Oxford Cambridge and RSA

GCE

Chemistry A

Advanced Subsidiary GCE **AS H032**

OCR Report to Centres June 2017

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.

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

CONTENTS

Advanced Subsidiary GCE Chemistry A (H032)

Advanced GCE Chemistry A (H432)

OCR REPORT TO CENTRES

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 Assessment[1] 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 and Cambridge English

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

activeresults

Active Results offers a unique perspective on results data and greater opportunities to understand students' performance.

It allows you to:

- Review reports on the **performance of individual candidates**, cohorts of students and whole centres
- **Analyse results** at question and/or topic level
- **Compare your centre** with OCR national averages or similar OCR centres.
- Identify areas of the curriculum where students excel or struggle and help **pinpoint strengths and weaknesses** of students and teaching departments.

http://www.ocr.org.uk/getting-started-with-active-results

CPD Hub
Your route to OCR's teacher training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessors or drop in to an online Q&A session.

https://www.cpdhub.ocr.org.uk

H032/01 Breadth in chemistry

General Comments:

H032/01 is one of the two AS examination units for the new revised AS examination.

Most candidates had prepared well for the examination and tackled all parts of the paper.

The standard of difficulty was appropriate.

Calculations sometimes required answers to a prescribed, or appropriate number of significant figures or decimal places. Please refer to the Mathematical Skills Handbook for Chemistry A, section M1.1 (http://www.ocr.org.uk/Images/295468-mathematical-skills-handbook.pdf) for guidance on using appropriate amount of significant figures.

There was no evidence that any time constraints had led to a candidate underperforming.

Comments on Individual Questions:

Section A

Multiple Choices Questions: Q1–Q20

Overall the multiple choice questions catered for the full range of ability and allowed for good differentiation.

Questions 1, 2, 4, 8, 9, 10, 12, 15 and 17 generally scored well.

Questions 11 and 18 were more challenging for candidates.

In responding to questions in section A there were some instances of numbers being entered rather than letters and it was occasionally hard to distinguish between a poorly written B and D. It is essential that the chosen letter is clear. If a candidate changes their mind, they should cross out the incorrect response and write the replacement letter beside the box, rather than trying to change the letter.

Surprisingly, a number of candidates did not choose any option on a few questions. Clearly an informed guess is better than no response.

Further comments on the questions are given below:

1) The majority of candidates provided the correct answer with only the very weakest candidates not achieving the mark.

2) Most candidates answered this question correctly with only the weakest candidates losing the mark. Some candidates incorrectly identified the answer as B, which has the same ratio but was not the simplest whole number ratio.

3) Able candidates answered this question correctly, with answer option A being a common distractor.

4) This question was generally answered well. Answer option D was a common distractor.

5) This question differentiated well. It appeared as if many candidates did not multiply the maximum error by 2 or used the final reading as opposed to a calculated titre.

6) This question discriminated well with less than half the candidates obtaining the correct answer. Answer option D was a common distractor.

7) Surprisingly, less than half of candidates obtained the correct answer. Many candidates incorrectly chose answer option B, BCl_3, despite it having no lone pair.

8) Most candidates correctly identified Si as giant covalent. A common error was answer option D.

9) This part was generally well answered. The common incorrect answer was answer option A.

10) Most candidates correctly identified answer option D as the correct insoluble compound. However, answer option A was a common incorrect answer, likely due to it being the only non-halide.

11) Very few candidates obtained the correct temperature change and this proved to be the most difficult of the multiple choice questions. The majority of candidates incorrectly answered as B, based on halving the quantities, leading to halving the temperature change.

12) The majority of candidates obtained the correct answer. As expected, the common incorrect answer was C: the correct value but the incorrect sign.

13) This question discriminated very well with most able candidates obtaining the correct answer.

14) Able candidates who approached this question correctly (based on priority) obtained the correct answer. Some candidates seemed to look for the same group (CH_3) on the same side (*cis*), and incorrectly identified the compound as answer option B, the Z isomer.

15) Most successful candidates showed rough working at the side with the formula displayed.

16) Most candidates correctly identified the correct number of isomers. However, about a third of candidates gave the incorrect answer C, perhaps trying to use an ethyl branch.

17) The majority of candidates correctly identified answer option A as the lowest boiling point alkane. The common incorrect answer was D, the complete opposite as it is the least branched and longest chain.

18) Candidates found this question challenging, with only the more able candidates obtaining the correct alcohol. Answer option C was a common incorrect answer.

19) Just over half of the candidates identified the correct alcohol. The common incorrect answer was C.

20) Fewer than half the candidates obtained the correct alcohol (A). The common incorrect answer was C.

Section B

Question 21

21(a)(i) This part was generally well answered with the majority of candidates scoring two or three marks. The most common errors were the omission of the C*l* atom from each structure, or identifying the minor product instead of the major product from the reaction with steam. For addition products of an alkene, candidates are advised to copy the alkene but with a single rather than a double bond, then to add the reagent across where the double bond was. This might have prevented the omission of the C*l* atom on so many of the structures seen.

21(a)(ii) Most candidates correctly identified an acid catalyst, with the most common response being phosphoric acid. Common mistakes were nickel, zinc and acidified dichromate.

21(b)(i) The majority of candidates correctly drew the repeat unit but only afew wrote a full equation, balanced with *n*. The most common error was omission of the '*n*' before the monomer. Candidates are reminded of the importance of balancing equations.

21(b)(ii) Most candidates realised that the combustion would produce toxic/harmful gases, but the majority either incorrectly identified the problem gas as CO_2/CO or did not identify the gas at all. Others referred to ozone damage and global warming. Good responses referred to the formation of chlorine compounds such as hydrogen chloride.

Question 22

22(a)(i) This straightforward question was generally well answered. Some candidates completed the table for atoms rather than 1+ ions, with 12, rather than 11 electrons.

22(a)(ii) This stock calculation proved to be one of the easiest questions on the paper. When an error was seen, it was inevitably for not showing the answer to two decimal places.

22(b) This was a challenging question that discriminated extremely well. The more able candidates derived the anions from the two chemical tests and identified the cations using the molar masses of the salt and the anions.

Weak candidates seemed to have little idea on how to approach such a question and they often achieved no credit.

It was disappointing that many candidates were unable to identify a carbonate and sulfate from their chemical tests. Common errors included incorrectly identifying the gas with dilute acid as hydrogen, and identifying the white precipitate with barium ions as characteristic of a chloride.

Candidates who used the provided molar mass of 140 usually went on to show that the cations contributed masses of approximately 80 for the carbonate and 44 for the sulfate. Candidates then needed to divide each value by 2 to obtain formulae of K_2CO_3 and Na_2SO_4. Many did not divide by 2 and instead concluded that the compounds were $RbCO_3$, KSO_4 or $CaSO_4$.

Strangely, some candidates thought they were identifying Group 1 metals and not salts.

22(c)(i) This part was poorly attempted with only the most able candidates adding a point on the graph above 1500.

22(c)(ii) Very few candidates realised the need to use the Avogadro constant, with most candidates responded with 500, or 5.00×10^{-2} in standard form, the energy for one mole.

Many candidates did not seem to know the meaning of standard form and there was some confusion between significant figures and decimal places, all basic mathematical concepts and requirements for Chemistry AS.

Answer: = 8.3×10^{-22} kJ

22(c)(iii) This part was answered well, with many stock answers seen in terms of atomic size, nuclear charge and attraction. Weaker candidates often produced long responses that lacked focus, which often obtained fewer marks than short concise answers.

22(c)(iv) Few candidates answered this part well. Candidates were expected to realise that Mg loses an electron from an s orbital, whereas Al loses an electron from a higher energy p orbital.

There were few clear answers and many candidates were distracted by paired and unpaired electrons or distance from the nucleus.

Few candidates responded in terms of the difference in energy between the s and p orbitals.

Question 23

23(a) This was a well answered question showing that the majority of candidates were well-acquainted with the Boltzmann distribution. Labelling of the axes was a common cause of error. Some candidates showed two curves, confusing the effect of a catalyst with temperature.

Most candidates knew that the activation energy was lower with a catalyst than without.

A significant number of candidates limited their explanations to ‘successful collisions’ without referring to more molecules exceeding the lower activation energy in the presence of catalyst.

The best responses secured all four marks from a well-drawn and annotated graph.

23(b) There were many excellent responses in terms of lower temperature, use of less fossil fuels and a reduction in emission of carbon dioxide as a contributor to global warming.

Weaker responses lacked precision and often repeated information supplied in the question about less energy demand.

23(c) Most candidates were able to obtain a value of 14.56 using a correct K_c expression, but a significant number of candidates were unable to give their answer to an appropriate number of significant figures. Candidates should use the least accurate data provided, here three significant figures, and to indicate the appropriate number of significant figures in the final answer.

Other common errors included the inverted K_c expressions and use of [CO] + [2H$_2$], rather than [CO] [H$_2$]^2, as the denominator.

Answer = 14.6 dm^6 mol^{-2}

Question 24

24(a) Most candidates were aware that an acid is a proton donor but many candidates gave imprecise responses for the concept of a weak acid. Good candidates used the expected term 'partial dissociation', but weaker candidates often focused on a lower concentration of hydrogen ions, pH range or indicator colour.

24(b)(i) The majority of candidates were able to balance this equation using whole numbers or half multiples. Where there was an error, it was invariably for the balancing number of H_2.

24(b)(ii) This question was not answered as well as expected. It was pleasing to see that almost all candidates recognised the importance of writing oxidation numbers correctly including a '+' or '–' sign where needed. Common mistakes included giving the total contribution from an element as opposed to the oxidation state of each atom of the element.

24(c)(i) This was a challenging unstructured titration calculation for AS level. Very able candidates rose to the challenge to secure all four marks. Many obtained the correct concentration of 0.0884 mol dm^{-3} for the diluted vinegar, but did not then use the dilution factor to convert this to the concentration of the original vinegar. Weaker candidates often obtained two relatively straightforward marks for the amounts of barium hydroxide and ethanoic acid used in the titration. Some otherwise good responses were not awarded full marks by excessive intermediate rounding, e.g. 0.0884 to 0.088, which then gave a rounding error in the final answer.

Answer: 2.21 mol dm^{-3}

24(c)(ii) This question proved to be the most difficult on the paper. Very few candidates realised the key assumption that ethanoic acid was the only acid in the vinegar. Most candidates responded with mistakes made in the procedure such as overshooting the end point, the meniscus not being read properly, faulty apparatus, etc.

Question 25

25(a)(i) Able candidates provided well-constructed and structured responses, which demonstrated their clear understanding of this key concept. Weaker candidates often responded in terms of bond making requiring energy and that breaking bonds releasing energy. Many responses referred to more bonds instead of more energy.

25(a)(ii) This question tested both chemical and mathematical ability. Two marks were available for calculating the energies involved in bond making and bond breaking. Many candidates miscounted the number of bonds involved in the calculation, especially for 3 × O=O and 4 × O–H. Candidates can avoid this error by drawing out each molecule and counting the bonds being broken and made. In calculating the bond enthalpy, weaker candidates often omitted the enthalpy change of reaction, –1318 kJ mol^{-1}, instead simply subtracting the energies already calculated for bonds broken and bonds made.

Answer: 612 kJ mol^{-1}

25(b) Most candidates realised the need to use the ideal gas equation. The equation was usually rearranged correctly, with substituted values for *p*, *V*, *R* and *T* being added. Pressure and volume were not always converted correctly into Pa and m^3, creating problems for subsequent parts. Many candidates attempted to convert from cm^3 to m^3 by multiplying by 10^{-3} rather than 10^{-6}.

Candidates usually obtained a value for *n*, although those who had struggled with unit conversion obtained values that differed by powers of 10. Finally, candidates needed to derive the molar mass using their value of *n* and the mass of the alkene. Some candidates over-rounded their value of *n*, introducing an error in calculating the molar mass. Surprisingly, an appreciable number of candidates wrote their value of *n* on the answer line rather than the molar mass indicated by the answer prompt. This suggested that some candidates do not understand the term molar mass.

Candidates who had obtained a molar mass of 70.0 usually determined that the alkene had the formula C_5H_{10}.

Answer: 70.0 g mol^{-1}

H032/02 Depth in chemistry

General Comments:

This is the second Depth in Chemistry paper for the revised AS examinations. It includes a number of short answer structured questions and two longer questions marked using level of response mark schemes. The paper tests knowledge of a wide variety of topics from the first four teaching modules in the specification and to achieve high marks, candidates require both sound mathematical skills and a good knowledge of practical procedures.

Not all candidates had prepared thoroughly for this examination and some questions presented in a format that had become familiar in papers from the legacy specification were poorly answered by a higher than expected proportion of candidates. Many scored poorly on questions that required the application of knowledge and understanding of chemical ideas, and on questions that required the development of a practical procedure.

Candidates were able to attempt all the calculations and most had learned a correct strategy for the calculation of enthalpy change and percentage yield. However, many lost marks when they presented intermediate values or final answers to an inappropriate number of significant figures. Please refer to the Mathematical Skills Handbook for Chemistry A, section M1.1 (http://www.ocr.org.uk/Images/295468-mathematical-skills-handbook.pdf) for guidance on using appropriate amount of significant figures.

There seemed to be quite a number of candidates who used additional sheets in spite of the availability of a page of additional answer space at the end of the paper. It is difficult to understand why some candidates used the first page of an additional answer booklet and left the additional answer space at the end of the paper blank. When used, the additional page usually provided ample space for any extended responses.

There was no evidence that any time constraints had led to candidates underperforming. However, there were a significant number of questions in which a small minority of candidates offered no response.

Comments on Individual Questions:

Question 1

1(a)(i) The specification describes ionic bonding as an electrostatic attraction and a small proportion of answers were missing this key phrase.

1(a)(ii) Covalent bonding diagrams were not common and this question was well answered by the vast majority of candidates.

1(a)(iii) Use of the relative mass of barium to calculate moles of barium oxide was a common error but these candidates were usually able to pick up one mark for correctly multiplying their moles by the Avogadro constant. Some candidates correctly calculated moles but then divided by two thus losing the final mark.

1(b)(i) Many precise answers gained full marks by describing the fixed position of ions in a lattice and the mobility of ions in aqueous solution. Delocalised or free electrons were occasionally mentioned. Vague answers often used the terms 'free' instead of mobile, 'charge carrier' instead of ion and 'carry a charge' instead of conduct electricity.

1(b)(ii) There was some confusion with the displacement reactions of halogens, the test for halide ions and the use of silver nitrate but the majority of students could recall the use of aqueous barium chloride to test for sulfate ions. Occasionally candidates described the use of dilute hydrochloric acid to remove carbonate ions from solution before their creditworthy description of the sulfate test.

1(b)(iii) Very well answered, the majority of candidates scored full marks for this simple calculation.

1(c)(i) Many incorrect answers but I am happy to report that the use of incorrect notation, mentioned in last year's report, was not an issue in the 2017 paper.

1(c)(ii) This question discriminated well and only the most able candidates were able to score full marks with a correctly balanced equation including state symbols. Weaker candidates were able to pick up some marks for identifying barium hydroxide or ammonia, although barium oxide and nitrogen were not uncommon. Some failed to score the more accessible marks because they used an incorrect formula instead of writing the name of the product.

Question 2

This question was marked using a level of response mark scheme and relatively few candidates were able to achieve Level 3. Many vague and rambling responses failed to mention the basic requirement to measure the volume of gas at regular time intervals. Some preferred to record the change in mass and ignored the diagram with a labelled gas syringe, while some carried out the experiment in a measuring cylinder. The question advises candidates to show working in their calculations but many omitted calculations from their answer. The question asked for an explanation of how the results could be processed graphically but this section was often lacking detail. Level 1 responses usually included the measurement and mixing of reactants and an attempt at processing the results by plotting a graph but further detail was missing. Candidates achieving Level 2 usually included a calculation of the moles of reactants and a more detailed description of how to process the results. Some excellent Level 3 responses included a full calculation of the mass of zinc and volume of hydrochloric acid required for the experiment.

Question 3

Q3(a)(i) A high proportion of candidates lost marks on this question for a variety of reasons including errors in the calculation of moles and/or energy change. Many candidates did not express their final answer to three significant figures and so failed to score the final mark. An incorrect or missing sign also resulted in loss of the final mark.

3(a)(ii) Almost all candidates scored at least one mark for this well-rehearsed practical question. There was some confusion regarding the use of average bond enthalpy values obtained from a data book which was not relevant to this question.

3(b)(i) Most, but not all, candidates were able to plot the value for butane accurately on the graph.

3(b)(ii) A good proportion of candidates scored full marks for their estimate but some did not extrapolate the line on the graph and many did not calculate the amount of pentane. This restricted their answer to an estimate of the energy released by one mole of pentane and this could only score one mark.

3(c) This calculation was generally well answered but there were a variety of errors that could lead to candidates scoring just one or two marks. These included incorrect signs associated with the data during the calculation, adding all the data together or missing out the sign associated with the final answer.

Question 4

4(a) Candidates did not cope well with the requirement to produce a hydrogen bonding diagram that was expected to match the content of all four of the bullet points listed in the question. Perhaps candidates did not read the question carefully enough but some diagrams did not include displayed formulae, dipoles were often missing from the methanol molecule, lone pairs were absent from oxygen atoms and the hydrogen bond was marked in an incorrect position. This resulted in a low scoring question for a diagram that had produced much higher scores when asked on papers from the legacy specification.

4(b)(i) 2-methylbutan-3-ol was a common incorrect answer.

4(b)(ii) Many candidates seemed unfamiliar with the analysis of fragmentation peaks in a mass spectrum. Some answer spaces were left blank and relatively few candidates scored both marks. The question asks for the structural formulae of the ions responsible for the peaks but a number of candidates presented molecular formulae and positive charges were often missing from structures.

4(c) A very wide range of responses was seen in the second question marked using a level of response mark scheme and a greater proportion of candidates were able to access the highest level in this question. Diagrams of a distillation apparatus were often disappointing and many poor answers failed to identify the oxidation products. A Level 1 response usually named the oxidising agent and included a crude diagram of a distillation apparatus. Diagrams in Level two responses often included more detail with a condenser cooled by water flow and an indication of where butanal can be collected. A Level three response was expected to include balanced equations for the oxidation reactions.

Question 5

5(a) The correct response; $C_nH_{2n}O_2$ or $C_nH_{2n+1}COOH$, was presented by a good proportion of candidates but many incorrect alternatives were seen.

5(b)(i) This question was poorly answered. Many candidates ignored the instruction to give the shape around the carbon atom in the alkyl group and instead focussed on the bond angle and shape around the carbonyl carbon. Even candidates who could identify the correct shape and bond angle did not explain that it is due to the repulsion between four bonding pairs.

5(b)(ii) Generally well answered but many examples of incorrect bond angles including 107, 120 and 180 were seen here.

5(c) Most candidates scored marks by identifying at least one of the bonds matched to characteristic infrared absorptions. The best answers gained full marks for a concise analysis of the infrared spectrum and two clearly drawn structures that could be inferred from their analysis. Incorrect structures included the carboxylic acid, esters, diols and alkenes.

5(d)(i) Most candidates scored this mark.

5(d)(ii) Many candidates could write the overall equation but there was some confusion with propagation steps and some equations contained radicals or missed out HCl as a product.

5(d)(iii) Homolytic fission is described in the specification in terms of each bonding atom receiving one electron from the bonded pair forming two radicals. A large proportion of candidates failed to match the essential points in this definition.

Q5(d)(iv) Generally well answered. Candidates took note of the instruction in the question and it was very rare to see radicals without their unpaired electron.

Q5(d)(v) Unfortunately, candidates who were not able to attempt equations for the propagation steps in part (iv) were then unable to suggest the structure of the radical formed in the first step. Many candidates did not present a fully displayed formula. However, formulae showing –OH were given credit in this question.

Q5(d)(vi) Generally well answered but it was clear from some of the structures drawn that some candidates did not understand what is meant by further substitution.

Question 6

Q6(a)(i) Candidates who were able to give the structure of the intermediate were not always able to state the conditions for the elimination of water from an alcohol. The presence of an acid catalyst and heat are stated in the specification. Some candidates confused this reaction with addition reactions of alkenes suggesting that a Ni catalyst or the presence of steam is required.

Q6(a)(ii) Although some candidates simply calculated 1.23/5.50, most followed an effective strategy for the calculation of percentage yield. Many gained full marks but a large number of candidates relied on the application of error carried forward when they made one or more careless errors during the calculation of molar mass and/or moles. Intermediate answers were sometimes rounded to 2 significant figures and marks were lost by candidates who presented their final answer to 2 or 4 significant figures.

Q6(b) The precise setting out of a reaction mechanism was a skill that a good number of candidates have mastered with many accurate mechanisms being drawn. Others need more time to develop these skills; many errors being made with the position of dipoles and curly arrows. Despite making errors in the mechanism, many achieved one mark for drawing a correct final structure.

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