

GCE

Chemistry B

Advanced GCE H433

OCR Report to Centres June 2017

About this Examiner Report to Centres

This report on the 2017 Summer assessments aims to highlight:

- areas where students were more successful
- main areas where students may need additional support and some reflection
- points of advice 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.

The report also includes:

- An invitation to get involved in Cambridge Assessment's research into **how current reforms are affecting schools and colleges**
- Links to important documents such as **grade boundaries**
- A reminder of our **post-results services** including Enquiries About Results
- **Further support that you can expect from OCR**, such as our Active Results service and CPD programme
- A link to our handy Teacher Guide on **Supporting the move to linear assessment** to support you with the ongoing transition

Understanding how current reforms are affecting schools and colleges

Researchers at Cambridge Assessment¹ are undertaking a research study to better understand how the current reforms to AS and A levels are affecting schools and colleges.

If you are a Head of Department (including deputy and acting Heads), then we would be very grateful if you would take part in this research by completing their survey. If you have already completed the survey this spring/summer then you do not need to complete it again.

The questionnaire will take approximately 15 minutes and all responses will be anonymous.

To take part, please click on this link: <https://www.surveymonkey.co.uk/r/KP96LWB>

Enquiry About Results

If any of your students' results are not as expected and University places are reliant on them, you may wish to consider one of our Enquiry About Results services. For full information about the options available visit: <http://ocr.org.uk/administration/stage-5-post-results-services/enquiries-about-results/>

¹ Cambridge Assessment is a not-for-profit non-teaching department of the University of Cambridge, and the parent organisation of OCR, Cambridge International Examinations and Cambridge English Language Assessment

Grade boundaries

Grade boundaries for this, and all other assessments, can be found on [Interchange](#).

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Supporting the move to linear assessment

This was the first year that students were assessed in a linear structure. To help you navigate the changes and to support you with areas of difficulty, download our helpful Teacher guide: <http://www.ocr.org.uk/Images/345911-moving-from-modular-to-linear-science-qualifications-teachers-guide.pdf>

Further support from OCR

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H433/01 Fundamentals of chemistry

General Comments:

It was clear that a great deal of effort had been put into preparing for the first A level examination for this specification, by both candidates and their teachers.

Candidates rose well to the new challenges of multiple choice questions and the two questions that required more extended writing. There were a good range of marks from below 20 to over 100 and little evidence that candidates ran out of time. The relatively few instances where there was no response to a question were due to lack of knowledge of the answer, rather than lack of time.

There were some areas where the responses to the questions were excellent, but others where a more detailed reading of the question would have enabled candidates to address its demands more exactly. This was also true in the calculations; there were some fully correct answers, but others where a more coherent thread of working might have enabled some of the marks to be gained. It is also important to note the need for the appropriate number of significant figures and the importance of rounding correctly.

The correct and detailed use of technical terms is also an important consideration; use of atom, ion or molecule interchangeably was a problem in some answers.

Candidates should be encouraged to use the additional pages in the question paper if they need extra space to continue their answer, rather than writing a few lines on a 4-page answer booklet and leaving these pages blank.

Comments on Individual Questions: Section A

Multiple Choices Questions: Q1–Q30 In general, this section was well done. The questions involving calculations proved most difficult and scores were lower in the final 4 questions where deciding how many of the responses were correct gave more scope for error.

Section B

Question 31

31(a) Many correct half equations were seen but there were a significant number using sodium or chloride ions. The explanations were often very general such as 'gain of electrons' and not related to the correct species in this case.

31(b) A significant number got this calculation correct, although, of these a relatively high proportion lost a mark through not giving the answer to the correct number of significant figures. Of the rest, a minority did not divide by 2 to account for the mole ratio or used the atomic mass of chlorine, some did not convert to moles at all.

31(c) This was well answered question but occasionally the answers given were vague, such as ‘harmful’, or included incorrect detail such as ‘toxic and flammable’.

31(d)(i) There were a few instances where the arrows were either omitted or were double-headed.

31(d)(ii) Many candidates did not use ethane in the propagation steps, and if they did, they split it into CH₃ groups. A good number also showed the chlorine radical binding to the ethane and releasing an H radical rather than showing the proton scavenging property correctly.

31(d)(iii) In this question, both propagation steps were often shown with ozone reacting. Explanations given of what a catalyst is were often general e.g. ‘provides a route with lower activation enthalpy’, and not related to the fact that the chlorine radicals were re-generated.

31(d)(iv) The success on this question was depended on knowing the formulae linking energy, frequency and wavelength. A significant number calculated the wavelength perfectly. Although there were various ways of scoring 1 mark through omitting to use one of the terms correctly, this was rarely scored. The most common mistakes were not using the Avogadro constant or using it instead of Plank’s constant and vice versa. There were also difficulties in converting between frequency and wavelength.

31(e) This question was well done.

31(f) The oxidation states were rarely incorrect, but constructing the equation was more difficult for some candidates.

Question 32

32(a) This question was very well done.

32(b) A significant number of candidates knew the answer to this question. If marks were lost it was due to using incorrect particles such as atoms or molecules, or relating the observations to the different reactivities of calcium and magnesium.

32(c) This question was well done, many perfect answers and many that just didn’t get the final unit conversion into dm³ at the end.

32(d) Most candidates made a reasonable attempt at this question and some answers were excellent. The most common mistakes made highlighted confusion with absorption and emission and absorbing light and transmitting the complementary colours. The analysis of the light

providing proof that strontium was a new element proved more difficult to explain, some explanations confined themselves just to flame colour or a comparison with barium only.

32(e) This proved to be a very difficult question. The most common areas of difficulty were with lead, either thinking its salts and hydroxide were soluble or thinking all its precipitates were yellow like its iodide. Not using the word 'precipitate' or not giving its colour were also causes of lost marks.

Question 33

33(a) This question was very well done. The effect of conditions on K_c was well understood.

33(b) This question was well done. The greatest difficulty was working out the equilibrium concentrations of each gas, but most were able to correctly substitute their values into a correct expression for K_c and give the correct units.

33(c)(i) The answers to this question were general and did not relate the increased entropy to the fact there were more moles of gas in the products.

33(c)(ii) This question was well done, although a significant number of correct numerical answers did not have the sign, despite all the entropy values in the data having positive signs.

33(d) This question was well done. Many correctly calculated the correct positive entropy, although a few forgot to multiply the ΔH value by 1000. A few candidates used the alternative approach of calculating the minimum temperature at which the reaction is feasible and finding it was below 1000 K. This was equally creditworthy.

33(e)(i) This question was well done, although a few people did not account for 3 moles of hydrogen being formed.

33(e)(ii) Co-product is a term that many candidates did not know.

33(f) Many candidates listed impacts linked to the use of the CO but often missed the second marking point by not emphasising that more H_2 is produced or that one reaction is exothermic and hence can provide energy for the other endothermic reaction.

Question 34

34(a)(i) The different bond lengths were well explained, although some candidates said there were shorter and longer bonds in structure 2, but did not say the double bonds would be the shorter ones. The bond angles were more difficult; angles of 60° were quite common, as were

109° in structure 2. Even if both were given as 120°, the explanation in terms of areas of electron density was rarely seen.

34(a)(ii) This was well done, although some candidates did not use the word ‘delocalised’ to explain the less exothermic enthalpy value for structure 1.

34(b)(i) The majority of candidates had the correct temperature, although some had refluxing as well or confused the conditions and put less than 5°C. The equation for the formation of the electrophile proved more difficult for many.

34(b)(ii) There was some confusion with sodium nitrate and sodium nitrate here and not realising the coupling with the phenol had to be done in alkaline conditions. The structure was, however, well answered.

34(c) Naming the sulfonate group proved difficult for most candidates.

34(d) There were a significant number of candidates who overlooked this question. Of those who did it, points 1 and 3 were the easiest to see where electrons were moving to and from.

34(e) This question was well done, although the ratio was the wrong way round in some cases. If full marks were not scored then the clarity of the working out was an important factor. If the pH had been used to find $[H^+]$, it needed to be clearly stated to score.

Question 35

35(a) This proved a challenging question as it asked candidates to respond to an unfamiliar method. A significant number of candidates scored level 3, but some thought the addition of sodium carbonate was a titration or they reacted the carbonate and collected the gas given off. Sources of inaccuracy often involved using a better balance.

35(b) There were a number of perfectly correct answers but there were many opportunities for making errors. These were the mass of the solution being 9.7 instead of 50, or 50 + or – 9.7. Candidates did not always realise the need to scale up for 1 mole of solute, or if they did, they used an incorrect molecular mass and had a negative enthalpy change despite the temperature falling.

35(c) This question was well done.

35(d) Many candidates lost marks by using inappropriate language such as ‘atomic’ or ‘molecular’ when describing ionic species. Candidates also focused on ΔH_{hyd} being ‘smaller’ or ‘larger’ rather than more or less exothermic or on the strength of ion-dipole forces.

H433/02 Scientific literacy in chemistry

General Comments:

This paper allowed candidates of all abilities to achieve success. Marks ranged from high teens to over 90 marks. Candidates had sufficient time to complete the paper with “no responses” generally limited to very weak candidates.

The majority of candidates were able to answer questions using the space provided with few making use of the additional blank page at the end of the question paper. Centres need to ensure that candidates use this space in preference to requesting additional booklets. In addition it would be beneficial to candidates if they could ensure that they clearly indicate on the additional response the exact question number, including the sub-question. There were a small number of candidates who provided additional information but had not indicated either on the question paper, or in the additional space, which question the written work referred to.

The quality of answers suggests that candidates had put in a significant level of preparation and this is reflected in the quality of answers in questions 1d, 2bv, and 3c.

Calculations and equations which did not rely on simple recall were reasonably well done, and it is pleasing to note that question 5 which is based on the pre-release material was well answered by a significant proportion of candidates.

Weaker candidates did find the open-ended nature of the calculations in question 1(e)(ii) and 4d(i) rather taxing and struggled to organise their thinking, resulting in a rather poorly organised response that made it difficult to award credit for appropriate steps in the calculation when the final answer was incorrect.

The main extended writing questions, 3d and 5b(i), allowed more able candidates to plan and structure their answers, and clearly demonstrated that candidates had benefitted from this type of question having been posed at GCSE and AS level last year.

Comments on Individual Questions:

Question 1

1(a)(i) Most candidates were able to score both marks here, when only 1 mark was awarded this was usually for identifying H_2CO_3 incorrectly as a product of the reaction.

1(a)(ii) In this calculation candidates used the appropriate equation to determine the number of moles of ethanoic acid, and then to determine the volume of sodium carbonate required (11.25cm^3). Where candidates had not given the correct equation in a(i) credit was allowed for correctly calculating a volume based upon their answer, usually calculating a value of 22.5cm^3 from an equation with a 1:1 ratio of reactants.

1(b) Most candidates scored this mark successfully.

1(c)(i) This equation was a bit more challenging for candidates, where the most common error was the use of an arrow between reactants and products rather than the equilibrium symbol.

1(c)(ii) This calculation was not as well answered as might have been expected. More able candidates used the information provided to correctly calculate the $[H^+]$ and hence the pH value of 3.15, but many weaker candidates used the figure of 0.03 in the calculation as this is the value given for the concentration of ethanoic acid in the question. Where this was used without any reference to the value of K_a no marks were awarded. However, if candidates had used this and multiplied it by K_a and subsequently calculated the pH then a mark was awarded. One mark was allowed for any answer derived from $3 \times 10^{-2} < [H^+] < 1.1 \times 10^{-7}$.

1(d) Most candidates scored 1 mark here for correctly recalling that buffer solutions act to maintain pH levels when small quantities of acid or alkali are added to the reaction. More able candidates also included an appropriate equilibrium equation in their answer and made reference to it in trying to explain how this occurred. Very few candidates identified that this was made possible where there was a large concentration of salt(ethanoate) anions.

1(e)(i) This question was generally well answered, the most common reason for candidates not scoring this mark was failing to recognise that when the concentrations of ethanoic acid and sodium ethanoate were equal that the $[H^+]$ is equal to the value of K_a for this system, and instead often used a value of 0.03 mol/dm^3 from earlier in the question.

1(e)(ii) This was a multi-stage calculation which required candidates to be able to structure their response clearly. Those candidates who had spent time practising this type of calculation were clearly at an advantage as they set out their calculation in a clear and organised manner. They understood the need to rearrange the equation for K_a to make [ethanoate] the subject and then calculated the required $[H^+]$ using the pH value given in the question. From here many candidates correctly calculated the concentration as 0.17 mol/dm^3 but then either failed to appreciate that the volume of buffer solution required was 25 cm^3 rather than 1 dm^3 and so failed to scale down their calculated value, or used a figure of 60 g/mol (ethanoic acid) for the formula mass rather than the correct value for sodium ethanoate of 82 g/mol . In either case marks were subsequently lost. Centres should ensure that candidates have sufficient time to practise this type of calculation, and should try to ensure that they are aware of the need to attempt to structure their calculations in an appropriate manner.

Question 2

2(a) A very straightforward question, well answered by many candidates. Common errors included identifying the OH group as an alcohol rather than phenol, or failing to indicate that the amide group was a secondary amide.

2(b)(i) Where candidates failed to score here was in not correctly scaling up their calculated mass of phenol from 3.38 g to 13.5 g or 14 g (2sf).

2(b)(ii) Many candidates struggled with this question, suggesting that they are unfamiliar with the bonding within the NO_2 group, but, in many cases they did correctly identify where the internal hydrogen bond would form and so scored 1 mark.

2(b)(iii) This question was not very well answered, very few candidates recognised that the conversion from a NO_2 functional group into a NH_2 functional group is an example of a reduction reaction and so failed to score this mark.

2(b)(iv) This question was generally well answered. Most candidates drew appropriate skeletal structures for the reactants, and it was pleasing to see so many correct representations for the anhydride, and subsequently identifying the products of the reaction.

2(b)(v) There were very few blank responses to this question. Candidates often identified the steps involved in the process and could communicate this effectively. Weaker candidates often lost marks for not correctly identifying where insoluble impurities were removed, or for failing to identify the removal of soluble impurities at the end of the process. The quality of response may be linked to the use of this task within the set of expected practical's that candidates are expected to undertake as they move through the course.

2(c)(i) This question was generally well answered by the majority of candidates, most recognised that the shape of AM404 was similar to andanamide and that this resulted in the active site of the enzyme becoming occupied and therefore prevented the enzyme from breaking down andanamide.

2(c)(ii) Generally well answered, the only common error was candidates who gave a response of E/Z isomerism.

2(c)(iii) Most candidates recognised that the reason for the chain being held in its shape was due to the lack of rotation around the carbon – carbon double bond(s).

Question 3

3(a)(i) The most common error here involved candidates failing to identify that the carbon atom bonded to the OH group of the pentose ring was also a chiral centre and so did not score this mark.

3(a)(ii) Most candidates scored this mark with the only common error was identification of the functional group as a carboxylic acid rather than an aldehyde.

3(a)(iii) Many candidates scored at least 1 mark, with the most common error being to incorrectly identify the reaction conditions associated with the tests, however where the test was identified the correct result was given and scored the appropriate mark.

3(a)(iv) Well answered. Candidates correctly identified the correct OH groups and explained why these groups were primary alcohol groups.

3(a)(v) Again, a well answered question. The vast majority of candidates recognised that water/a small molecule was not a product of the reaction.

3(a)(vi) Very few candidates scored this mark, and many left the space for the answer blank.

3(b) This question was attempted by the majority of candidates, however, very few candidates scored more than one mark, with a significant number scoring 0. The most common error was the failure of candidates to realise that when the phosphate groups bond to the deoxyribose ring that all of the hydrogen atoms are lost in the formation of water, and therefore when candidates left OH groups attached to the central phosphorous atom this cost them one mark. However, it was pleasing to note that they did know where the phosphate groups bonded to the ring and so the second mark for showing the correct connection of the phosphate groups to the pentose ring was often awarded.

3(c)(i) Again very well answered. Candidates recognised that adenine, cytosine and guanine are bases, and that they combined with the sugar phosphate backbone via a condensation reaction at the hydroxyl group of the deoxyribose ring. The most common error in this question was to suggest that the bonding between the bases and the ring was through hydrogen bonding rather than a condensation reaction.

3(c)(ii) Generally well scored, the only common error was the inclusion of thymine rather than adenine in the triplet code.

3(c)(iii) Candidates correctly identified that leucine was the desired amino acid.

3(c)(iv) This question produced a variety of responses, with no common errors being evident. Most candidates recognised that there was a process whereby the sequence of bases on DNA was converted into a complimentary sequence of three bases on a strand of RNA that then proceeded to be read to produce a response that involved a strand of RNA collecting an amino acid. Where they lost marks was in not identifying mRNA or tRNA correctly, or failing to mention that it was a particular sequence of three bases (a codon or anticodon) that was necessary and linking these ideas correctly to the mRNA/tRNA, eg “DNA produces a strand of mRNA that goes to the ribosome and produces a strand of tRNA with the appropriate amino acid” or, “the sequence of three bases on the DNA produces a codon on the RNA that then produces an anticodon to select the required amino acid”. These were the types of response that demonstrated that candidates understood the basic process occurring, but did not make the appropriate links required to score the marks.

3(d) This question proved to be very challenging to the vast majority of candidates. It was targeted to be of high demand. Most candidates made a very good attempt at the question and often produced a detailed response where they identified many of the key features of the structural isomer using all three spectra as instructed in the question. Most candidates correctly identified the presence of a C=O group from both the IR spectrum and the CNMR spectrum, they also correctly identified that there were 3 proton environments from the proton NMR spectrum, and that there were 4 carbon environments from the CNMR spectrum. However, many candidates insisted that the molecule contained OH groups from incorrectly identifying this group from the IR spectrum. The peak at approximately 3000cm^{-1} indicated the presence of C—H bonds as it was not a broad peak associated with OH groups in a variety of molecular environments that would have been characterised by a broad peak. Consequently they then identified the O—CH peaks in the HNMR spectrum as being associated with an alcohol rather than an ether, even though many had identified a C—O stretch from the IR spectrum at $1000 - 1300\text{cm}^{-1}$. As a result of this many candidates proposed structures containing OH groups which were incorrect, but were rewarded for their interpretation of the various spectra at L2 with many scoring 4 marks.

Question 4

4(a)(i) This question, was very well answered, most candidates correctly calculated the oxidation state of the Chromium atom in the various species and correctly stated the change that occurred in each step of the reaction sequence.

4(a)(ii) This calculation was attempted by most candidates, with many scoring full marks. Most scored one mark for correctly calculating the number of moles of chromite in 1000g of chromite, but if they did not appreciate that there were 2 atoms of Cr in the ore then they did not score the second mark for the mass of chromium being 0.465(kg).

4(b)(i) This question was well answered by most candidates, the only common error was to give the outer electron structure as $4s^2 3d^1$.

4(b)(ii) This question produced a variety of diagrams. Many candidates recognised the need for a power supply and a solution containing the correct electrolyte, but a common error was to use graphite electrodes for both the anode and cathode, or to label the anode as being the steel object. Another common error was to draw a diagram containing a two beakers, a salt bridge, and a high resistance voltmeter, however, provided that they labelled one of the electrodes as a steel electrode (not an anode) and had this inserted into a $\text{Cr}^{3+}_{(\text{aq})}$ solution they could still score 1 mark. Very few candidates did not attempt this question, and almost all who did scored at least 2 marks.

4(b)(iii) A common error in this question was that the equation was written as if the Cr atom was being ionised rather than the Cr^{3+} ion being reduced.

4(b)(iv) This calculation was attempted by most candidates, with many scoring at least two marks. The most common error made was not recognising that each Cr^{3+} ion required 3 electrons to become reduced, and so the required number of moles of electrons was 1.5 rather than 0.5, consequently many candidates calculated the time required as 2.7 hours and so scored 2 marks. The correct expected answer being $3 \times 2.7 = 8.1$ hours.

4(c)(i) This question produced a variety of responses. Most marks were lost for identifying Cl as a chlorine ligand when it should have been chloride, or only identifying water as a ligand.

4(c)(ii) Most scored one mark for correctly indicating that the equilibrium needed to move to the left to restore the green colour of the solution, but a common error was to suggest that this could be achieved by evaporating water from the complex ion.

4(d)(i) A pleasing aspect of this question was that there were very few candidates who did not attempt it. However, it posed a challenge to weaker students who struggled to organise their response and so produced a set of numbers where it was difficult to identify what they were trying to do. It is hoped that centres will spend some time when they are preparing candidates for this paper in trying to ensure that they realise that it is vital in this type of calculation to try to identify what they are trying to work out. Where candidates did do this they often scored some marks, usually for calculating the number of moles of dichromate and thiosulfate used. But after this many candidates scaled up or down with no reference made to what they were attempting and it became very difficult to give them any further marks as the numbers produced often did not bear any resemblance to those given in the mark scheme. Where candidates did correctly calculate the concentration of the ethanol the only subsequent error was in calculating the percentage as 9.77 rather than 0.977 as they had not recognised the units as g per 100cm^3 and had simply converted from mol dm^{-3} to g dm^{-3} .

4(d)(ii) Very few candidates scored this mark. Most gave answers linked to all of the ethanol reacting with the dichromate, and failed to consider that there could have been other substances in the beer that might have interfered with the reaction.

Question 5

This question was based on the pre-release material and it was clear that in the vast majority of cases, candidates had been well prepared by their teachers. This was particularly obvious in the extended writing question as there were very few responses that did not address all three areas of the marking criteria. It was also pleasing to note that candidates had not restricted their preparation to any one area, as the answers to parts d) and e) demonstrated that they had covered the whole of the material provided appropriately.

5(a) This question was generally well answered with most candidates scoring at least two marks for correctly identifying the OH groups that could be converted into an aldehyde or carboxylic acid. They often failed to score the third mark as they only identified one of the secondary OH groups in the middle diagram.

5(b)(i) This question produced a full range of marks and allowed the more able candidates to demonstrate their understanding of this topic. Most candidates were able to explain what happens to electrons when they absorb radiation and linked this to the idea of quantisation of energy. They also linked the amount of energy to the appropriate frequency absorbed and that this could be used to identify the colour of the decomposition products as being complimentary to the frequency/colour absorbed.

More able candidates also discussed the nature of the chromophores in lignin and in its decomposition products and correctly stated that when the degree of delocalisation in the chromophore increased, this reduced the size of the energy gap between the ground state and the excited state and that this resulted in the decomposition products absorbing light in the blue(or violet) part of the visible spectrum and so the complimentary colour was reflected.

Some candidates did lose marks for stating that the colour produced was a result of electrons being promoted to a higher energy level and then dropping back to their ground state with the release of energy in the visible spectrum that resulted in the paper appearing yellow.

This question gave very clear differentiation between the candidates, strong candidates produced a very clear and well organised response that addressed all three areas in depth. Whereas, weaker candidate responses were characterised by a lack of organisation, or in producing a response that either only addressed one area, or gave a brief account of what happens when radiation is absorbed by molecules and how this produced a yellow colour.

5(b)(ii) This question was generally well answered with many candidates scoring at least 2 marks for the correct rearrangement of $E = h\nu$ and $c = \nu\lambda$, and then the correct calculation of the energy of the photon absorbed. More able candidates subsequently calculated the energy per mole correctly as 342kJ mol^{-1} .

5(c)(i) This question was generally well answered with $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ being the most common correct answer given.

5(c)(ii) Common errors here included incorrect bonding to the water molecules in the diagram, or not clearly showing the 3D nature of the bonds in the equatorial region of the molecule resulting in a diagram that gave the impression of all of the equatorial ligands being in the same plane as the polar ligands. Most candidates, however, did give the correct description for the shape of the complex ion.

5(d) Responses to this question often produced 2 marks, where a mark was lost usually for not balancing the equation correctly.

5(e) Most candidates scored 2 marks here, with many scoring all 3 marks. The only reason for marks being lost was in failing to either give an appropriate equation for either the use of diethylzinc gas, or the use of magnesium (or calcium) hydroxide nanoparticles, or in discussing the use of bleaching agents.

H433/03 Practical skills in chemistry

General Comments:

This paper, taken for the first time as part of the new specification, is designed not only to test candidates' knowledge and understanding of chemical concepts, but also to allow candidates the opportunity to showcase their understanding of chemistry in a practical context.

This latter aspect includes the ability to demonstrate and apply knowledge and understanding of experimental design, and the collection, analysis and evaluation of experimental data.

The paper proved accessible to all candidates, with a low number of 'no responses' confirming this accessibility.

Overall, the majority candidates were able to demonstrate their chemical knowledge and understanding and had clearly been well prepared by centres.

The standard of the extended response (Level of Response) questions was in general pleasing, with many candidates being able to construct a logical and well-structured response.

It is worth centres explaining to their candidates that their scripts are scanned and marked online.

Questions requiring students to transfer experimental data to a graphical format are increasingly common and candidates should thoroughly rub out any drafting lines so they do not show up after scanning, and clearly show any working which may be required on the graticule (see specific questions).

Comments on Individual Questions:

Question 1

This question discriminated well.

1(a) This practical technique question was generally well answered.

1(b)(i) A fairly straightforward question requiring the identification of functional groups. Common incorrect responses included polyamide/peptide or amine and ether.

1(b)(ii) Many candidates scored the ion (NH_3^+) mark but a minority did not correctly work out the rest of the structure.

1(b)(iii) In this question the majority of candidates produce a correct zwitterion structure but unfortunately their explanation of the internal proton transfer lacked detail or sloppy terminology (e.g. hydrogen instead of hydrogen ion or proton).

1(c) Many candidates produced well-structured answers to this practical technique question.

The explanation of how their results could be used to show hydrolysis had taken place tended to be the weaker part of some answers.

1(d) Very few students realised the phosphoric acid acted as a catalyst in the hydrolysis of the aspartame. A minority thought that there would be less hydrolysis overall, not slower hydrolysis.

Question 2

This question proved to be the most accessible on the paper.

2(a)(i) This question was straightforward but candidates should be made aware that vague answers such as 'fair test' will not receive credit at this level.

2(a)(ii) A large number of candidates chose to base their calculation on the highest concentration of acid used in the experiment instead of the lowest, nevertheless error carried forward marks were commonly scored.

2(a)(iii) This question was straightforward and well answered.

2(b) This question was well answered. The most common mistake was the inclusion of magnesium in the equation.

2(c) Candidates generally scored well on this question; however a significant number could have scored more marks if they had followed the instruction in the stem to 'show your working on the graph'.

In this question, to access all the marking points, examiners were expecting to see a tangent line to a curve drawn through the data points, as well as construction lines showing how the slope of the tangent had been calculated.

The units were simply cm^3s^{-1} .

2(d) This question, requiring the transfer of data from one form to another before analysis, was pleasingly well attempted by many candidates.

There were marks available not only for the numerical answer, but also for the way the data had been transferred to the graticule, including labelling of axes, use of graph area, point plotting and line of best fit.

Candidates should note that an activation energy value will not have a minus sign.

Question 3

3(a) This question was well answered.

3(b) This question was well answered.

3(c) This question was variably answered. Examiners were looking for the simple idea that equal volumes/amounts of the two alcohols could have bromine solution added (either dropwise or by titration) until an orange colour persisted.

A significant number of candidates wrongly thought time was a factor and many candidates tried to use a colorimetric method. This is fine, but required a more sophisticated answer to score all four marks.

3(d) The type of isomerism and the structure of the other isomer commonly scored. However, the explanation required not only the idea of limited rotation around the double bond, but also the idea of two different atoms or groups on each carbon of the double bond.

3(e) This question was straightforward but required care when converting from the skeletal to molecular in order to work out the m/z value.

Question 4

This question was the most challenging on the paper.

4(a)(i) The most suitable apparatus to use in this experiment is a volumetric pipette. A large number of candidates were imprecise in their answer and lost this mark.

4(a)(ii) The average of titres 2, 3 and 4 give a value of 22.60. Examiners expected to see the answer to two decimal points in order to score the mark.

4(a)(iii) This proved the most discriminating question on the whole paper.

Candidates usually successfully calculated the number of moles of thiosulfate used in the titration, but then commonly got confused by the ratio, often wrongly dividing by two. The scaling up by 10 was also missed in many cases, though multiplying by 63.5 often score on error carried forward.

The final answer was needed to 3 sig. figs. in order to score the final evaluation mark.

4(a)(iv) This question was disappointingly answered. The calculation of uncertainties has become increasingly important in GCE specifications in recent years. This question expected candidates to calculate the percentage uncertainties associated with the electric balance and the use of the burette in the titration.

4(a)(v) Examiners were expecting a different type of method in answer to this question e.g. colorimetry or gravimetric.

4(b) Weaker candidates found this extended writing question more difficult than the one in Question 1(c).

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Answers sometimes drifted away from the making of a standard solution from a solid into serial dilution, or even reactions in acid, nevertheless there were still a significant number of excellent answers.

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OCR (Oxford Cambridge and RSA Examinations)

1 Hills Road

Cambridge

CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

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Head office
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Facsimile: 01223 552553

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