GCE

Chemistry B (Salters)

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

OCR Report to Centres

January 2013

Oxford Cambridge and RSA Examinations

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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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OCR REPORT TO CENTRES

Overview

It is gratifying to see good work reported in all four units, especially, perhaps, the ‘re-take’ units F332 and F335, where some candidates are taking advantage of a second chance to show what they can achieve.

A failure to ‘read the question’, always the teacher’s complaint, seems more prevalent in this series, with candidates sometimes going off on the wrong track and wasting time and marks, or failing to give an explanation where one is asked for. Many candidates still have trouble expressing themselves clearly and lucidly in long answer questions. We have advocated before the use of a ‘plan’ jotted in the margin (and subsequently crossed out) to help the candidates get their thoughts in order before writing, but such plans are very seldom seen.

Calculations were variable, with some Principal Examiners reporting a better setting out of the method, allowing ‘error carried forward’, but others being more critical. Candidates must realise that words make up a calculation as well as numbers.

When additional pages are used, please urge candidates to indicate this in the script (e.g. ‘continued on additional pages’) and to write the *correct* question number on the additional page.

So, the last January series draws to a close and we wish all those who took part success in June.

Keep up-to-date with developments in GCE Chemistry

The OCR community, www.social.ocr.org.uk , is becoming a useful reference point to help keep teachers up-to-date with GCE Chemistry (and science) developments. I would recommend visiting the site and registering if you find it useful.

On 1 January we saw another year of the Cambridge Chemistry Challenge launched, OCR is very pleased to be sponsoring this initiative from Cambridge University, see: http://social.ocr.org.uk/groups/science/conversations/cambridge-chemistry-challenge

OCR are organising a CPD Chemistry Conference on 1 July in London (see http://social.ocr.org.uk/groups/science/conversations/new-ocr-chemistry-conference-theory-practice). This event will include practical demonstrations by the Naked Scientists, as well as sessions on other key areas of Chemistry. Further details will be posted to www.social.ocr.org.uk when they are available.

F331 Chemistry for Life

General Comments

As usual the paper proved accessible to all candidates, giving the opportunity for more able candidates to score highly, but providing weaker candidates with plenty they could attempt; the lack of ‘no responses’ confirmed this accessibility. Marks ranged from zero to 60 and time was not an issue.

Examiners reported encouraging evidence of candidates more logically and concisely setting out longer answers and numerical questions. These, in the main, also followed the recent welcome trend of being much better attempted. It was clear that many candidates had been well-prepared for this exam and centres are to be commended for their efforts.

Question 1

Part (a)(i), as befits a straightforward opening question, was generally well-answered although fewer candidates knew that in (a)(ii) cyclic compounds were the result of the reforming process.

(b)(i) had many correct answers, but some candidates still confuse and mix the two strands that are acceptable in the definition of a catalyst. In (b)(ii) most candidates explained that the catalyst poison prevents the reactant molecules from adsorbing on the catalyst surface but considerably fewer explained that the poison was essentially irreversibly bound to the surface. (b)(iii) did unfortunately produce a range of non-scoring and vague answers such as ‘little pollution’, or ‘less carbon monoxide’ (rather than zero, which was accepted) and (b)(iv) was better attempted this series, despite a number of candidates falling into the usual traps such as ‘It takes more energy to break bonds than it does to make them’ or ‘more bonds are broken than are made’ .

1(c) was generally well answered.

Question 2

Part (a)(i) was correctly answered by the vast majority of candidates and in (a)(ii) most correctly identified beta decay and many successfully explained how they had arrived at their answer.

(b)(i) was well answered with (b)(ii) generally producing correct, but sometimes rather wordy, answers.

(c)(i) as expected proved very straightforward but (c)(ii), also as expected, produced a much wider range of responses, with many struggling to construct their answers concisely.

In (d) it was clear from many answers virtually paraphrasing the section in the ’Chemical Ideas’ that a majority of candidates had looked very carefully at this part of the specification. Probably the most common error seen was to suggest that the acceleration was brought about by magnetic fields. A small number of candidates talked about deflection and seemed to have learned their mass spectroscopy from the previous specification.

Tip for Centres:
Many answers had the idea that electronic energy levels are quantised for any element, but missed the vital point that it is the actual values of these quantised levels that are *unique* for every element. A perfectly acceptable alternative way to describe this would be to explain that the *gaps* between electronic energy levels will therefore be unique for every element.

Question 3

Part (a) was correctly answered by the majority but the number of candidates correctly working out the molecular formula for 3b(i) were smaller, with even some good candidates attempting to name the compound. Impressive, but not the question asked.
Part (b)(iii) proved quite discriminating with only the better candidates obtaining full marks for this calculation.

c(i) was quite straightforward but parts (ii) and (iii) provided good discrimination, with the interpretation of the skeletal structure in (iii) and therefore bond angle, only being answered correctly by the very best of the cohort.

The simple calculation in part(d)(i) gave the vast majority an easy mark but the required ‘raw’ information in part (d)(ii) was surprisingly more problematical with many suggesting processed data such as the moles of fuel burnt. Part (d)(iii) was one of the most challenging questions on the paper with only a small minority recognising the same number and type of bonds were being broken and formed. Part (iv) was correctly answered by most candidates.

Question 4

Most candidates were able to write a balanced equation for (a)(i) and a pleasingly majority successfully worked out the formula for the oxide of cerium.

Parts (b)(i) and (ii) were correctly answered by most candidates but the difference between the silicon dioxide dot-and-cross structure and the CO_2 structure proved elusive. The lack of double bonds was all that was required here.

Metallic bonding diagrams in part (c) were generally accurate, the few dropped marks often derived from the labelling of the metal cations as positive nuclei.

Finally part (d), the Mendeleev question, was broadly well answered, however in (d)(i) many students did not score the first of the two available marks, although nearly all scored the second. For the first mark, examiners were looking for answers which described Mendeleev as realising that without the gaps, elements that were already known did not fit in the right group. The second very straightforward mark was merely for stating that he proposed elements were yet to be discovered, which later proved to be correct.

The final parts, (b)(ii) and (iii), were gained by the majority of candidates.

F332 Chemistry of Natural Resources

General Comments

A wide range of marks was achieved by candidates for the paper as a whole, but high marks were seen less frequently than in previous exam sessions. There were few blank spaces on the paper and no indication that candidates had problems completing the questions in the permitted time.

Questions involving calculations were generally answered well, with the majority of candidates setting out their working in a way that made it possible to give credit for partially correct answers and apply 'error carried forward' rules. Questions on bonding and structure were often well done, with good use of technical terms.

Answers to questions involving organic chemistry tended to produce lower marks, with a lack of knowledge being indicated when being asked about structures of products and functional groups. The marks for question 5 were often below those for other questions on the paper. The long answer required at the end of question 5 was often answered in a general way that suggested candidates were not using the article to help them with the content of their response and that they were not following the guidance from the three bullet points as to the content that their answer needed to cover.

Question 1

Many candidates scored well on the middle section of this question, but achieved lower scores on the first few parts.

(a)

i) Some candidates did not score here, or obtained only partial credit, possibly because they had not read the question carefully enough and gave examples that were not industrial processes.

ii) Many candidates obtained no credit here, with answers often not being worded carefully enough to score.

(b) Most candidates scored well here, with many gaining all three marks. Those scoring less well had often given explanations that lacked key details, such as not being clear whether they were comparing chemical bonds or intermolecular bonds in the two compounds.

(c)

i) This question was well answered by a majority of candidates.
ii) A good proportion of candidates scored both marks here and few failed to score at all.

(d) A large majority of candidates scored this mark.

(e)

i) Most candidates scored this mark.
ii) Most candidates gained some credit here. Those not scoring both marks often gave the forward and backwards reactions as being equal, rather than the rate of these processes being equal.
iii) Most candidates gained this mark
iv) Many candidates scored well on this question. For those who did not, it was often because they had misinterpreted the question and answered it with regards to hydrogen carbonate ions, instead of carbonate ions.
v) Many candidates scored this mark. Common errors were having H_2 or H^+ as a product instead of $2H^+$.

(f)

i) Most candidates gained some credit here, although a common error was to have $BaCl_2$ as a reactant rather than Ba^{2+} ions.

ii) Most candidates scored here, with a good percentage gaining all three marks. The most common reason for not gaining full credit was a miscalculation of the relative formula mass of the sulfate ion.

iii) Few candidates gained this mark, sometimes because they had correctly worked out that some barium carbonate would form, but did not go on to say that it would be a precipitate as well.

Question 2

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

(a) Many candidates gave well-worded answers that showed a good understanding of the topic. A large minority did not score because they gave an incomplete explanation in their answer.

(b)

i) Many candidates scored both marks here and set out their answers in a clear and logical way.

ii) Those scoring well on the previous part of the question often went on to gain full credit here as well.

(c)

i) Many scored both marks here. Those not gaining full credit often gave abbreviations, such as pd-pd, or left out part of the name of the intermolecular bond.

ii) Nearly all candidates gained credit here, with many scoring all four marks. A few did not get the last mark, for O–H–O being straight, and a few did not get the first mark because they had drawn an incorrect structure for the water molecules.

iii) Most candidates gained this mark. Those not scoring had often only given two of the three elements required.

(d)

i) Many candidates scored this mark, but those who did not had given answers that were poorly worded and did not make a clear comparison, which prevented them gaining credit.

ii) Most candidates gained some credit here, with a small proportion going on to gain full marks. The most common reason for not gaining full marks was answers that compared strength of permanent dipole–permanent dipole bonds in the two compounds, instead of instantaneous dipole–induced dipole bonds.

(e) Most candidates scored this mark. Those who did not had often given the particle a negative charge or a full outer shell of electrons.

(f)

i) A large proportion of candidates scored here. Those who did not had often given CH_4 as a product instead of CH_3OH.

ii) The majority of candidates gained credit, with those who did not often naming the inorganic product rather than the organic one.

iii) Many candidates gained full credit here. Those who did not had often underlined ‘radical’ instead of ‘nucleophilic’.

(g) Good marks were scored on this question by the most able candidates. Others found it difficult to word their answers sufficiently clearly to gain credit.

- i) A minority of candidates scored here. Many who did not score were not clear about which atoms were being compared, or did not make a direct comparison at all.
- ii) Many who did not score had incorrectly given the C–Br bond as being the stronger one. Of those who chose the correct bond, some did not score because their reason for their choice was not clearly explained.
- iii) A small minority of candidates gave very clear and detailed explanations that gained credit. Many who did not score had simply restated the question.

Question 3

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

(a)

- i) Most candidates scored here.
- ii) A very high proportion of candidates gained this mark.

(b)

- i) It was very common for candidates to gain full credit on this question. Those not doing so had often put the sign after the number or miscalculated a value for the sulfur.
- ii) Only a small proportion of candidates score both marks here, often because they had given the wrong chemical as the reducing agent (with sulfur being the most common incorrect response).
- iii) Most candidates did not score this mark. In many cases lack of credit was because candidates were describing iodine solution, and gave ‘brown’ and ‘aqueous’ as their answer, rather than describing iodine itself.

(c)

- i) A very high percentage of candidates scored here.
- ii) Most candidates gained this mark. Those who did not had often given an answer that was not divided by 1000.
- iii) Most candidates, including those who failed to gain credit on the previous question, scored this mark. For those not scoring on (ii), credit came from ‘error carried forward’.
- iv) A large majority of candidates gained credit here.
- v) This mark was awarded in the majority of cases. The most common reason for not scoring was when candidates gave answers like ‘the amount is sufficient’, which was not clear enough to gain credit.

(d) A small proportion of candidates scored here. Most of those who did not gain credit had stated that there would be a colour change but had not made it clear that an indicator would need to be used.

Question 4

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

(a)

- i) Many candidates did not score here, having given alkane or cycloalkane as their response.
- ii) A very high proportion of candidates gained credit here.

(b)

- i) Most candidates gained some credit here, but a small proportion gained both marks. The most common reason for not gaining full credit was not giving a fully displayed structure for the carboxylic acid group.
- ii) The majority of candidates did not score this mark because they had ticked more than one of the boxes.
- iii)

(c)

- i) Most candidates scored this mark. Those not scoring had frequently tried to draw an isomer by rearranging groups around the C=C at the right-hand end of the molecule.
- ii) Most candidates gained some marks here, with a few going on to gain full credit. The most common reason for scoring less than full marks was answers that did not make it clear which double bond was being considered.

(d) Most candidates scored here.

(e)

- i) Many candidates gained this mark. In many cases, those not scoring had either given only one of the two required conditions, or had given values that were too low.
- ii) Many candidates gained no credit here. Answers often showed structures that would have resulted from the reaction of neral with hydrogen instead of water, or had an OH group on both carbon atoms that had been joined by a double bond. Those gaining partial credit had often only reacted one of the C=C groups in the molecule.

(f) Many very good responses were given to this question. Answers were often clearly worded and showed a good understanding of the reaction. Those gaining lower marks often had not made it clear which double bonds were taking part in the reaction.

Question 5

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

(a) The most common outcome here was a candidate scoring both marks, with many gaining one mark for a correct example.

(b)

- i) Many candidates gained some credit for stating that the diagram shows the molecule having one double bond and one single bond. A few went on to state that the double bond would be shorter. Those not gaining full credit had often said there is a double bond and a dative bond.
- ii) Those gaining full marks here were rare and many did not score at all. Answers were often vague; with the wording not making it clear what was repelling what and which electrons were being referred to.

(c)

- i) Many candidates scored something here, although answers scoring full marks were rare.
- ii) Most candidates gained some credit here. Those scoring one mark only had often gained credit for correctly identifying that the molecules are closer together.
- iii) A small proportion of candidates gained this mark, with answers that were clearly worded and showed they had a good understanding of the information in the article.

(d) Most candidates gained some credit, with a good proportion gaining both marks.

(e) Most candidates gained some credit here, although marks were generally quite low and suggested that candidates had not made full use of the article to help them construct their response. Many gave the explanation of ozone depletion by chlorine radicals from halogenoalkanes they had learnt as part of the course and went no further. Those who used the bullet points and the article to help them construct their response often gained close to full marks.

F334 Chemistry of Materials

General Comments

Perhaps sensing that this was the last January series for this paper, candidates of all abilities appeared to be better prepared for the examination; both with regard to the quality and depth of revision and in general examination awareness. There were fewer 'no response' answers and time did not appear to be a problem.

Some important general points arising from the examination for candidates to note:

- Reading questions more carefully and in particular noticing the command words used. Instructions given on the paper to *'circle'*, *'underline'* or *'draw arrows'* were not always complied with. A number of alternative methods were often substituted. Perhaps 'highlighting' the command word would be a suitable strategy for such candidates.
- Checking formulae used in answers. Mistakes were particularly prevalent in question 1 with carbon chains simply represented as -c-c-c- without any Hs etc. and functional groups shown as odd combinations *e.g.* amide as CNOH.
- Balancing equations. See questions 2b(i), 3c(ii), 4d(iii).
- Providing adequate working-out for calculations. At A2, calculations are often complex because they are unstructured and there may be several routes to the final answer (*see question 2bii)*. This requires the candidate to be particularly careful in laying out the appropriate working. Good presentation was rare and jumbled numbers normal. Teachers need to keep emphasising this requirement for clarification using words and units of the methods employed. The use of appropriate 'significant figures' remains a challenging concept.
- Realising that parts of questions numbered with roman numerals (i), (ii), etc are linked and earlier parts can often be clues to the final 'suggest' *e.g.* question 4a parts (i) and (ii) could have helped students unravel part (iii). They did but only for a few.
- Using the *Data Sheet* to identify infrared spectrum peaks. Whilst the frequencies from the spectrum in question 2 were generally given more accurately, sometimes peaks need to be classed as 'broad' to differentiate from other peaks which are present. Furthermore as well as giving the frequency and functional group, it is important to state the bond responsible for the absorption *e.g.* –OH AND carboxylic acid or alcohol as appropriate.
- Using technical terms correctly. 'Readings' is often used for a particular type of measurement instead of the appropriate technical term *e.g.* in question 4a(ii) for 'absorbance'. Comparing electrode potentials still causes difficulty for some candidates. Inappropriate words here include 'electronegativity', 'higher' and 'lower'.
- Planning extended writing responses. An exceptionally rare practice, consequently answers to question 4a(ii) and 4c(iii) were often quite muddled.
- Comparing data clearly. This often occurs where several pieces of information are given, such as electrode potentials *e.g.* in question 4c(iii) 'the electrode potential of Fe(III)/Fe(II) is more positive so it will oxidise…'. There needs to be a comparison phrase saying 'more' positive than what?

Question 1

(a) Some struggled to get the repeating unit correct particularly with the structure of the secondary amide linkage, and when present it was not always circled correctly.

Naming compounds was much improved and the diamine was often correctly numbered.

(b) Common errors with the structure of the monomer were identical functional groups at each end and a 6-C chain between the two functional groups.

Some addition reactions were seen, and some gave 'condensation' without any explanation, failing to read the complete question, perhaps.

(c) The nature of polymer crystallinity was well known although some considered it to be solely how close chains were packed.

In explaining T_m values it was usually the first marking point that was omitted – the comparative 'PPA chains are closer together'.

Most candidates were aware of the cold-drawing process.

(d) Only the best candidates were able to identify the type of reaction correctly in all three cases. Perhaps there was a lack of confidence to choose 'addition' twice.

Question 2

(a) The definition of an acid was well known but many believed that both hydroxyl groups were sources of hydrogen ions and in some cases hydrogen atoms. Strangely, they then wrote the correct equation in (b) for the neutralisation reaction.

(b) Most were able to calculate the moles of NaOH and hence glycolic acid but then many were at a loss how to proceed effectively, even though a correct M_r usually appeared at some point for another mark. Difficulties in presentation and significant figures have already been referred to.

(c) Some failed to circle the ester linkage, whilst naming esters always leads to some confusion with ethyl ethanoate a common error.

Only the more able specified 'butan-1-ol', most went for the generic 'butanol' as a reactant.

Surprisingly many were unable to recognise which compound would form hydrogen bonds and which did not. There also seemed to be a tendency to write nearly all alternatives in, on the assumption that some must be correct. Many also failed to name the intermolecular bonds precisely, coming up with inappropriate alternatives *e.g.* permanent dipole, permanent-permanent bonds etc.

Candidates should have noticed that there are 3 marks are on offer here so only one or two answers were not going to be sufficient.

(d) Careful reading of the question was required here. Many missed the point that the absence of both the alcohol and the carboxylic acid needed to be addressed. It was common for answers to include two pieces of evidence for the absence of just one of the reactants. It was also common for answers to discuss what peaks were present rather than absent.

Many were able to compute correct formulae from the mass data but rarely with the correct charge or no charge as appropriate.

(e) Only the better candidates were accurate enough to score all five marks. Most succumbed to the usual problems in describing mechanisms; carelessness with the beginnings and ends of the curly arrows, a lack of understanding of when the charges were whole or partial, and the structure of the nucleophile.

Question 3

(a) Whilst most scored well with parts (i) and (ii), few managed to link the relative numbers of amino acids and bases to a possible source of genetic code carrying material.

(b) Although most understood the nature of hydrogen bonding, most errors involved completing the structure of adenine and choosing the correct hydrogen bonds.

(c) The only real problem here was in drawing the correct structure of the ion in part (iii) where the ionisations of the amine and alcohol groups were often included.

Question 4

(a) There were some problems with the dative covalent bonding in drawing the 'dot-and-cross' diagram but otherwise mostly correct.

Unfortunately few knew the formula of an ammonium ion, 'NH_2' or 'NH_3' with a variety of charges were often seen.

(b) Many achieved the first marking point with far fewer students using 'higher' for 'more positive' in this question than in the past though sadly it still did occur. The second mark was more difficult to achieve with a number not providing any explanation at all whilst others failed to compare the two systems.

(c) The most common error in describing the colorimetry experiment was a result of writing out a rehearsed answer. This led to failure to address the fact it was a rate experiment leaving out any reference to time. Other problems included not specifying what a filter was 'complementary to' and using absorbance measurements from a rate experiment to construct a calibration curve.

Most drew a suitable results curve with construction lines but failed to indicate where their 'constant' half-lives would be found.

(d) Explanations of homogeneous catalyst often failed to convince through poor use of vocabulary whilst some failed to offer any explanation.

There were some excellent, well planned responses from the higher scoring students, who were able to express their answers clearly and straightforwardly.

However, many were not precise about which $E°$ values were being compared ('it' was often used for a particular ion), some mixed up iodine and iodide and others began with Fe^{2+} as the catalyst. Here 'higher/lower' remained a major problem, as did 'electronegativity'. A good number discussed variable oxidation states and activation enthalpy without thinking about why they needed to write at length on the additional pages.

(e) Unfortunately many rounded the rate constant calculation down to 0.006 but the use of the correct units tended to better addressed.

Generally only the more able understood part (iii) and were able to give the correct numerical answer.

F335 Chemistry by Design

General Comments

This paper was taken by just a few candidates, almost all retakes. The ability of the candidates was varied, though a reasonable number were able to show good understanding.

Candidates showed they understood:
- naming organic compounds and functional groups
- equations
- acid/base theory
- entropy calculations
- intermolecular forces.

But they were less confident with:
- organic structures
- shapes and structure types
- ionisation energy explanations
- NMR spectroscopy.

Calculations were often well done, especially simple pH ones. Long answers were often well laid-out, though some candidates struggled here.

Question 1

(a)
   i) Most candidates could draw the ester correctly, though some left out the 'CH_2' in the alcohol part.
   ii) Most candidates got this right, $C_7H_7O_2$ being the commonest wrong answer.
   iii) The reagent and conditions were reasonably well known here.
   iv) Again, a good number could classify the reactions correctly.

(b)
   i) Most could correctly calculate the atom economy.
   ii) Almost all were aware that a high atom economy indicated little waste.

(c)
   i) Many could draw the curly arrow and a good number were able to identify the synthons correctly.
   ii) A few understood the step from the synthons to synthetic equivalents but many found this difficult. Those closest to scoring the second mark used water rather than alkali as the reagent.

Question 2

(a)
   i) Most could define a pharmacophore as part of a *molecule* that had pharmaceutical action. A few wrote 'part of a *drug*' which did not score.
   ii) Only a few could circle the correct atoms here to identify the pharmacophore. Most circled the sulfonamide group alone.

(b)
   i) Most showed correct double bonds here, but quite a number showed single bonds or lone pairs.
   ii) Many could identify the bond angle and give the reasons. Just a few got tangled up with identifying two different bond angles in the structure.

Most could calculate the concentration of OH^- correctly.

(c)

i) Some realised that it was the acid properties of the –OH group that led to the formation of ions that were soluble in water. Only a very few named the group as ‘phenol’ and many answered in terms of hydrogen bonds.

ii) Quite a number of candidates realised that pH 8 was alkali and would irritate the eye.

(d) Most could identify the correct place for the hydrogen bond and draw it with the correct detail. The commonest error was the omission of the d– on the N or O attached to the H.

(e) Most could identify the two chiral carbons. Some realised that just a wedge on one and a dotted line on the other would suffice. Some added more detail which was often incorrect. Many left out the second part.

(f)

i) Almost all could identify the amide.

ii) Many realised that ammonia was needed.

(g)

i) Some got the equation completely right. Some missed out the hydrogen ion and some did not write an equilibrium sign.

ii) Most realised that the inhibitor fitted or was bonded to the active site, stopping the substrate from fitting. A description of the action of non-competitive inhibitors, while not in the Specification, was also accepted.

Question 3

(a)

i) Most could write the electron configuration correctly. The commonest error was to write ‘$3d^2$’ instead of ‘$4s^2$’.

ii) Almost all candidates got this correct.

iii) Some candidates wrote the correct equation with the correct state symbols and then went on to explain that the third electron was closer to the nucleus and thus had greater attraction. Some gave ‘(aq)’ as the state symbols and some talked about the ‘stability of the filled shell’ without giving sufficient detail.

(b) Most scored here. The commonest error was referring to the oxidation state of the ‘nitrate’.

(c)

i) This equation was often well done, with the formula for $Ca(OH)_2$ correct (even though not supplied). The commonest errors were not to balance the nitric acid or the water.

ii) Most candidates gave sufficient detail that the compound contained *nitrogen* that was *needed by plants*.

(d)

i) Some candidates did a correct calculation but many found it difficult as such questions have not been set in this Specification before.

ii) Some got the correct equation and state symbols, much to their credit in this tricky situation. Many others identified NO_2 and CaO as the products and/or got the state symbols correct, while failing to get the correct equation.

iii) Most realised that calcium oxide was ionic (with strong bonds), though some ‘hedged their bets’ and talked about covalent bonds as well. It is best not to use the term ‘intermolecular bonds’ in these circumstances, though these were ignored on this occasion.

(e)

i) A good number of candidates got ‘+46’ as the answer, with quite a few putting ‘46’ and others also scoring one mark for not doubling the entropy of the nitrate ion.

ii) A majority scored two marks here, in some cases with ‘ecf’ from part (i). It was gratifying to see how few used ‘19’ rather than ‘19000’ in their calculation.

(f)

i) Some managed to navigate this question completely correctly and most scored reasonable marks. The commonest error was to write 'B+C' for the hydration, rather than 'B+2C' but ecf was allowed from this. The second commonest error was to write just one nitrate ion on the top line (which, of course, made 'B+C' *correct* on an ecf).

ii) Most got this right.

Question 4

(a)

i) Most got this right.

ii) Most got this right, often because a formula was accepted. Candidates should be reminded to answer the question as set.

iii) Many were successful here with 'molybdenum(VI) oxide'. The spelling of the metal was seldom wrong, but 'moybdenum trioxide' was the commonest wrong answer, followed by some who tried to name it as an anion.

(b) Many got this right, but it is of concern that '63.2' was quite often seen (the answer obtained by just using the masses). Significant figures were usually correct.

(c) Most understood that the higher temperature required more energy.

(d)

i) Many identified nitric acid and gave the reason.

ii) Many identified sulfuric acid but fewer explained in terms of it giving protons to the nitric acid. Some specifically gave 'it gives two protons' as an (incorrect) reason.

iii) Many identified these correctly.

iv) Most gave the correct equation and did the calculation correctly. The commonest error was to give an equilibrium sign in the equation.

v) Just a very few were able to solve this challenging calculation. A few began to score by realising the acid was half neutralised, but failing to identify the dilution factor.

(e) Most were able to give a good answer here. Many said correctly that the rings were over the carbon atoms, rather than 'over the molecule'.

(f)

i) Many could identify all or most of the correct reagents, one of which was on the *Data Sheet*.

ii) Many could give the 'cold' condition, though some contradicted themselves by adding 'reflux'. The alkali scored if mentioned either here or in the box above.

iii) Such questions are common and many candidates could score good marks here. There were still too many 'but when the electron falls, light is emitted' answers and the marking points often not made were a clear statement of there being more delocalisation in the dye and that more delocalisation led to a smaller ΔE.

Question 5

(a) Most could draw the structure of 'formaldehyde' and name it correctly.

(b) Most scored the majority of the marks here, the one that was seen least often was that methanal had permanent dipole–permanent dipole forces (many gave just instantaneous dipole–induced dipole).

(c)

i) Many got these three correct.

ii) Some candidates realised that the temperature (not particularly high for an industrial process) was a compromise between rate and yield. Others criticised the temperature or repeated what they had said in part (i).

(d)

i) A large majority got this right.

ii) Most got these right.

(e) A few candidates realised that this question needed analysing in terms of entropy changes of system and surroundings and their resultant effect on the total entropy. Many others hardly mentioned entropy at all in their answers.

(f)

i) Many candidates got this right.

ii) This again was well done.

iii) A few candidates realised that the 'structure type' was *giant* but many seemed not to understand what was being asked for.

(g)

i) Most understood that, although there were oxygen atoms, these were not present in O–H or C=O bonds.

ii) Some were able to explain that the triplet meant that the *adjacent* carbon had two hydrogen atoms attached, and similar for the quartet.

iii) Quite a few identified the structure correctly, which was much to their credit. One of the commonest errors was to have just one ether group. Relatively few thought to explain that the singlet meant that the carbon on which the protons occurred had no protons on an adjacent carbon.

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