presentation and logical development in responses is much improved by many at the top end; the best papers were characterised by clear logical answers which showed very sound knowledge of the specification and an ability to think through the question asked. The long calculation, in particular, was neatly laid out and accurate with good arithmetical grammar. The use of good English by these candidates was notable throughout.

However, for a proportion of the cohort the steady decline in written communication skills continues. Too often poor English expression cost marks, where the answers were garbled or contradictory. Some candidates obviously had a reasonable knowledge of the subject but they did not always express their ideas clearly enough to gain marks.

Candidates showed good understanding in interpreting the results of chemical tests, atom economy, calculations and experimental techniques, particularly colorimetry. They were much less certain understanding *E/Z* isomerism, electrode potentials, the relationship between the rate equation and reaction mechanism, polymer structure, properties and bonding and the naming of both organic and inorganic compounds.

Comments on Individual Questions

Question 1

a) Many based their answer on *2-propanoic acid,* though only a minority were able to accurately name the substituent.

Common errors: start with *propan-2-ol* or use *hydroxyl*.

b) Many candidates were not selective in using information about optical isomers relevant to the term *'enantiomers'* but wrote about optical isomerism in general, usually at length!

Common errors: just using the term *chiral carbon* and/or the phrase '*have four different groups*'. Three dimensional structures often showed only 3 groups/atoms bonded to carbon

Student tip: practise drawing structures using the convention used in the textbooks. Do not think up your own method and do make sure that bond angles are realistic.

c) Most identified the three compounds correctly but marks were lost through poor communication skills.

Student tip: give enough detail to explain your reasoning when interpreting given data.

d) Marks were often lost through lack of specific detail about bonds and frequencies. The C=O bond was often assigned to the peak around 1620 cm^{-1} and a general statement relating the peaks in the region 1400–1620 cm^{-1} was said to indicate an arene. Candidates were asked to provide evidence, some made deductions such as the broad peak above 3000 cm^{-1} means a –COOH group is present, rather than it indicates the presence of an OH group (in a phenol or alcohol).

Student tip: state both the frequency (range) and the appropriate bond when identifying a particular functional group using the *Data Sheet*.

e) This involved new knowledge about nucleophilic addition reactions and the use of rate equations to provide evidence about the mechanism of the reaction. The latter in particular was a stumbling block for many candidates, even the more able.
There was some confusion in whether arrows should be single headed and clearly they were invoking a radical mechanism. Others were unclear about the movement of the electron pair in the double bond.

The main problem in using the rate data was the failure of most to recognise that water was a reactant. Those that did usually gained at least two marks. However many just stated the meaning of the rate equation in word form.

f) Most deduced which had the highest atom economy, though a few thought that both reactions were 100%. The problem lay in finding a good reason for this comparison, without too much digression into waste production. In the second part *'minimising waste minimises costs'* would have been fine, but many candidates wrote four or five lines which did not achieve this.

Question 2

a) This question discriminated well. Good candidates had no difficulty picking out the right $E^{\ominus}$ values, writing the equation and describing the chemistry. Others fell at each, sometimes all, of these hurdles – the reaction of iron with copper sulfate being a common resort at for weaker candidates.

Common errors: referring to $E^{\ominus}$ values in terms of high and low.

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

b) Well prepared able candidates scored all 5 marks for the cell diagram. However many were troubled by theFe^{2+}/Fe^{3+} half-cell, including only one oxidation state, usually with an Fe electrode.

c) The vast majority of candidates failed to appreciate the need to include the oxidation state of copper, those that did were just as likely to choose copper(II) iodide.

Student tip: always include the oxidation state of the metal in the name of a transition metal compound.

Better candidates produced well argued calculations, keeping track of the dilution and retaining an appropriate number of significant figures at each stage. Many made one or two slips, usually missing the dilution or inverting a mole ratio. Significant figures were a problem, with many two figure final answers. Also common were attempts to turn 3.47g of coin directly into moles of copper. There was also confusion about the mass of copper coin and how to use this in the final calculation and, several times, the % purity was calculated using a ratio of moles instead of masses which is a serious conceptual error.

d) The only real problem in this section was in identifying the formula of the product containing the copper. Only the most able correctly identified the correct complex ion, some managed $CuCl_4$ but either with no charge or more usually 2+.

Numerical answers: 2(b)(ii) 0.43V; 2(c)(ii) 75.0%

Question 3

a) Few gained both marks for the organic product, with the bond between the phosphate and sugar usually being the wrong one. Many had the idea of the condensation reaction but used the wrong OH group. Given that the structure of the sugar was on the *Data Sheet*, comparatively few candidates had the full structural formula correct with several errors in writing down the sugar structure.

Student tip: do use the *Data Sheet* carefully when there is a command to that effect in the briefing to the question.

Most candidates knew that bases were proton acceptors, but only half of these were able to invoke the lone pairs responsible. Some suggested that several or all of the hetero atoms were basic. There were also a significant number that misunderstood the context of the word 'base'; they discussed cytosine behaving as a base in terms of hydrogen bonds to another of the bases in DNA.

b) Able candidates invariably scored three marks; elsewhere marks were lost for only one hydrogen bond, inappropriate lone pairs and insufficient number of partial charges.

c) Most candidates clearly explained the difference between the current model and that proposed by Pauling. The less successful wrote too much and left out one or two points, when *‘two strands with bases inside, phosphate outside’* would have been sufficient.

d) Many good answers to this open question involving ’how science works’ criteria. They are always going to be subjective, however a few were too vague or emotive with their reason for not wanting a DNA data base *e.g. unfair to criminals*!

Question 4

Many found this the hardest question; the bonding, structure and properties of polymers remains one of the most conceptually demanding parts of the specification. This is also where the lack of attention to detail and power of expression lost the most marks.

a) Better candidates had no difficulty, but others made a mess of one or both structures. The neoprene monomer was often drawn with only one double bond or as an allene. Weaker answers to the nylon polymer showed a lack of understanding of polyamides.

b) (i) Although *cis/trans* isomers were well known most were unable to explain why they occur. Those who drew simple diagrams often scored the second mark.

Common errors: *molecules* could not be rotated, rather than the C=C bond, the idea of *different* groups was rarely mentioned.

b) (ii) The second marking point was often awarded, the first rarely; the structure of a chain or idea of 'kinky-ness' in a chain was only visualised by a few. The command words given in the question 'Describe and explain' were not really addressed, candidates tended to write what they knew about polymers, in particular why some polymers are flexible.

c) Full marks were exceptional; even the better candidates did not pick out the amide groups for their hydrogen bonding. Few understood the role of water in disrupting the hydrogen bonding between chains resulting in looser packing and weaker intermolecular bonds. The effect of this on the value T_g was often thought to make it higher.

Common errors: water forms hydrogen bonds with COOH or NH_2 groups, water hydrolyses the nylon, no mention of neoprene.

d) **Common errors**: COOH and/or NH_3^+ groups or the wrong number of carbons in the chain.

Student tip: do not omit H atoms joined to the C atoms in a carbon chain when drawing structural formulae.

Question 5

a) Some forgot that oxidation states have a sign **preceding** the number.

b) This was not answered as well as expected. Comparatively few candidates recognised the precipitate as iron(III) hydroxide and named it correctly. The number of correct ionic equations was also low indicating that this is still a poorly understood area.

Common errors: the precipitate was often given as iron oxide, rust, or sometimes iron hydroxide.

Student tip: remember that in a precipitation reaction the state symbols are:
(aq) + (aq) → (s)

c) (i) A rare mark even at the top end, implying that candidates are happier using a prescriptive method than explaining it. Many saw the significance of the excess of reactants but failed to explain how their concentrations were affected as the reaction proceeded.

c) (ii) As long as the half life approach was chosen, candidates scored well. Sometimes a lack of precision and use of a ruler led to values outside the accepted range.

c) iii) Drawing the electron structure of Mn^{2+} was generally good, only a few clung on to the 4s electrons.

d) The marks were mainly gained from measuring gas volumes rather than use of some sort of titration method. Titration experiments were invariably confused.

Grade Thresholds

Advanced GCE Chemistry B (Salters) (H035 H435)
January 2010 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
F331	Raw	60	41	36	31	26	21	0
	UMS	90	72	63	54	45	36	0
F332	Raw	100	74	67	60	54	48	0
	UMS	150	120	105	90	75	60	0
F334	Raw	90	65	58	51	44	37	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
H035	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
H035	12.9	37.1	61.7	83.6	97.4	100.0	823

823 candidates aggregated this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums/index.html

Statistics are correct at the time of publication.

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