GCE

Chemistry B (Salters)

Advanced GCE **A2 H435**

Advanced Subsidiary GCE **AS H035**

Examiners' Reports

January 2011

HX35/R/11J

Oxford Cambridge and RSA Examinations

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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Advanced Subsidiary GCE Chemistry B (Salters) (H035)

EXAMINERS' REPORTS

Chief Examiner's Report

We are now fully into the swing of this Specification with numbers of candidates similar to last year's. It is good to see so many candidates taking this 'alternative' specification. Their involvement can be judged from the relatively small number of parts omitted throughout the units. This also indicates that there is time for the candidates to finish the papers.

Calculations were often well done, with candidates showing their working sufficiently to allow 'error carried forward' marks to be given if a mistake is made in an early stage.

Less good was candidates' ability to read the question and to answer logically. It is always a shame when an answer is seen which indicates some understanding of a chemical idea but does not contain the necessary clarity of expression to score many marks.

Re-take candidates sometimes revealed patchy revision and this showed up in the comments of the Principal Examiner for F332 concerning preparation of the Advance Notice Article.

Examiners try to estimate the amount of space needed for an answer. They do not want to provide too many lines, however, in case a concise candidate with small writing feels constrained to write more than they need. Those who wish to overflow may use the space below the lines if the question is the last one on the page. Answers that continue elsewhere on the page are not helpful. Otherwise, there are additional pages at the back of the answer booklet which may be used. Candidates must realise, however, the need to indicate (in the body of the paper) where they are continuing their answer and give the correct part number on the additional page.

F331: Chemistry for Life

General Comments

This paper again proved very accessible to all candidates, giving the opportunity for more able candidates to score highly, yet providing weaker candidates with material on which they could achieve success.
Marks for the paper ranged from single figures to 59 marks.
Time was not an issue with this paper and there were relatively few 'no responses' to questions.

The quality of candidate answers reflected the relatively high numbers of scores in the 50's and this has been a pleasing trend in recent sessions.

The addition of extra blank pages at the end of the answer booklet proved useful, but candidates should be reminded that they must indicate they have used those pages by comments next to the appropriate question(s).

Comments on Individual Questions

Question 1

Part (a)(i) This proved a good discriminator. The strongest candidates scored highly but weaker candidates frequently failed to identify the ether (ester being a common mistake), as well as wrongly naming the branched alkane.
Disappointingly, as in the last session's paper, candidates were very sloppy in their positioning of the bond between the C and the O atom in the alcohol.
Parts (a)(ii) and (iii) discriminated at the E/U boundary with common wrong answers being, 'cracking' and 'isotopes' respectively. Part (a)(iv) was well answered, as was part (b).
In part (c), the majority of candidates correctly completed the cracking equation in (i) but very few were able to produce the reforming equation for part (ii).

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. This is the same advice given for the last session.

Question 2

Part (a)(i) was generally well answered, however some candidates used polonium-209 in their nuclear equation, despite polonium-210 being in the stem; a few wrote the mass and atomic numbers on the right hand side of the symbol. Part (a)(ii) was less confidently answered with a number of candidates multiplying the actual mass by the mass number. Significant figures were better handled than in recent sessions, however, some candidates used calculators that could not cope with the number of figures needed.

Tip for Centres
Try to persuade candidates to use calculators that have the facility to use scientific notation. This will certainly make it easier to deal with significant figures and very large or very small numbers.

Part (b) tended to produce two potential answers; either the idea that alpha particles are not very penetrating or, a wrong answer based on half life or tiny mass involved.
In part (c)(i) the one mark of the three available that was commonly lost was a result of students either not taking their line on to the 10 day mark, or producing a curve cutting the x axis. In (c)(ii)

some candidates gave a definition of half-life in terms of the decay of a nucleus or atom rather than the plural (this is a common error in recent papers).
Candidates should also realise that where there is an instruction, such as 'Show your working on the graph', this needs to be complied with in order to score that mark.

Question 3

Part (a)(i) was reasonably well attempted by most candidates. The most common error was a calculation of the % by mass of platinum hexafluoride in the xenon hexafluoroplatinate.
Part (a)(ii) proved a good discriminator for the more able candidates, although even within this cohort there was a minority who forgot to convert to cm^3. The calculation was, in general, better set out than in past sessions and this allowed intermediate 'ecf ' marks to be scored by some.
In parts (b)(i) and (ii) a common failing was to merely reword the stems of these parts in terms of Xe being a member of the noble/inert gases. Examiners were, however, looking for a discussion in terms of the outer electronic structure.
Parts (c)(i) and (ii) were reasonably dealt with, which was pleasing, however, few candidates spotted that the fundamental reason for the exothermic nature of the reaction was the fact that only bond formation was involved and there was no endothermic bond breaking term.
Part (d) proved straightforward for the vast majority of candidates. However in part (e), though in the main answered correctly, a minority thought Xe was in Period 4, not 5.

Question 4

This was the most discriminating question, particularly at the higher grades.
Part (a)(i) generally was answered correctly (full configuration allowed); the most common wrong answer was the electronic configuration of the K atom. In part (a)(ii) both marks were scored by all except the weakest candidates.
In part (b)(i) very few candidates used the term 'atomic' emission spectra, although most were able to spell emission, a pre-requisite for gaining the Quality of Written Communication (QWC) mark.
Part (b)(ii) was better attempted by candidates than in previous sessions and reflects the careful teaching of the topic. There was of course a range of marks, depending often on the logic and clarity of the explanation. Although several marks could be scored from a labelled diagram, it was easier for candidates to score such marks using a horizontal energy level diagram, rather than from a Bohr atom drawing, where energy levels were often not clearly drawn as getting closer the further out they were.
In part (c)(i), candidates need to avoid very general statements such as 'harmful'. Examiners were looking for toxic/poisonous or a more specific explanation of the role of CO in binding to haemoglobin. Part (c)(ii) was well answered and the equation in (c)(iii) was usually correct, although some candidates used dinitrogen oxide (nitrous oxide) in their equation. This was not given credit in this part question, but allowed as an 'ecf' in part (c)(iv).
In (c)(iv), one explanation which was given by a sizeable minority was to discuss entropy in terms of the arrangement of atoms rather than in terms of molecules. Better candidates realised that the number of moles decreased on the product side and therefore the entropy should decrease on moving to that side.
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F332: Chemistry of Natural Resources

General Comments

There was a wide mark range for the paper as a whole, with candidates scoring from single figures to the high eighties. There was no indication that lower marks resulted from a lack of time. Answer spaces that were left blank were rare and resulted more from a lack of knowledge or understanding of the question rather than from an inadequate amount of time.

Good attempts were made at most of the calculation questions, where many candidates set out their answers sufficiently clearly to be able to see what was being calculated at each stage, allowing credit to be given under the 'error carried forward' rules if a mistake had been made.

Answers to the longer questions did not score as well as in some recent sessions. It was evident from answers to question 5, based on the pre-release article, that some candidates had not spent sufficient time reading the information or found the concepts covered by the article rather challenging.

Comments on Individual Questions

Question 1

Most candidates found that this was one of their lower scoring questions, with scores of around half the allocated marks being common.

(a) Most answered this correctly.
(b) Candidates found this question more challenging and only about half of candidates scored here.
(c) This was a high scoring question, with most candidates giving appropriate initial and final colours.
(d) Most candidates scored at least one mark here, with the mark for electrophilic being awarded less frequently.
(e)
   i) Very few candidates failed to score this mark.
   ii) Many scored here too. The most common reason for not gaining the mark was a failure to identify that it was the OH group that is bonded to the carbon with only two other attached carbons.
   iii) Scores here were often low, except from the most able candidates. This organic reaction was clearly not well known. Many scored for the inclusion of a suitable catalyst, but most failed to include water or suitable reaction conditions in their answer.
(f) Most candidates scored at least one mark here. Those failing to score often had two bromine atoms on each of their structures.
(g) Answers that scored any marks were extremely rare. Most incorrect answers had hydrochloric acid reacting with the propane and heat for the reaction condition.
(h)
   i) The most able candidates scored both marks here and many scored at least one. In some cases, those failing to score had clearly understood what to do, but had been careless in where they had drawn the arrows.
   ii) The majority of candidates scored this mark.
   iii) Marks on this question were surprisingly low, with most candidates drawing the diagram for the hydroxyl radical, rather than the hydroxide ion.
   iv) The most able candidates scored here with well-worded definitions.

Question 2

The most able candidates scored well on this question, with others finding difficulty with the parts on equilibria and the long answer in part (g).

a) Few scored this mark and gave answers that did not link back to the information given in the stem of the question.
b) The majority of candidates scored here. The most common reason for failing to score was an incorrect bond attachment from the benzene ring.
c) Most scored here.
d)
    i) Marks on this question were generally low. Some candidates gave a good description of the effect of the change on the position of equilibrium, but forgot to say how that would impact on the yield of the phenylethene.
    ii) The same applies here as in part (i).
e)
    i) Most candidates score one mark here, but few went on to give a sufficiently precise answer to gain the second mark for how an increase in surface area increases the reaction rate.
    ii) Many scored both marks here.
f) The majority of candidates scored this mark.
g) Although nearly all candidates attempted this question, marks of four or more were not seen often. A significant minority of candidates failed to score at all. Answers were often too vague, with poor use of technical terms. It was not always clear which particles the candidate was referring to, or where the forces of attraction being described were acting. Some described the way that the intermolecular bonds form, but then forgot to finish their answer by explaining why one polymer is slightly soluble in water and the other is not.

Question 3

For many candidates, this was their best scoring question, with the majority scoring well over half marks.

(a) This was the least well done calculation on the paper, with only the most able candidates realising that they had to compare a ratio by moles.
(b)
    i) Most scored this mark.
    ii) Nearly all candidates gained the mark here.
    iii) Many gained this mark.
c)
    i) Most candidates scored here, with the most common incorrect answers failing to give both a colour and a physical state.
    ii) Incorrect answers to this question were rare.
d)
    i) Most candidates scored here. Those failing to score often had in incorrect number of electrons.
    ii) Only the most able scored both marks here. Many scored one mark, but did not have the correct state symbols for the second mark.
    iii) Many failed to score here, because their answers were too vague. Candidates referred to weak forces of attraction to the nucleus, but not what the weak forces were attracting, or did not make it clear which atom they were referring to in their answer.

e) Most candidates scored one mark here for the alternating K^+ and Cl^- ions or for the repeating pattern. Few scored both marks. A small minority misread the question and drew a diagram for sodium chloride.

f)
   - i) Most candidates scored here.
   - ii) Incorrect answers to this question were rare.
   - iii) The majority scored this mark.
   - iv) Most candidates scored some marks here, with the most able consistently scoring full marks. A few lost the final mark as they did not seem to understand what is meant by 3 significant figures.

g)
   - i) Most candidates scored here.
   - ii) Many scored this mark. Those that did not often referred to one of the chemicals being more expensive, rather than both.

h)
   - i) Most candidates scored here.
   - ii) Many candidates scored this mark.
   - iii) A good proportion of candidates scored all three marks here, with those only scoring two often failing to state that all carbons are bonded to four other carbons.

Question 4

The quality of answers to this question was generally good, although low marks on parts (e) and (f) resulted in weaker performances for some candidates.

a) The majority of candidates scored this mark.

b) Most candidates scored at least one mark here and many scored both. Some failed to score a second mark because they did not quote a bond angle value.

c) Very few candidates failed to score here.

d)
   - i) Many candidates scored this mark.
   - ii) A score of 2 was common here. Those failing to score had often divided the frequency by Planck's constant instead of multiplying by it.
   - iii) Most candidates scoring both marks in part (ii) did the same here.

e) Marks on this question were very low. Answers lacked detail and used phrases like: 'the results were overlooked because they were outside of the expected range' rather than that they were so low. Few candidates knew that the research used a spectroscopic method to collect the data.

f)
   - i) Many gained one mark here. Few got the second mark for stating that as the amount of gas increasing the amount of infrared absorbed also increases.
   - ii) Many gained the mark here.

Question 5

The quality of answers to this question was generally below those of the other questions, with marks on parts (a) and (e) being very low.

a) Many gained 0 or 1 on this question. Answers to the first part were often describing what is meant by propagation, rather than defining a propagating chain. Examples from the article, where they were given, tended to score.

b)
   - i) The majority of candidates scored here, with some incorrect answers referring to a lone pair or lone electron, rather than an unpaired electron.

   - ii) This mark was scored by the majority of candidates. Those failing to score often had an oxygen molecule reacting with water, rather than an oxygen radical.

c)
   - i) Few candidates failed to score here.
   - ii) Only the most able scored both marks here, with answers that demonstrated a good understanding of how infra-red spectroscopy is used to identify compounds. In cases where only one mark was scored, it tended to be for the peak at an appropriate wavenumber range for the C=O bond.

d) Both marks were scored by many candidates, with most gaining at least one mark.

e) Marks on this question were low in most cases. Candidates often failed to describe the pattern of changing nitrogen dioxide concentration during the day at all or, if they did, with lack of precision. Answers explaining why the concentration changed often focussed on the nitrogen monoxide instead of the nitrogen dioxide, or lacked detail about how the changes occurred.

f) The most able candidates gave clear and well-worded answers that covered all the bullet points and showed good use of technical terms. In many cases however; marks were low, often because some bullet points had not been addressed or there was insufficient information about processes that make and destroy ozone in the troposphere.

F334: Chemistry of Materials

General Comments

The paper was of comparable demand to the first examination of the present specification taken in January 2010. Candidates had little difficulty in completing the paper in the allocated time. The questions discriminated well leading to a wide range of marks, with fewer really low scores. However, at times some of the easier marks were not scored mainly for lack of precision rather than inadequate knowledge.

Candidates showed good understanding in interpreting infrared spectra, structural and stereoisomerism, atom economy, calculations and experimental techniques, particularly recrystallisation and determining reaction rates. Most excelled in discussing redox and complex ion chemistry.

In some cases answers lacked clarity and failed to deliver the accuracy that such a subject as chemistry demands. This was prevalent in many areas: balancing equations, writing (or in some cases copying) correct formulae, drawing structures, using given data in given equations, including charges for ions when asked to do so, naming a compound or functional group rather than drawing a structure. Candidates' presentation was sometimes poor.

Some candidates failed to read the question to gain a sense of what was required. Many times the command words were not given enough thought *e.g* '*Explain how the concentration of the blue dye changed when added to the polymer*' often elicited the response *'it increased'*. Furthermore, although key ideas were understood, candidates failed to apply their knowledge to the context given and so again failed to gain the full mark allocation. This was particularly noticeable in applying colorimetry to measuring change in concentration.

Comments on Individual Questions

Question 1

(a) A gentle opener, but some unfortunately gave 'no side-effects'.

(b) Many answers here were spoilt through lack of precision.
Many found the first part a problem: they either redrew the *E* (trans) isomer or repositioned the –OH groups, or indeed did both.
Most wrote about 'lack of rotation' but it was not always clear what this referred to. The type of double bond was often unstated. The second mark was rarely awarded, often due to confused writing.
Many recognised the importance of shape in explaining the difference in activity of the isomers, though others loosely referred to structures. However, the 'specificity of enzymes' was well known, although this was not always expressed clearly.

Student tip
Practise drawing *E/Z* structures using bond angles of 120° around the C=C bond.

(c) Some confused solvent and solute so it was not clear what they meant, whilst others wrote at length about boiling and melting points.

(d) Only the minority of candidates identified that the OH groups in resveratrol were phenols, some then discussed dissociation of the OH groups in water, missing entirely the reaction with NaOH. Misreading of the question resulted in a number discussing solubility in terms of hydrogen bonding by *un-ionised* resveratrol.

Although a number determined the molecular formula of the anion correctly, many failed to give it the correct charge of 3-.

(e) The formula for the first part was largely correct but often without the positive charge. In the second part OH was often given a charge, either + or -.

(f) Many candidates missed the stoichiometry of the reaction and reacted all three phenol groups; otherwise this was reasonably well answered, though some candidates gave a large number of different structures.

Question 2

(a) Most understood using oxidation states to explain redox reactions. A common error was to give the oxidation state of O as -6. If working for this was shown then credit was given.

Student tip

When asked to give the actual reducing or oxidising agent, give the name or formula of the actual species, not just the element *e.g. bromide ion/*Br^- *rather than bromine/Br*.

(b) Only the more able or better prepared scored all 3 marks in part (i). Common errors: including 'change' in stating the property (usually fine then for the final 2 marks), choosing inappropriate or even random 'substances' such as water or sodium thiosulfate, giving irrelevant descriptions of practical work. Many candidates would have been well advised to 'analyse' the question before starting writing.

Most were excellent at deducing the orders of reaction. However, again a poor reading of the question in the third part led them to use these data to construct their own rate equation for the calculation.

Scoring on the last part was low. Many concentrated on excess reagents and did not really understand the concept of initial rate or concentration. This highlighted a difficult concept which needs to be explained with care, probably several times during the course.

Question 3

(a) There was no real problem in identifying the alkene but the amide was sometimes designated as secondary or was described as an amine and a carbonyl of some description (either ketone/aldehyde or ester).

The equations proved much more difficult, only a few candidates were successful. There were many wrong charges and impossible formulae. The ammonium ion was often written as NH_3^+ whilst NH_2 was favoured for ammonia.

(b) The only problem here was not stating which aminopropane or deciding that it was 3-aminopropane.

Most candidates were comfortable using the *Data Sheet* and their own knowledge to interpret the infrared spectrum.

Student tip

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

(c) Only the second part caused any difficulty and then for candidates of all abilities. Few understood the concept of what is meant by a 'zwitterion'. The few structures which appeared with only two charges usually involved the protonation of the amide group rather than the amine.

(d) The first part proved to be easy for most but in the second part many did not notice the codes for translation on the *Data Sheet*.

Question 4

(a) This was usually incorrect and attempts usually involved trying to join repeating units using an O atom. 'Addition' is synoptic but it is mentioned in the 'What's in a Medicine?' specification.

(b) Addition was usually identified as the type of reaction but was sometimes spoiled by qualifying it as nucleophilic. Unspecified double bonds were broken but there was little idea about what they then joined to.

The identification of a diol in part (ii) was rare though all managed condensation or esterification and most drew an alcohol structure.

The last part was generally well done, with a minority discussing 100% atom economy in general terms rather than with reference to the example in the question.

(c) The first two parts were well done, the last part less so. Many clearly had some relevant ideas about the difference in properties but were unable to express these well enough to score a mark. The hydrogen bonding to water did well for the polymer without crosslinks, but a reverse argument did not do for the cross-linked version because of misunderstanding of what the cross-links meant in terms of a fixed structure.

(d) Most knew the concentration of the dye would increase but the reason for this was not always given.

Some candidates read this as requiring a standard answer on colorimetry. They added a concentration time graph, which would calibrate nothing. The main problem seems to have been in expressing their answer with precision. Too many forgot that they were dealing with a dye solution and/or failed to mention 'polymer' at any stage. Unfortunately, some candidates did not seem to understand what was going on.

(e) Many excellent answers although it was not uncommon for the nappies to be dried without first being washed.

Question 5

Most did well in this question. Those that read the paper at the start of the examination may have done this question first. A good tip for candidates!

(a) In the second part many tried to discuss standard conditions but had not read the question carefully enough and failed to link this to the NiCd battery. Some suggested that the data given in the table were only average values.

The equation was sometimes back to front, sometimes with extra hydroxide ions each side (*accepted*) or even extra electrons as well (*not accepted*).

(b) Many candidates discussed the formation of a green Fe^{2+} precipitate or that ferrates contained Fe^{2+} ions as the reason why the super-iron battery was called 'green', missing entirely the product given in the question. Few wrote anything reasonable about the relative difficulties of disposal of the batteries.

(c) There were a good number of correct answers and these showed an improvement in calculations though not always in the presentation of the appropriate working-out. Some candidates still do not show their working logically.

(d) The only part which gave any real difficulty was choosing a colour for the complex ion. Some sort of rust coloured shade was most popular, green was sometimes given and blue not uncommon.

F335: Chemistry by Design

General Comments

Many of these re-take candidates showed strengths as well as weaknesses on this paper, but different candidates did better in different parts, possibly depending on the areas they had revised most thoroughly. Candidates' powers of expression varied widely too, with some showing good communication. Calculations were often well done and candidates showed good understanding of buffer solutions and the effect of catalysts on equilibrium. Unfamiliar questions requiring energy-level diagrams explaining emission spectra and rates of forward and back reactions caused problems, as did the naming of the intermolecular bonds involved when an ionic substance dissolves.

Question 1

Part (a), requiring recognition of functional groups, was usually well done.
In part (b), circling two chiral centres was only reasonably done, with the features of enantiomers being answered slightly better.
Expanding a skeletal formula in part (c) was quite well done, the commonest error being to omit the hydrogen on the carbon at the branching point.
Defining a pharmacophore in part (d)(i) was reasonable, but candidates must realise that this term is used at the molecular level, so 'part of a drug which...' is not a suitable answer.
In part (d)(ii), a large proportion of candidates could identify the pharmacophore. Description of a competitive inhibitor often suffered from imprecision of expression. Some incorrectly thought that cholesterol was the substrate (rather than a product) of the reaction.
Part (e) attracted a great range of answers, many having merit and some showing a good understanding of drug design. Several concentrated only on certain aspects of testing for effectiveness and safety, analysis and synthesis, when all aspects were needed.

Question 2

Part (a) was only reasonably done, with some candidates thinking they had to draw copper ethanoate, which they then showed as a covalent structure.
Quite a good number deduced the correct oxidation state in part (b)(i) but very few were able to name the compound correctly.
Part (c)(i) caused a few problems, with many giving '....$3d^7 4s^2$' as the configuration.
'Error carried forward' was applied to part (c)(ii), so more scored here.
Explanations of the colour in part (c)(iii) suffered from the usual (erroneous) spate of electrons emitting the colour as they fall back down. Those who avoided this did not always give sufficient detail to score all the marks. A significant proportion were unclear of the role of the ligands in causing the splitting of the d-orbitals.
Some candidates did not understand what they were expected to do in part (d) and drew spectra or circular diagrams. Some failed to appreciate that this *is* emission of light.
Most understood what caused the dye to be coloured in part (e)(i) and could have a good shot at the effect of alkali on the molecule in part (e)(ii). However, relatively few scored all three marks here.
In part (f)(i), many scored the mark, the commonest error being 'nitrous acid'.
Fewer were sure of 'coupling' in part (f)(ii) and very few could name 'sulfonic acid' in part (g)(i).
Part (g)(ii) asked a familiar question on solubility in a slightly different way. Many candidates talked (unnecessarily, here) about hydration of ions, but few named all the intermolecular bonds broken and made, and then went on to comment on their relative strengths.
Part (h)(i) is relatively common on this unit, and many scored here.

In part (h)(ii) many candidates did not give the nature of the double bond causing unsaturation. Those who did often gave the C=O bond.

Question 3

In part (a)(i), almost all could draw the structure of urea, but many stumbled on one of the bond angles, or omitted one, or did not indicate clearly that the angle went from bond to bond.
Most knew the structure of the ammonium ion in part (a)(ii), but quite a proportion drew dot/cross diagrams and not full structural formulae.
The unfamiliar cyanate ion was tackled well in part (a)(iii), the main error being not to add the extra electron (from the negative charge) on the oxygen or the omission of the lone pair on nitrogen.
In part (b), very few said that both inorganic and organic compounds are made from the same elements.
In part (c), nearly all could calculate the percentage of nitrogen in urea, but some failed to realise that the A_r values were to three significant figures. Also, there were some rounding errors.
Part (d) on entropy was done quite well. Most could calculate the ΔS_{sys} in part (i) and talk about its sign in part (ii) in terms of numbers of moles, though seldom in terms of 'ways of arrangement'. Calculation of ΔS_{tot} was better done than last time it appeared with fewer failing to convert the enthalpy change to Joules. The sign was quite frequently omitted, though. In part (iv), a few worked out the effect of changing temperature on ΔS_{tot} and drew their conclusions from there. Some scored one mark by using the 'Le Chatelier' method.
In part (e), the oxidation states were usually correct in part (i) but candidates found writing the ionic half-equation in part (ii) hard, with many cases of the electrons being on the wrong side of the equation. The equation for the formation of ammonium nitrate in part (iii) and its atom economy was quite often correct, though the formula of the product defeated some. In part (iv), most named a hazard but did not always ascribe it to a particular substance.

Question 4

Relatively few were able to work out that ethanoic acid was formed in part (a).
In part (b), some seemed disconcerted by the novel situation of the sulfur atom and failed to identify four pairs of electrons.
'Hydrogen carbonate' was well known in part (c)(i), in contrast to when it was last asked.
Part (c)(ii) was often well done, with many candidates saying 'it will not affect the position of equilibrium but the equilibrium is set up faster' or similar words.
Candidates found part (c)(iii) difficult. A lot of detail was needed to score the four marks, and this was seldom seen. Candidates failed to answer the part of the question referring to the reverse reaction.
Part (d)(i) was reasonably well done, with relatively few candidates failing to spot that lower $[H^+]$ means higher pH.
Answers to part (d)(ii) were often clear and correct.
Part (e) was also often correct, even though the calculation was asked the other way round from usual. Those who failed to arrive at the correct answer did not always show enough working for 'error carried forward' to be considered.
Most candidates had learned the general explanation of buffering for part (f), but they were less good in applying it to the particular equilibrium shown.
In part (g), a few misread the question and gave ways of emitting less carbon dioxide but most knew two methods of removing it. There was some vagueness in how carbon was stored after capture, however.

Question 5

Quite a number could name ester B, 'methyl propanoate' being the commonest wrong answer.
In part (b) there was considerable success, the commonest error was naming the alcohol '2-methylpropanol', not 2-methylpropan-1-ol'.
Part (c) was too open-ended for high marks to be often achieved but most scored the marks for the information that could be obtained from the three spectroscopic methods, the commonest error being to say that mass spectrometry measured mass rather than M_r. A proportion scored the mark for indicating that the M_r values and bonds were the same, and went on to consider NMR as the main method. Candidates who got this far did not analyse the structures carefully enough, and comments like 'ester A has two methyl groups while B does not' were sometimes seen.
Parts (d) (i) and (iii) indicate that more practice is needed in drawing curly arrows, in particular ensuring they start and finish unambiguously.
'Water' was not always identified in part (d)(ii), and the products in part (d)(iii) were not always correct.
In part (e)(i), a relatively small proportion of candidates realised that an equilibrium sign was needed, but part (e)(ii) was well done.
In part (f)(i), 'measuring pH' was a more popular (erroneous) method than 'titration with an alkali of known concentration'.
Parts (f)(ii) and (iii) are not easy. Sometimes the [H_2O] term in K_c was omitted. However, candidates tried hard in part (f) and had some success, which is to their credit.

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