Rewarding Learning

GCE Chemistry
(January Series) 2011

Chief Examiner's Report

chemistry

Foreword

This booklet contains the Chief Examiner's Report for CCEA's General Certificate of Education (GCE) in Chemistry from the January Series 2011.

CCEA's examining teams produce these detailed reports outlining the performance of candidates in all aspects of the qualification in this series. These reports allow the examining team an opportunity to promote best practice and offer helpful hints whilst also presenting a forum to highlight any areas for improvement.

CCEA hopes that the Chief Examiner Reports will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This report forms part of the suite of support materials for the specification. Further materials are available from the specification's microsite on our website at www.ccea.org.uk

Contents

Subject Code 1110
QAN 500/2495/4
QAN 500/2494/2

GCE CHEMISTRY

Chief Examiner's Report

Grade boundaries

AS Units 1 and 2	
Weighting 17.5%	
Maximum Uniform Mark 105	
A	84
B	74
C	63
D	53
E	42

A2 Unit 1	
Weighting 20%	
Maximum Uniform Mark 120	
A*	108
A	96
B	84
C	72
D	60
E	48

Assessment Unit AS 1 Basic Concepts in Physical and Inorganic Chemistry

Q11 **(a)** Candidates had few problems in converting the value of 305 kJ into Joules. A handful of incorrect calculations were seen.

(b) The rest of Q11 caused severe problems for candidates which was entirely unexpected and gave the impression that the examination was far more difficult than the rest of the paper proved it to be. Many candidates did not even use the Avogadro number and those that did often used it incorrectly by multiplying by the number rather than dividing by it.

(c) Even though errors are carried through and they would have been from part (b) to part (c) this was often done with errors being made. Very few candidates indeed obtained a total of three marks for Q11.

Q12 **(a)** It has been stated before, and again it is mentioned, that those candidates who provide the full calculation can be rewarded if errors are made because they can be seen. Fortunately the vast majority obtained the three marks for this calculation. It was very rare to see atomic numbers used and the main error was to use the wrong number of lithium atoms.

(b) **(i)** The response to this question was very good with the mark being obtained. Naturally the major errors were using the Be^{+} ion and taking electrons away rather than adding them to the ion.

(ii) Similar comments apply to part (ii) as to part (i) with regard to valency rules. Strange equations were seen e.g.

$BeF_2 + Mg \rightarrow BeMg + F_2$

If this had been marked "left and right" then it would have gained one mark for the left hand side but unfortunately this was not the case!

(c) **(i)** One interesting feature of this examination was the success achieved with reproducing the demands required by the specification. Such an example was the definition of the term electronegativity. Many answers obtained two marks and very few obtained zero.

(ii) This question was unique to the examination and required candidates to apply their understanding of the role of electronegativity in the formation of molecules. It proved to be very difficult. The major problem was that candidates wished to compare beryllium with barium and not to compare the metals with chlorine itself.

(iii) The question was straightforwardly stated. Physical properties were required but they were not always given without reference to the metal chlorides themselves. Consequently if the properties were mentioned without reference to the individual metals then the marks were earned but if the property was inappropriate to the compound stated then the mark was lost. On the whole the marks were lost.

(d) **(i)** The equation was correctly deduced by the majority of candidates.

(ii) There is always the problem of knowing whether to draw the covalent or the ionic compound. In this situation it is mentioned in the specification that beryllium chloride is covalent but this was not known by a significant number of candidates. There were many examples where the covalent structure was given then followed by the ionic structure.

(iii) The octet rule was well known. It was stated involving either outer electron shells or valence shell.

(iv) There was the difficulty of following any error made with the structure of beryllium in part (iii) to part (iv). Whilst the examiners were prepared to carry the error through this was not often done by the candidates. However, there were few difficulties experienced with the chloride structure which followed naturally from the definition of the octet rule.

(v) The shape of the beryllium chloride molecule was inevitably drawn as a straight line i.e. linear.

(vi) The name of the shape followed naturally from part (v).

(vii) Over the years the reasons for the structure of molecules has been well understood. It was quite a revelation that the structure drawn in the earlier parts as ionic were inevitably drawn as covalent in this part of the question paper. Almost without exception reference was made to electrons rather than atoms in the determination of the structure. Sometimes it was vague as the electrons could have been bonding or non-bonding. But success was far better than expected.

Q13 **(a)** Surprisingly, the systematic name of chlorine heptoxide was very badly done. A common error was to name the oxide as chlorine(VI) oxide but even more common was to name it as chlorine(VII) heptoxide. The correct answer of chlorine(VII) oxide was very rarely seen.

(b) Disproportionation is a very frequently asked question in AS chemistry examinations. As a consequence the success rate is very high. There are a few who cannot calculate the oxidation numbers. As usual the major error was not always linking the oxidation number change to oxidation or reduction.

(c) The molarity of the chlorine water was a straightforward calculation that produced two marks for virtually all candidates except those who ignored the given formula of Cl_2 and used Cl instead in their calculation. Any candidate who used the number 24 was vastly wrong and scored zero.

Q14 **(a)** This was a relatively simple question and it proved to be so.

(b) **(i)** For this examination series the new colour changes applied. Hence any reference to the colour of bromine solution as being red or red-brown was incorrect. Originally it was thought that candidates would say that the solution would become darker but this answer was not seen in the examination. Despite the help of the colour change guide it was not a well done question.

(ii) Candidates often have problems with ionic equations and this was the case with this particular equation. Either the ionic equation was not attempted or the one presented was badly wrong with incorrect species.

(c) **(i)** The original solution needed to be colourless or green but these colours were rarely stated. The final colour of yellow or brown etc was the more frequent colour seen.

(ii) This non-ionic equation was better known than the ionic equation expected in part (b)(ii).

(d) This was one of the easier "quality of written communication" questions asked for some considerable time and it was the common practice for candidates to obtain full marks. Weaker candidates tended to mix up the colours of the precipitates and to add ammonia at the same time as silver nitrate. However the most common error was to regard the solutions as those of chlorine rather than chloride etc.

Q15 **(a)** The missing intermolecular forces were well know as van der Waals and dipole-dipole. The only variation in this was the mention of dipole forces.

(b) **(i)** After some considerable deliberation it was decided that there needed to be a very full definition of the meaning of a hydrogen bond for the two marks to be awarded. Hence it will be seen from the mark scheme that the answer involved the attraction of the lone pair on an oxygen atom for the hydrogen on another water molecule. Omission of any one point led to the loss of a mark and consequently there were very few candidates scoring maximum marks. The most common mark was one.

(ii) There are a variety of answers in text books to explain why ice has a lower density than water. Thankfully there were very few answers which wished to give a "physics" answer by defining density. A variety of answers were accepted but they had to involve some chemistry rather than just concentrating on the fact that the molecules were further apart. Hence better answers which mentioned the role of hydrogen bonds were rewarded more although the mark scheme reveals what was acceptable.

(c) This question involving fluorine was a new question and candidates' answers needed to be seen before final decisions were made. Answers did not follow the expected lines. Answers should have been based on the greater electronegativity of fluorine compared to oxygen but this was rarely mentioned. The shape of the water molecule was mentioned but the reasons affecting the bonding were not.

(d) **(i)** Most candidates obtained one mark because the lone pair was not involved in the formation of the hydrogen bond. Even when the lone pair was drawn it was often not involved in forming the hydrogen bond.

(ii) Candidates were able to deduce that the reason for the lack of reaction was the disappearance of the lone pair often by the formation of the dative bond.

Q16 **(a)** It was quite a surprise to see the poor performance of candidates with what should have been previously learnt basic knowledge. Unfortunately many candidates did not read the question carefully enough and the sub-atomic particles were not labelled. Sometimes the protons and neutrons simply formed the nucleus without any further explanation. However, the electrons were the worst drawn and often did not even number three in total.

(b) The definition of an s-block element was well understood by the great majority of candidates.

(c) The calculation was done successfully by virtually all candidates. There were hardly any problems with recording the value to two decimal places.

(d) **(i)** Most of the text books agree that water of crystallisation is chemically bonded and this was the definition required. Very few candidates obtained the mark.

(ii) The formula for lithium sulfate should have been better known than it was. $LiSO_4$ was popular but so were many formulae incorporating water.

(iii) Candidates often recovered by carrying the error through and were able to obtain marks in part (iii). However, there were a considerable number of errors made by using the wrong masses of water in the calculation. Full marks were rare.

(e) The flame test was not as well known as might have been expected. Naturally there were many candidates who stated that the flame colour would be red but now only crimson is accepted. It is important to state that concentrated hydrochloric acid is used as the dilute acid is never used. Hence some candidates wrote quite good answers but did not obtain the expected marks.

Assessment Unit AS 2 Further Physical and Inorganic Chemistry and Introduction to Organic Chemistry

The paper was successful in allowing the vast majority of candidates to attempt all of the questions. The range of questions allowed for differing abilities among the candidates and discriminated between the most able and the least able candidates. There was a bunching of candidate performance, as always, in the mid-range of the marks. The mark scheme was easy to follow. The candidates appeared to have ample time to complete the paper.

Q11 **(a)** **(i)** This was extremely well answered with few mistakes, an easy introduction to the paper.

(ii) This was generally well answered with the most common mistake was the labelling of the y-axis as ΔH or enthalpy change instead of H or enthalpy.

(iii) This was generally well answered although some candidates failed to use the molar ratio from the equation. Some candidates were penalised for incorrect rounding.

(b) **(i)** Most candidates were able to give the correct equation, did not recognise this as combustion and failed to use oxygen in the equation.

(ii) Less well answered with a number of candidates unable to work out the formula of nitrogen(II) oxide.

Q12 **(a)** This question has been asked before and was well answered, although a few failed to state that the **outer electrons** are in the s-subshell.

(b) **(i)** Again this has been asked a number of times and should be well known. The same mistakes are still appearing regarding the state symbols, gaining an electron and an incorrect charge on the ion.

(ii) This was generally well answered with evidence that candidates had used previous mark schemes in their preparation. A number of candidates lost a mark by failing to refer to the outer electron in their answer and simply referring to electrons.

(c) **(i)** Whilst the majority of candidates gained this mark it was disappointing to note the number of candidates who did not know the formula of calcium hydroxide.

(ii) Many of the candidates failed to give the correct stability trend and so gained no marks. Explanations often did not refer to the change in polarising power of the cation. There were also issues of incorrect terminology e.g. use of atom instead of ion and also referring to magnesium instead of magnesium hydroxide.

(iii) Candidates often failed to state the change in pH, instead using the terms acidic or alkaline. Many candidates failed to realise that the question related to the change in solubility. Few candidates gained both marks.

Q13 **(a)** This was very well answered although a small number of candidates referred to cracking instead of fractional distillation.

(b) **(i)** Most candidates were able to give satisfactory answer to both parts of the question. A few candidates lost a mark for not using the word **only** when describing hydrocarbons.

(ii) Few candidates were able to give the correct name with a number using 'quad' in place of 'tetra'.

(c) **(i)** This was correctly answered by the vast majority of the candidates.

(ii) This was generally well answered although a number of candidates simply referred to heat as opposed to a high temperature. At this level candidates should know that 'heat' is too vague a term to use when answering questions of this nature.

(iii) This equation was generally well answered.

(iv) This test is well known and was well answered by the majority of the candidates. A small number of candidates are still describing bromine water as red-brown despite the guidance given on the acceptable colours document.

(v) This equation is generally well known and was given correctly. A number of candidates inexplicably used hydrogen bromide in the equation despite using bromine water correctly in the previous part of the question.

(d) Many candidates thought it enough to state that alkenes have a C=C and failed to explain the reactivity in terms of the high electron density around the double bond as noted on the syllabus.

(e) **(i)** This mechanism is generally well known and most candidates were able to gain some marks. Candidates should note that the use of 'curly arrows' is not required on the syllabus but where they are used they should be used correctly.

(ii) There were the usual mistakes on naming the mechanism but the majority of candidates were able to gain both marks.

Q14 This question proved to be the most difficult on the paper with very few candidates gaining full marks and the vast majority gaining only one or two marks.

(a) **(i)** This was poorly answered with many candidates using -0.9 instead of 0.9 for the temperature change and so giving a negative enthalpy change instead of a positive value. Many candidates also gave incorrect units as J/mol or kJ/mol.

(ii) It was disappointing how many candidates could not calculate the relative formula mass of ammonium nitrate, even when they knew the correct formula.

(iii) The errors from the previous parts were carried through enabling some candidates to gain a mark.

(b) Very poorly answered with most candidates failing to recognise that the question could be answered by using simple proportions.

Q15 This question was generally poorly answered as candidates failed to explain the changes as required by the question. They often explained the effect on either the rate or the yield but not both. It is not sufficient to state 'to counteract the change' or 'move to right/left hand side'.

(a) Candidates generally explained the effect on the rate well but the effect on the yield was poorly explained.

(b) The effect on the rate of increasing the concentration of the nitrogen was poorly explained. Candidates were able to give better explanations of the effect on the yield.

(c) The effect of increasing the pressure on the rate was poorly answered; the effect on the yield was generally well understood.

(d) The effect of the catalyst on the rate was well explained but few candidates gave a satisfactory explanation of the effect on the yield.

Q16 **(a)** **(i)** This question was generally well answered with many candidates even giving descriptions of the bending and stretching of the bonds.

(ii) The interpretation of the spectra was poor with few candidates gaining both marks. Many simply appeared to refer to the table without using their knowledge of the structure of the molecules involved.

(iii) Few candidates were able to correctly identify both spectra, failing to use the information they should have gained in the previous part.

(b) **(i)** Many candidates failed to include the acid in the oxidising agent.

(ii) The formula of the ion, Cr^{3+}, was not well known.

(iii) Many candidates were unable to give the correct techniques and simply stated oxidation. A few candidates gave distillation or refluxing for both parts and so gained one mark.

(c) This was generally well answered although there were some problems with the formula of the ester.

Q17 **(a)** **(i)** Many of the candidates gained the mark for this question. A number of candidates gave NaBr or KBr without the use of the acid and so gained no mark.

(ii) The reaction mechanism was generally well known, although the usual mistakes did appear.

(iii) The conditions for the reaction were not well known. Reflux was often used despite the fact that this would allow the ammonia to escape from the reaction vessel.

(b) This was very poorly answered with a significant number of candidates describing recrystallisation despite being told that the product was a liquid in the question. The examining team decided allow marks for QWC in this case as a purification technique was being described.

Detailed explanations are required for each of the stages as this process has been asked before and the mark scheme was strictly applied.

Assessment Unit A2 1 Periodic Trends and Further Organic, Physical and Inorganic Chemistry

The paper was successful in allowing candidates of differing abilities to respond positively to the questions posed. Statistics indicate that in most Section A questions more than 50% of the responses were correct.

Q11 Candidates performed very well in this question. Many Grade E candidates scored 5, 6 or 7 out of the 8 available marks. Candidates should be advised on the importance of including units with the values for ΔH, ΔS and ΔG.

Q12 This question showed a much more significant range of scores. Some of the definitions of lattice enthalpy were very poor with no marks scored. In the calculation of lattice enthalpy many candidates did not double the electron affinity or the atomisation enthalpy of fluorine. Too many candidates included diagrams with magnesium fluoride shown as a covalent molecule. In the final calculation many candidates did not double the hydration enthalpy of the chloride ion.

Q13 In general the answers to this question were of a high standard. However, some candidates lost very easy marks. The name of the product proved challenging for many. Greater care should be taken when using 3D representations. Wedges and dashed lines should be adjacent. The mechanism was well done by the strongest candidates but many others were only scoring 1 or 2. The geometric isomers were well drawn but not well labelled. Greater emphasis on how to prioritise the groups and decide which isomer is E and which is Z is needed.

Q14 Many definitions for the term buffer solution indicated that the pH remains constant rather than approximately constant or resists change in pH. Part (a)(iv) proved to be very discriminating. Part (b) was well done by many although even in part (ii) easy marks were being lost.

Q15 This question showed a significant range of scores. The systematic name for glycerol was often incorrect. Serious errors were often evident in the structure of the oil. The definitions of iodine value were often incomplete and lacking in essential detail. Part (a)(v) highlighted that many candidates did not really appreciate the significance of the iodine value in terms of the structure of the oil i.e. the degree of unsaturation. 2-methylbutanoic acid was a common

incorrect name and water was often missing in the esterification equation. The answers in (b)(iii) often lacked detail and resulted in the loss of easy marks. An incorrect sequence of steps was often an issue.

Q16 There was a wide range of marks in the final question. Part (c) exposed a lack of knowledge of the greenhouse effect for many candidates.

Contact details

The following information provides contact details for key staff members:

- Specification Support Officer: Nuala Braniff
  (telephone: (028) 9026 1200, extension 2292, email: nbraniff@ccea.org.uk)
- Officer with Subject Responsibility: Patricia Quinn
  (telephone: (028) 9026 1200, extension 2267, email: pquinn@ccea.org.uk)