

CCEA GCE - Chemistry
(Summer Series) 2012

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 Summer Series 2012.

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's/Report 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

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

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GCE CHEMISTRY

Chief Examiner's Report

Assessment Unit AS 1 Basic Concepts in Physical and Inorganic Chemistry

The paper appeared very straightforward and the average mark was the highest seen in recent years. The vast majority of candidates were able to attempt all the questions.

Definitions were not well known and loosely presented but the production of a list of definitions for future examinations should help.

Q11 All of the questions in part (a) were well answered but candidates often violated the question as asked i.e. that the definitions should be in terms of protons, neutrons and electrons. This was allowed if the answer was correct even though it might involve a previous definition that had involved the sub-atomic particles listed.

(a) (i) The atomic number definition was well known but a minority of candidates should be aware that stating the number of protons + electrons is ambiguous and that the number of protons or electrons is not. The former did not gain the mark but the latter did.

(ii) Mass number did not have the same problem as part (i) because the word *and* was needed and was given.

(iii) All the definitions of isotopes were given and were accepted because of what was said earlier. The most common one seen and accepted was that the number of protons is the same but the number of neutrons is different.

(b) (i) This question was well answered but a very small minority had some confusion with the number of neutrons in the chloride ion. The answer 17.5 was frequently seen for the number of neutrons in the chloride ion.

Although it might have been thought that the number of electrons would have been affected, this, with the protons, was the best part of the question answered.

(ii) There was no need for a "carry error through of marks" because the previous answers did not usually affect the answers to part (ii).

(iii) There were many hints that magnesium chloride was ionic in part (b), hence it was thought that there would be no problem with the production of covalent dot cross structure in part (iii) but they were seen. Yet they were rarer than ever seen before.

There were the usual problems seen with all crosses or all dots but they did appear to be less.

(c) (i) It was a slight surprise but not unexpected that although the correct equation had been given in part (ii), it was not reproduced in part (i). There were problems with candidates saying that an *electron* was removed from a mole of unipositive ions and there were also further

problems with the use of +1 rather than 1+ and with +2 rather than 2+. Overall the response to the question was impressive.

- (ii) The equation was well written with most candidates securing the two marks available. Problems with balancing the equation were very few.
- (iii) Candidates' responses to the reasons for the third ionisation energy of magnesium being much larger than the second followed the specification well. There were three marks available for full shell, less shielding and closeness of electrons to the nucleus. The question proved discriminating because not all candidates provided all of these three items.
- (d) This question has been asked for many years. A slight change to the mark scheme was to say that the energy emitted should be in the form of light. This meant that there was a basic need to mention energy three times although alternatives were seen such as "excited". Candidates usually obtained the three marks but there were still problems with candidates stating that the electrons in *strontium* were excited to a higher energy level.

Q12

- (a) This was possibly the most difficult question for candidates of the whole paper. Despite this being a definite area of the specification, candidates wished to use a wide range of definitions such as "the number of particles found in one mole of substance."
 Very few candidates gave the accepted definition based upon the carbon -12 atom.
- (b)
 - (i) The simple calculation involved in the deduction of 46 g as the molar mass of the oxide of nitrogen proved quite discriminating. Only about half the candidature secured the correct answer.
 - (ii) Nitrogen dioxide was a popular answer even for those who could not work out the molar mass of the oxide. But, what was more surprising, was the fact that even transition metals were quoted as having a molar mass of 46.
- (c) The equation for the reaction of dinitrogen tetroxide with water was very demanding for candidates and proved to be very discriminating. Less than half of the candidates obtained the correct equation.
- (d) Candidates tackled the whole of part (d) with some confidence. Most candidates obtained the maximum mark of five and even if an error was made, it was possible to carry it forward so that all the possible marks were obtained. Indeed, this was a feature of this particular examination that the structured calculations were carried out so successfully.

Q13

Mention was made of the success of structured calculations in Q12. The success was continued in question 13. But, also, the answers to part (a) were equally successful and both the definition of standard solution and the indicator for the titration were both well known.

Most candidates obtained 12 marks for Q13.

Q14

- (a) Recently the colours of the compounds and elements mentioned in the AS specification were detailed in a publication presented on the web site and circulated to all centres. In this publication, mention was carefully made of the

colours of the halogens both as elements and in solution. But, the essential feature presented was the use of the hyphen and the oblique slash. Hence, if iodine was described as grey-black it meant that iodine was a mixture of grey and black. If iodine was described as grey/black it meant that iodine was either grey or black. In the description of colours iodine is not grey. Hence the writing of grey or grey/black was incorrect.

Sadly this advice in the 'Acceptable Colours' document was not well followed and many candidates who obviously knew the colours did not write them down correctly and consequently lost the marks available.

In the case of chlorine the colour green was acceptable and as it was not linked to any other colour it was accepted.

- (b) (i) The chemistry of the reaction of silver nitrate with halide ions was well known and this question was well tackled by all candidates. There was a problem with the use of ammonia. Quite a few candidates used the term excess ammonia rather than dilute or concentrated and some did not even describe the concentration of the ammonia solution. However, marks were freely obtained.
- (ii) There were a variety of answers, many of which did not contain ions. A balanced ionic equation was in the minority.
- (c) (i) Although this is a frequently asked question in chemistry examinations, it is still surprising how many candidates manage to get the reaction of sodium chloride with sulfuric acid wrong. However, the majority still write it correctly.
- (ii) The mark scheme allowed one mark for the writing of the unbalanced equation which meant that most candidates gained a mark but only the better candidates were able to balance the equation.
- (iii) Similarly with part (iii) it was far easier to write the correct species rather than to balance the equation.
- (iv) Hydrogen sulfide is often associated with the smell of rotten eggs but this was not as popular as might have been expected. Sometimes the smell was given as that of eggs or even as pungent but many answers described fumes and even white precipitates or effervescence.
- (v) The other reduction products were not well known, it was very rare to see two sulfur compounds mentioned. A whole variety of compounds were mentioned involving iodine, water, sodium chloride and even compounds that could not possibly have been formed from the compounds stated.
- (vi) This was a new question and was not well understood. Often answers were long but did not deal in any way with the detail required to answer the question asked. Often there was mention of atomic or ionic radius but it was not related to the distance of the outer electrons from the nucleus. Yet, there were a small minority of exactly correct answers.
- (d) (i) The equation for the reaction of chlorine with hot concentrated sodium hydroxide solution was generally well known but inevitably was frequently confused with that for the cold dilute solution.

- (ii) Although the name for the type of reaction was well known by the majority of candidates there was quite a variety of different spellings for the actual name, disproportionation. Most of the time the start of the word was correct but the finish was often a distortion of the expected word.
- Q15**
- (a) Naturally, the dot and cross structure of water posed few problems for candidates but it should be realised that a dot and cross diagram excludes the use of internal electrons which were used by a very small minority of candidates.
- (b) (i) The bond angle for water was expected to be given between 104–105° and very few values were outside this limit.
- (ii) The shape of the water molecule was limited to a narrow list of definitions. Although non-linear was frequently given, it was not acceptable.
- The reason for water adopting the shape that it does was quite a simple one based upon the repulsion between the electron pairs. However, candidates tended to give a list of the strength of the repulsion between lone pairs and bond pairs which was not required but still gained the two marks available.
- (iii) Either candidates stated that methane contained just bonded pairs or that it contained no lone pairs. Both were popular and correct answers.
- (c) The first mark for stating that water had hydrogen bonding was easily obtained but the second mark concerning the intermolecular forces in hydrogen sulfide was far more difficult. Inevitably candidates said that hydrogen sulfide had van der Waals forces and completely ignored the fact that dipole-dipole forces were the most important.

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

This paper was generally well answered with candidates performing to a similar level as the previous June's AS 2 paper.

The paper rewarded those who had learned the factual material and were able to apply this knowledge. The paper gave all candidates an opportunity to answer at least some of the questions. All questions were answered correctly by at least a few of the candidates.

Q11 This question proved to be a straight forward start to Section B.

- (a) Many candidates gained full marks in this section and most gained at least 3 out of the 6 marks available. The most common mistakes were:
- the incorrect calculation of the relative formula mass in parts (i) and (iii);
 - the incorrect calculation of the mass of ethanoic anhydride from its density; and
 - incorrect rounding – the examiners have stated previously that candidates must use correct rounding in calculations. Although not an essential requirement, examiners would suggest

that candidates should correctly round to three decimal places where possible. Candidates were only penalised once for incorrect rounding in this question.

- (b) Whilst many candidates understood what was meant by atom economy, evidenced by their ability to calculate it in part (ii), they had difficulty in expressing it in part (i). Many simply described atom economy as the efficiency of the reaction, which was too vague. The examiners required the use of mass/relative formula mass of the desired product compared to the total mass/relative formula mass of the reactants/products. A number of candidates incorrectly compared the number of atoms.

Q12 This question was generally well answered with many candidates gaining high marks although marks were lost through poor expression and failure to complete the answer in the detail required.

- (a) (i) It was surprising how many candidates were unable to name this correctly. The spelling of Boltzman proved problematic for some and a variety of spellings were seen. A number of candidates appeared to think it was an energy level diagram.
- (ii) Most candidates gained at least 1 mark and many gained both marks.
- (iii) Most candidates gained at least one mark for identifying that more particles had energy greater than the activation energy but often they failed to extend the answer to explain that this would result in more successful collisions, simply stating there would be more collisions.
- (iv) This was well answered with most candidates gaining both marks. Some candidates correctly identified that the endothermic process was favoured and then either failed to name which this was or incorrectly gave it as the forward reaction.
- (b) (i) Some candidates confused this with the equilibrium and failed to answer the question. Most candidates did answer the question correctly and gained both marks.
- (ii) This was very well known and the best answered section of this question. The vast majority of candidates gained both marks.
- (c) (i) Most candidates correctly identified lowering of the activation energy but then failed to state that more of the collisions would be successful, instead incorrectly stating that there would be more collisions.
- (ii) Most candidates recognised that the catalyst would not affect the yield of the nitrogen(II) oxide. Only a few candidates were able to state that the forward and reverse reactions would be sped up equally.

Q13 This question was reasonably well answered but the drawing of the polymer, in particular, was disappointing.

- (a) (i) Candidates generally gained a mark for correctly comparing the bond length and bond strength. A small number of candidates answered the remainder of the question correctly but failed to compare both the bond length and bond strength.
- (ii) Candidates often failed to answer this question in terms of electron density and electrophiles. Many gained a mark for identifying the high electron density of the double bond.

- (iii) The test for unsaturation is well known. Some candidates are still describing bromine water as red-brown despite the acceptable colours list.
- (b) (i) This was generally well answered. A few candidates used cis/trans notation instead of E-Z. A combination of both was seen and accepted provided they were used correctly.
- (ii) Most candidates were able to identify the restriction to rotation for 1 mark but few identified the different groups on the carbon atoms of the double bond for the second mark.
- (c) (i) Most candidates correctly gave addition polymerisation but a few are still incorrectly using additional polymerisation.
- (ii) Few candidates were able to draw this correctly and the standard of the structures was generally very disappointing.

Q14 This question was generally well answered with most of the sections being familiar from previous years.

- (a) Most candidates were able to complete the equation correctly. The most common mistakes were in the formula of sodium carbonate and/or sodium sulfide.
 - (b) (i) This equation was also well written. Some candidates included oxygen in the equation, presumably mistaking this for combustion rather than decomposition despite this being in the stem of the question.
 - (ii) This proved to be the most difficult question on the paper. Despite the familiarity of the use of coke in the blast furnace at GCSE, few candidates were able to identify the combustion of the coke as the source of heat for the decomposition.
 - (iii) This question was familiar from previous years and most candidates gained a mark for correctly identifying the trend. Some candidates incorrectly compared the size of the barium carbonate and calcium carbonate or the barium and calcium atoms instead of the ions and were penalised accordingly.
 - (iv) The description of the flame test is now well known and most candidates gained high marks in this question. The most common mistakes were the lack of **concentrated** hydrochloric acid and incorrect flame colours. The acceptable colours list gives the barium flame as green and therefore the use of apple green or any other shade of green is incorrect.
- (c) Some candidates appeared to think that all that was required was the test for carbonate/hydrogencarbonate, i.e. the use of hydrochloric acid and lime water to test for carbon dioxide. When describing precipitation tests such as this, candidates must make solutions of the solids before carrying out the test. Despite this having appeared in previous mark schemes candidates are still answering this poorly. A few candidates thought that hydrogen would be given off by the sodium hydrogencarbonate.

Q15 A few candidates showed excellent knowledge of the organic chemistry involved in the question. This question proved difficult for the weaker candidates. The calculations in parts (c)(iii) and (d)(ii) were generally well done.

- (a) (i) Most candidates were able to give one condition for the fermentation but few were able to gain both marks. Yeast often appeared as a condition despite the bacterium being named in the stem.
- (ii) This was very well answered by all candidates. A small number of candidates suggested filtering.
- (b) (i) The systematic names were generally well answered. Any error in naming **A** was carried through.
- (ii) A few candidates answered this question extremely well and gained full marks. Most candidates gained at least 2 or 3 marks. A small number of candidates appeared to think that iodoform was a reagent used in the test rather than the product of the test.
- (iii) Some candidates compared butan-1-ol and butan-2-ol rather than **A** and **B**. Most candidates gained 1 or 2 marks. The most common mistake was the omission of acid when describing the use of sodium/potassium dichromate. The colour change was well known.
- (c) (i) The examiners accepted a variety of answers for the term 'alternative fuel' and this enabled most candidates to gain the mark.
- (ii) This calculation was generally well done with many candidates gaining full marks. The most common mistakes were the incorrect sign for the enthalpy change and the failure to use molar quantities in the calculation.
- (iii) Disappointingly many candidates did not know the standard conditions. Standard pressure was better known than standard temperature which was often given as room temperature or 20°C.
- (iv) Most candidates recognised that oxygen is an element and correctly answered the question.
- (d) (i) Most candidates gained a mark for describing the breaking of a bond. Some candidates incorrectly described the making or breaking of a bond. Only a small number of candidates were able to gain the second mark as descriptions of the bond broken were often vague.
- (ii) This calculation was generally well done with many gaining full marks. Any errors were carried through so most candidates gained at least 1 or 2 marks. The most common errors were the omission of some bonds in the calculation or the incorrect sign for the enthalpy change.
- (iii) This question was correctly answered by the majority of candidates. A sizable proportion of the candidates incorrectly thought that the difference was due to experimental error.

Assessment Unit AS 3 Internal Assessment

Paper 1

- Q1** (a) The preparation of a solution of the “organic acid” using a set volume of the acid which had a density of 0.80 g cm^{-3} proved to be very discriminating because of the added demand of performing a calculation. Only the stronger candidates managed to obtain the two marks available for the calculation, largely because of the difficulty of making sense of the amount needed for the 250 cm^3 graduated flask. There was the added problem that the concentration of the solution was given as 7.4 g dm^{-3} but the density was in g cm^{-3} .

Naturally, candidates were led into the expectation that the volume of acid had to be calculated and then added to the volumetric flask. However, those that chose to weigh the acid were not incorrect and were awarded the marks available. A problem arose when candidates wished to add a volume of acid that was measured to three decimal places using a 25 cm^3 pipette. This was obviously incorrect. However, the use of a graduated pipette was quite acceptable. Certainly some confusion was created with regard to the method used to add small volumes.

Making the solution up to the mark and shaking the flask was well known.

- (b) The titration and the presentation of results in a suitable table and the calculation of the average titre were all done well. Certain aspects of the mark scheme were not brought into operation this year and will be expected next year. Whatever rules are laid down for the presentation of results there are always examples presented that defy the mark scheme with regard to the type of table or lack of table presented.

However, the application of the marking rule for those that presented three or more accurate values for the titration worked well. Titration accuracies were well in accordance with the supervisors' values.

- (c) The colour change at the end point of the titration was given correctly by the vast majority of the candidates. Only one mark was available and hence the colours given in the incorrect order did not receive the mark.
- (d) Whilst the equation for the reaction of the carboxylic acid, RCOOH , with the sodium hydroxide was well done by most of the candidates, there were some very strange answers from weaker candidates. Although RCOONa was the accepted answer there were formulae including, NaRCOO . The weakest answers produced hydrogen and a variety of products. Water was usually included as a product.
- (e) The calculation of the molarity of the acid solution used in the titration varied. Either the answer was left as the number of moles in 25 cm^3 of solution or the full molarity of the solution was calculated. Most candidates made some progress on this question.
- (f) (i) As mentioned in part (e) the molarity was calculated in two different ways but whichever calculation was used it was normally successfully carried through to this part to calculate the relative formula mass of the acid.

However, there was a sizeable number of candidates that simply had to guess the answer and work backwards from what was a “correct” answer for the value of R. Hence there were often spurious numbers presented and then finally a very suitable value of R appeared. Candidates would appear to be well skilled in the art of carrying errors through and whatever value of R would then be used in part (ii).

- (ii) The formula of the alkyl group, R, of the acid, whatever the value calculated in part (i) was carried through. What was utterly surprising was the significant number of candidates, by this stage had lost track of what R was and gave R as a transition metal compound presumably thinking that they were calculating a relative atomic mass. This just meant that the carry error through facility had finished.
- (iii) The problem for some candidates in using the identity of R to deduce the formula of the acid, RCOOH was that they did not appreciate that R had to actually be an alkyl group. For example, if R had a value of 31 it would be given the formula of C_2H_7 and the acid the formula C_2H_7COOH which was incorrect. Sometimes the alkyl group was left on its own as the answer.

- Q2** (a) It was mentioned that one of the salts was soluble in water and the other was insoluble but this was not always fully appreciated.
- Test 1** The appearance of **A** was appreciated but there are still too many candidates who write transition metal/element present rather than ion.
- Test 2(a)** There was a poor response by candidates to what was expected by the question. It was expected that candidates would have mentioned what the filtration process had achieved but unfortunately they did not. Eventually the mark scheme was modified to basically reward those that said that one substance dissolved and the other did not which was not what was intended by the question as set. Furthermore there were far too many candidates who stated that a “cloudy” green “solution” was produced and then went on to give the correct explanation. It was not very easy to award marks in this situation.
- Test 2(b)** The test for a chloride was better answered than usual without the problem of the cream/white/off-white situation mixing it up with the test for bromide.
- Test 2(c)** The flame test posed problems for some candidates. Despite the fact that the great majority correctly stated the correct flame colour for sodium as expected there were quite a few who insisted that copper ions were present. Occasionally the colour was on its own but often it was mixed with the orange or yellow of the sodium. This was a surprise. Could it be that some candidates did not know the meaning of filtrate? It would appear so.
- Test 3(a)** Candidates realised that the mixture fizzed with nitric acid and gave an appropriate comment. The comment with regard to the colour was more variable but was normally correct.

Test 3(b) The test with limewater caused a few problems because of the acceptable colours list which stated the expected result for the limewater test. Of course there are many variations and the list includes chalky, white, milky etc. but only those listed were accepted.

The conclusion initially expected was that the deduction of a hydrogencarbonate would be incorrect because all hydrogencarbonates are soluble and this should have been the copper compound. However, in view of the fact that candidates might not be expected to know this fact despite the test for carbonate and hydrogencarbonate in the specification, a deduction of either carbonate or hydrogencarbonate was allowed.

Test 3(c) The mark scheme was very specific in the award of the three marks i.e. the colour of the initial precipitate, the fact that it dissolved and the final colour produced. Candidates provided these three facts regularly but the minority confused blue and green and did not deal with the word 'dissolved' correctly, they might have said "formed a solution" which is a conclusion/deduction.

The naming of the salts caused problems for those who favoured soluble copper compounds such as the hydrogencarbonate because at the end of the day one salt was soluble and one was not. Hence the presentation of two soluble salts caused a problem for the candidate. Sometimes rather strange deductions were made in the deduction section of Test 3(c) which meant that a variety of salts were presented. If the facts met the requirements then the marks were awarded.

Q2 (b) Test 1 Candidates had a few problems expressing their views on what miscibility actually meant. The mark scheme considered a variety of views but allowed views expressed in the different columns to be transferred. Hydrogen bonding was a popular answer but consideration had to be attached to answers which stated that either molecule was polar. A definitive answer was needed with regard to the polarity of both molecules. It was good to see that "like dissolves like" answers were absent.

Test 2 This question has been asked many times and candidates have, over the years, provided more carefully considered answers. Indeed the mark scheme has also become tighter and the presentation of an incorrect deduction now results in the loss of the mark. For example, stating only 'primary alcohols' loses the mark, stating 'primary and secondary alcohols together with tertiary' also loses the mark.

In this mark scheme the smell or change of smell was needed. It was often given but neglected by a sizeable few. Any valid smell was acceptable or even a description.

Test 3 Obviously the substance burnt but it was important to describe the flame accurately. This was usually achieved. There were many possible answers for the deduction from the type of flame produced. All were seen. Occasionally when a candidate produced several answers it was often to their disadvantage as one of them was sometimes wrong and this lost the mark for the answer.

The functional group present in **B** had to be the –OH group which could either be written as the formula or the name but the answer “alcohol group” could not be accepted.

- Q3**
- (a) (i) The equation for the reaction of calcium hydroxide with nitric acid was usually correctly given but there were, as usual, many candidates that used the formula CaOH for calcium hydroxide. The mark for balancing the equation was occasionally lost.
- (ii) Explanations stating how you would ensure that the reaction was complete were surprisingly poor. Despite the fact that this was a hydroxide and no gas would be given off, the answer “fizzing” was continually seen. But most candidates either stated that no more solid would dissolve or simply said that a solid remained.
- (iii) The excess of calcium carbonate used was regularly filtered but this term was not always used and a description was given or mention was made of the insolubility.

- (b) (i) The following equation was given for the decomposition of the group II metal nitrate.



It was expected that candidates would find it relatively easy to replace the symbol M by the symbol Ca throughout the equation but this was not the case. Either new species were introduced or the equation was not balanced or the formulae were rewritten. It was not a small number that wrote an incorrect equation, it was a sizeable minority but obviously far greater than ever would be expected.

- (ii) The boiling point of nitrogen(IV) oxide was given as 21°C and candidates were asked to ensure that the nitrogen(IV) oxide was collected in the U-tube. It was not sufficient to say that the temperature should be kept below 21°C because this might have implied a temperature just below 21°C. Candidates were expected to actually say how they would practically ensure that the temperature was well below 21°C and this should have involved ice or cold water. Some candidates wished to use a condenser but this was impractical for a condenser to surround a U-tube.
- (iii) Candidates of course knew how to confirm the presence of oxygen in the gas jar using a glowing splint.
- (iv) The colour of calcium oxide was either well known or well deduced as white.
- (v) Almost without exception candidates referred to the oxygen in the gas jar being no longer collected. What was surprising was the number of candidates that said that the fizzing stopped. It was only when a candidate actually stated that fizzing referred to the number of bubbles appearing in the water, was the answer revealed. Initially it was thought that this would refer to the bubbles in the molten calcium nitrate. However, no candidate actually referred to the reaction taking place in the test tube. No candidate knew that nitrogen dioxide was coloured.

- (c) (i) The meaning of the term ‘water of crystallisation’ has been asked many times on AS Chemistry papers and candidates fully appreciate that it is ‘water that is chemically bonded’.
- (ii) The formula of calcium nitrate crystals was expected to be easily deduced from the information provided in the question but the most frequent error was to actually state the formula of calcium nitrate as CaNO_3 despite what had been said with regard to the equation presented in part (b).
- (iii) It was expected that the removal of the water of crystallisation from calcium nitrate crystals would be achieved by gentle heating. The question had said that strong heating would decompose the salt. Hence it was expected that heating at a controlled temperature would be the common answer. Yet, almost without exception candidates used the well and trusted method of “heating to constant mass” and were exact in their answers.
- (d) The calculation of the percentage yield of the reaction based on the volume of oxygen produced was quite well done. It was inevitable that even average candidates would gain marks if they showed sufficient initiative which they often did. That is, that the calculation of the percentage yield was based on the moles of oxygen collected divided by the theoretical yield multiplied by 100. Any values for both moles of oxygen would be carried through to the answer and the two marks obtained. Furthermore, the calculation of the theoretical moles of oxygen depended on the relative atomic mass which usually gained a mark because of carrying the error through. Hence, overall, candidates managed to score well.
- Q4** (a) The equation for the reaction of ethanol with hydriodic acid was not tackled very well. Often quite spurious products were given.
- (b) The calculation of the number of moles of hydrogen iodide in 60 g of hydriodic acid solution was well done. It was necessary to appreciate that the acid was 57% concentrated. Hence there were two steps in the calculation. A mark was not given for those candidates who only did one part of the question.
- (c) The use of a separating funnel to wash the iodoethane with water was not done well. Quite a few candidates wished to do many other things such as distil and add drying agents. If these were at the end of the separation then everything was acceptable but if they were in the middle of the drying process then they were not. But, the greatest problem was in the separation of the layers. For many years it has been stated that it is essential to remove the stopper before the layers are separated. Hardly any candidates performed this step. In this question it was not essential to state which layer was which despite candidates doing so.
- (d) The purpose of using anhydrous calcium chloride was correctly deduced. Only very few candidates stated that it was a dehydrating agent.
- (e) The calculation could have been carried out using either the ethanol or the hydriodic acid. But, the introduction to the question did state in the last sentence that there was a slight excess of hydriodic acid. Despite this statement, a sizeable minority did calculate the yield based on hydriodic acid.

Perhaps it was the calculation of the number of moles of hydriodic acid in part (b) which encouraged candidates to be on automatic pilot mode for part (e).

- Q5**
- (a) There should have been no problem with the understanding of the term density because the units were given in the table. Most candidates did not give precise answers and sometimes they were contradictory because the mass was mentioned and the size of the molecule. For example, it was said that the mass of the molecule increased which was correct but then it was also said that the size of the molecule increased which was contradictory to the first answer and was incorrect. Candidates should have referred to mass rather than weight. Either the mass of the halogen could have been mentioned or the mass of the haloethane.
 - (b) Although the mass of the haloethane was needed, it was essential to mention the intermolecular forces. It was a frequent mistake to say that there were more van der Waals forces in the chloroethane than the iodoethane. This was a subtle error as the forces were greater rather than there were more of them. Sometimes the number of electrons were mentioned rather than the mass of the haloethane which was acceptable. The marks were given for the interpretation of the forces rather than any explanation related to undefined intermolecular forces affecting the boiling point.
 - (c) As expected, very few candidates realised that chloroethane was a gas at room temperature as revealed by the table which stated the boiling point to be 12°C. Consequently very few scored the three marks available. The two marks for distillation for the remaining haloethanes were, in comparison, easily obtained.

Paper 2

- Q1**
- (a) The preparation of a solution of the “organic acid” using a set volume of the acid which had a density of 0.90 g cm⁻³ proved to be very discriminating because of the added demand of performing a calculation. Only the stronger candidates managed to obtain the two marks available for the calculation, largely because of the difficulty of making sense of the amount needed for the 250 cm³ graduated flask. There was the added problem that the concentration of the solution was given as 6.0 g dm⁻³ but the density was in g cm⁻³.

Naturally, candidates were led into the expectation that the volume of acid had to be calculated and then added to the volumetric flask. However, those that chose to weigh the acid were not incorrect and were awarded the marks available. A problem arose when candidates wished to add a volume of acid that was measured to three decimal places using a 25 cm³ pipette. This was obviously incorrect. However, the use of a graduated pipette was quite acceptable. Certainly some confusion was created with regard to the method used to add small volumes.

Making the solution up to the mark and shaking the flask was well known.

- (b) The titration and the presentation of results in a suitable table and the calculation of the average titre were all done well. Certain aspects of the mark scheme were not brought into operation this year and will be expected next year. Whatever rules are laid down for the presentation of results there are always examples presented that defy the mark scheme with regard to the type of table or lack of table presented.

However, the application of the marking rule for those that presented three or more accurate values for the titration worked well. Titration accuracies were well in accordance with the supervisors' values.

- (c) The colour change at the end point of the titration was given correctly by the vast majority of the candidates. Only one mark was available and hence the colours given in the incorrect order did not receive the mark.
- (d) Whilst the equation for the reaction of the carboxylic acid, RCOOH, with the sodium hydroxide was well done by most of the candidates, there were some very strange answers from weaker candidates. Although RCOONa was the accepted answer there were formulae including, NaRCOO. The weakest answers produced hydrogen and a variety of products. Water was usually included as a product.
- (e) The calculation of the molarity of the acid solution used in the titration varied. Either the answer was left as the number of moles in 25 cm³ of solution or the full molarity of the solution was calculated. Most candidates made some progress on this question.
- (f) (i) As mentioned in part (e) the molarity was calculated in two different ways but whichever calculation was used it was normally successfully carried through to this part to calculate the relative formula mass of the acid.

However, there were a sizeable number of candidates that simply had to guess the answer and work backwards from what was a "correct" answer for the value of R. Hence there were often spurious numbers presented and then finally a very suitable value of R appeared. Candidates would appear to be well skilled in the art of carrying errors through and whatever value of R would then be used in part (ii).

- (ii) The formula of the alkyl group, R, of the acid, whatever the value calculated in part (ii) was carried through. What was utterly surprising was the significant number of candidates, by this stage had lost track of what R was and gave R as a transition metal compound presumably thinking that they were calculating a relative atomic mass. This just meant that that the carry error through facility had finished.
- (iii) The problem for some candidates in using the identity of R to deduce the formula of the acid, RCOOH was that they did not appreciate that R had to actually be an alkyl group. For example, if R had a value of 31 it would be given the formula of C₂H₇ and the acid the formula C₂H₇COOH which was incorrect. Sometimes the alkyl group was left on its own as the answer.

- Q2** (a) It was mentioned that one of the salts was soluble in water and the other was insoluble but this was not always fully appreciated.

Test 1 The appearance of **X** was appreciated but there are still too many candidates who write transition metal/element present rather than ion.

Test 2(a) There was a poor response by candidates to what was expected by the question. It was expected that candidates would have mentioned what the filtration process had achieved but unfortunately they did not. Eventually the mark scheme was modified to basically reward those

that said that one substance dissolved and the other did not which was not what was intended by the question as set. Furthermore there were far too many candidates who stated that a “cloudy” green “solution” was produced and then went on to give the correct explanation. It was not very easy to award marks in this situation.

- Test 2(b)** The test for an iodide was better answered than usual without the problem of mixing it up with the tests for other halides.
- Test 2(c)** The flame test posed problems for some candidates. Despite the fact that the great majority correctly stated the correct flame colour for sodium as expected there were quite a few who insisted that copper ions were present. Occasionally the colour was on its own but often it was mixed with the orange or yellow of the sodium. This was a surprise. Could it be that some candidates did not know the meaning of filtrate? It would appear so.
- Test 3(a)** Candidates realised that the mixture fizzed with nitric acid and gave an appropriate comment. The comment with regard to the colour was more problematic for some candidates. It was apparent that there was a problem with the iodide ion being oxidised presumably by the nitric acid which might have been of a higher concentration than expected. What was strange was that many answers from the same centre varied in what was observed despite the reagents presumably being the same. It might have been that the candidates were in different laboratories but in some cases this was not possible. However, judging by the variable observations for the filtration experiment in Test 2(a) it should not have been a surprise to see such a variation.
- A range of colours were seen and if they were not too extreme they were accepted.
- Test 3(b)** The test with limewater caused a few problems because of the acceptable colours list which stated the expected result for the limewater test. Of course there are many variations and the list includes chalky, white, milky etc. but only those listed were accepted.
- The conclusion initially expected was that the deduction of a hydrogencarbonate would be incorrect because all hydrogencarbonates are soluble and this should have been the copper compound. However, in view of the fact that candidates might not be expected to know this fact despite the test for carbonate and hydrogencarbonate in the specification, a deduction of either carbonate or hydrogencarbonate was allowed.
- Test 3(c)** The mark scheme was very specific in the award of the three marks i.e. the colour of the initial precipitate, the fact that it ‘dissolved’ and the final colour produced. Candidates provided these three facts regularly but the minority confused blue and green and did not deal with the word ‘dissolved’ correctly, they might have said “formed a solution” which is a conclusion/deduction. The problems with the oxidation of the iodide ion were not seen here because the test for copper ions was so dramatic.

The naming of the salts caused problems for those who favoured soluble copper compounds such as the hydrogencarbonate because at the end of the day one salt was soluble and one was not. Hence the presentation of two soluble salts caused a problem for the candidate. Sometimes rather strange deductions were made in the deduction section of Test 3(c) which meant that a variety of salts were presented. If the facts met the requirements then the marks were awarded.

- Q2 (b)**
- Test 1** Candidates had a few problems expressing their views on what miscibility actually meant. The mark scheme considered a variety of views but allowed views expressed in the different columns to be transferred. Hydrogen bonding was a popular answer but consideration had to be attached to answers which stated that either molecule was polar. A definitive answer was needed with regard to the polarity of both molecules. It was good to see that “like dissolves like” answers were absent.
- Test 2** This question has been asked many times and candidates have, over the years, provided more carefully considered answers. Indeed the mark scheme has also become tighter and the presentation of an incorrect deduction now results in the loss of the mark. For example stating only ‘primary alcohols’ loses the mark, stating ‘primary and secondary alcohols together with tertiary’ also loses the mark.
- In this mark scheme the smell or change of smell was needed. It was often given but neglected by a sizeable few. Any valid smell was acceptable or even a description.
- Test 3** Obviously the substance burnt but it was important to describe the flame accurately. This was usually achieved. There were many possible answers for the deduction from the type of flame produced. All were seen. Occasionally when a candidate produced several answers it was often to their disadvantage as one of them was sometimes wrong and this lost the mark for the answer.
- The functional group present in **Y** had to be the –OH group which could either be written as the formula or the name but the answer “alcohol group” could not be accepted.
- Q3 (a)**
- (i)** The equation for the reaction of magnesium oxide with nitric acid was usually correctly given but there were, as usual, many candidates that used the formula MgOH for magnesium oxide. The mark for balancing the equation was occasionally lost.
- (ii)** Explanations stating how you would ensure that the reaction was complete were relatively poor. But most candidates either stated that no more solid would dissolve or simply said that a solid remained.
- (iii)** The excess of magnesium oxide used was regularly filtered but this term was not always used and a description was given or mention was made of the insolubility.
- (b) (i)** The following equation was given for the decomposition of the group II metal nitrate.
- $$2\text{M}(\text{NO}_3)_2 \rightarrow 2\text{MO} + 4\text{NO}_2 + \text{O}_2$$

It was expected that candidates would find it relatively easy to replace the symbol M by the symbol Mg throughout the equation but this was not the case. Either new species were introduced or the equation, was not balanced or the formulae were rewritten. It was not a small number that wrote an incorrect equation, it was a sizeable minority but obviously far greater than ever would be expected.

- (ii) The boiling point of nitrogen(IV) oxide was given as 21°C and candidates were asked to ensure that the nitrogen(IV) oxide was collected in the U-tube. It was not sufficient to say that the temperature should be kept below 21°C because this might have implied a temperature just below 21°C. Candidates were expected to actually say how they would practically ensure that the temperature was well below 21°C and this should have involved ice or cold water. Some candidates wished to use a condenser but this was impractical for a condenser to surround a U-tube.
 - (iii) Candidates of course knew how to confirm the presence of oxygen in the gas jar using a glowing splint.
 - (iv) The colour of magnesium oxide was either well known or well deduced as white.
 - (v) Almost without exception candidates referred to the oxygen in the gas jar being no longer collected. What was surprising was the number of candidates that said that the fizzing stopped. It was only when a candidate actually stated that fizzing referred to the number of bubbles appearing in the water, was the answer revealed. Initially it was thought that this would refer to the bubbles in the molten magnesium nitrate. However, no candidate actually referred to the reaction taking place in the test tube. No candidate knew that nitrogen dioxide was coloured.
- (c)
- (i) The meaning of the term ‘water of crystallisation’ has been asked many times on AS Chemistry papers and candidates fully appreciate that it is ‘water that is chemically bonded’.
 - (ii) The formula of magnesium nitrate crystals was expected to be easily deduced from the information provided in the question but the most frequent error was to actually state the formula of magnesium nitrate as MgNO_3 despite what had been said with regard to the equation presented in part (b).
 - (iii) It was expected that the removal of the water of crystallisation from magnesium nitrate crystals would be achieved by gentle heating. The question had said that strong heating would decompose the salt. Hence it was expected that heating at a controlled temperature would be the common answer. Yet, almost without exception candidates used the well and trusted method of “heating to constant mass” and were exact in their answers.
- (d) The calculation of the percentage yield of the reaction based on the volume of oxygen produced was quite well done. It was inevitable that even average candidates would gain marks if they showed sufficient initiative which they often did. That is, that the calculation of the percentage yield was based on

the moles of oxygen collected divided by the theoretical yield multiplied by 100. Any values for both moles of oxygen would be carried through to the answer and the two marks obtained. Furthermore, the calculation of the theoretical moles of oxygen depended on the relative atomic mass which usually gained a mark because of carrying the error through. Hence, overall, candidates managed to score well.

- Q4**
- (a)
- (i) The equation for the reaction of ethanol with hydrogen bromide was not tackled very well. Often quite spurious products were given.
 - (ii) The calculation of the number of moles of potassium bromide and ethanol used in the reaction was well done. It was necessary to carry errors through that were made with the formula of ethanol in part (a).
 - (iii) The percentage calculation was carried out quite well. The usual errors were seen e.g. using 100/80 and miscalculation of RFMs but they were few.
- (b) The use of a separating funnel to wash the bromoethane with water was not done well. Quite a few candidates wished to do many other things such as distil and add drying agents. If these were at the end of the separation then everything was acceptable but if they were in the middle of the drying process then they were not. But, the greatest problem was in the separation of the layers. For many years it has been stated that it is essential to remove the stopper before the layers are separated. Hardly any candidates performed this step. In this question it was not essential to state which layer was which despite candidates doing so.
- (c) The purpose of using anhydrous calcium chloride was correctly deduced. Only very few candidates stated that it was a dehydrating agent.
- Q5**
- (a) There should have been no problem with the understanding of the term density because the units were given in the table. Most candidates did not give precise answers and sometimes they were contradictory because the mass was mentioned and the size of the molecule. For example, it was said that the mass of the molecule increased which was correct but then it was also said that the size of the molecule increased which was contradictory to the first answer and was incorrect. Candidates should have referred to mass rather than weight. Either the mass of the halogen could have been mentioned or the mass of the haloethane.
- (b) Although the mass of the haloethane was needed, it was essential to mention the intermolecular forces. It was a frequent mistake to say that there were more van der Waals forces in the chloroethane than in the iodoethane. This was a subtle error as the forces were greater rather than there were more of them. Sometimes the number of electrons were mentioned rather than the mass of the haloethane which was acceptable. The marks were given for the interpretation of the forces rather than any explanation related to undefined intermolecular forces affecting the boiling point.
- (c) As expected, very few candidates realised that chloroethane was a gas at room temperature as revealed by the table which stated the boiling point to be 12°C. Consequently very few scored the three marks available. The two marks for distillation for the remaining haloethanes were, in comparison, easily obtained.

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

The vast majority of candidates completed the entire paper with very few empty spaces being left. The overall level of performance in the paper was very good. The mark scheme was easy to follow although some of the calculations created challenges for the examiners as it took time to discern how many errors had occurred.

- Q11**
- (a) (i) Poorly answered. Most candidates wanted to titrate NaOH against RCl. Many of those who did take samples and titrate against acid either didn't name a standard acid or didn't specify a named indicator.
 - (ii) Well answered. Most candidates specified the correct graph.
 - (b) (i) Most candidates scored all three marks here. A few dropped the third mark because they did not write a rate *equation* (i.e. rate = ...). The capitalisation of the rate constant, k , was not penalised on this occasion – if it had been penalised then a large proportion of candidates would have lost the mark.
 - (ii) The calculation was carried out well and the units were usually correct.
 - (iii) Most knew the mechanism name. Some candidates used the “S_N” terminology for the mechanism and scored the mark as long as the order was consistent with their earlier rate equation.
 - (iv) Most candidates gave ‘primary’ with correct explanation. Error from earlier parts was carried through here. Some classified RCl correctly as a primary chloroalkane but lost the mark as they went on to explain structurally what a primary chloroalkane is rather than how their earlier answers led to their conclusion.
- Q12**
- (a) Most candidates knew what an empirical formula was.
 - (b) Most candidates only scored one mark for mentioning that ethanoic acid is able to form hydrogen bonds but they did not score a second mark as they failed to specify how the hydrogen bond was formed. Many candidates knew about the hydrophobic ‘tail’ in lauric acid but wrongly stated that lauric acid “cannot form hydrogen bonds” rather than saying that formation of hydrogen bonds is hindered.
 - (c) Poorly answered. Despite the stem of the question mentioning that the insoluble lauric acid is solid at room temperature and also stating its melting point, only a handful of candidates realised that it would have to be melted before the test was carried out. Failure to specify that the lauric acid had to be liquid negated the mark for sodium carbonate/hydrogencarbonate. Most correctly described the limewater test for the carbon dioxide that was produced. Only cloudy/milky was accepted as per the acceptable colour changes booklet.
 - (d) Quite a few candidates did not know the formula of thionyl chloride.
 - (e) (i) The reduction equation was frequently incorrectly balanced with a lot of candidates using 2[H] instead of 4[H].
 - (ii) Well answered by the majority.

- (f) (i) Many candidates did not read the question and simply wrote down a definition of saponification value. A correct definition of saponification value only scored one mark because the candidates did not answer the question that was asked.
- (ii) Poorly answered. A lot of errors in the structures of the triester and the glycerol.
- (iii) This was a difficult calculation that had two slightly different answers depending on the path followed. Most candidates scored some marks even if they didn't make it to the final answer. Errors were carried through from incorrect formulae in the previous part.
- Q13** (a) (i) Poorly answered. Most candidates attempted to include phosphorus pentoxide as a reactant.
- (ii) Poorly answered again. The most common error was a failure to know the correct formula of phosphorus pentoxide. Candidates who used P_2O_5 were awarded one mark if the equation was correctly balanced. The specification gives the formula as P_4O_{10} . A substantial number of candidates lost both marks for losing PO_5 .
- (b) Most candidates scored well here. Error was carried through from the incorrect use of PO_5 in the previous equation. Positive signs were required although their absence was only penalised once.
- (c) A seemingly straightforward question was surprisingly poorly answered. About half the candidates carried out the calculation for perchloric acid instead of dichlorineheptoxide and therefore scored zero. Many of those who did the calculation for dichlorineheptoxide made mistakes in calculating the RFM, the most common mistake being the use of 35 as the RAM of Cl instead of 35.5. Errors in the formula of dichlorineheptoxide were carried through from the equation in part (a)(i).
- Q14** (a) Well answered by the vast majority of candidates.
- (b) A lot of candidates did not "name" the functional groups but simply gave the formulae and scored zero. The hydroxyl group was frequently wrongly referred to as the "alcohol" group. Carbonyl was occasionally confused with carboxyl.
- (c) Many candidates contradicted the stem of the question by stating in their answer that fructose did not reduce these reagents. This negated a mark. Observations were surprisingly poor considering how frequently they are asked and the availability of the acceptable colours list. The most common errors were "red-brown" instead of red and the failure to mention precipitate. Quite a few candidates had novel descriptions of the outcome of the Tollens' test – only "silver mirror" was accepted. The explanations were disappointing. Candidates had to specify that glucose contained the aldehyde group or a primary/secondary alcohol group, and that fructose contained primary/secondary alcohol groups. Few classified the alcohol groups.
- (d) (i) The product of the reaction with 2,4-dinitrophenylhydrazine was known but many gave an alcohol for the reaction with acidified potassium dichromate.
- (ii) Well answered.

- (iii) Most candidates scored highly here but many gave a lengthy and completely unnecessary description of recrystallisation before actually answering the question.
- (e) Candidates couldn't score full marks here without specifying that the nucleophilic attack was from CN^- (not simply HCN). Otherwise most candidates made a good attempt at this scheme.
- Q15**
- (a) (i) The answer came straight from the specification. A minority of candidates made statements about "ozone depletion" while others failed to specify that the radiation involved was infrared.
- (ii) Well answered.
- (b) (i) Most candidates scored two or three marks here. The most common error was to omit the reaction ratio when working out the number of moles of oxygen at equilibrium. A surprising number of candidates seemed to struggle with percentages e.g. a lot of candidates started with 1 mole of ozone dissociating by 30% to somehow give 0.8 moles of ozone at equilibrium.
- (ii) Well answered.
- (iii) Around half the candidates got this wrong.
- Q16**
- (a) Well known.
- (b) (i) Well answered.
- (ii) Most candidates were able to identify the asymmetric centres although some only marked one carbon while others marked every atom.
- (iii) Most candidates used the term 'racemic mixture' which was fine.
- (c) This common type of calculation was very well done. The only common error was the usual one – failure to square root.
- (d) (i) Most candidates correctly specified phenolphthalein with an array of different spellings employed. Phonetically correct spellings were accepted (e.g. "phenophthalein" was not accepted nor was "phenylphthalein"). Explanations frequently referred to the "vertical portion of the graph" without specifying what the "graph" actually was.
- (ii) This calculation wasn't easy but was well done by most candidates with many scoring three or four marks. Common errors were failure to use the 2:1 ratio correctly or failure to scale the answer for a 750 cm^3 bottle.
- (e) Very poorly answered. Most candidates tried to join two acid groups together to form the ester linkage. A good discriminator.
- (f) Despite questions like this being very common there are too many candidates who cannot score full marks here. Most were able to get the equation for the addition of acid correct and score one mark. But the majority simply wrote $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ for the equation for the addition of base, which is inadequate to answer the question as it does not show the source of the H^+ .

- Q17**
- (a) Generally very well answered.
 - (b) Well answered. The main error was that candidates did not specify “of calcium”.
 - (c) A lot of candidates dropped one of the marks either by doubling the bond enthalpy or not doubling the electron affinity.
 - (d) Error was carried through from the previous calculation. Again a lot of candidates dropped a mark here usually by not doubling the enthalpy of hydration of chloride.
 - (e) Surprisingly poor suggestions for the pH with equally poor explanations.
 - (f) A very common error here was to use the answer for part (c) as ΔH in the calculation instead of using -795 as given in the list of data at the top of the page. A good number of candidates also failed to divide the entropy value by 1000. Errors were carried through from the calculation to the explanation.

Assessment Unit A2 2 Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

Section A

The mean mark for Section A was identical to 2010 and slightly higher than in 2011. The multiple choice questions proved to be very accessible to most candidates. Question 2 proved to be the most discriminating and Question 8 the least.

Section B

Overall, the standard of answering was high and the paper allowed candidates of differing abilities to respond positively to the questions posed. The mean mark for this section was lower than in 2010 and very slightly higher than in 2011. Centres and candidates would be well advised to stick rigidly to the colours which appear in the “Acceptable Colours” support material.

- Q11** Overall, the answers were of a high standard. The description and naming of the product in part (a)(iii) was poor. In part (b)(ii) many candidates only protonated one of the amino groups and in part (b)(iii) many candidates used the structures of lysine and valine rather than glycine and alanine. Many candidates at the E boundary only scored 3 or 4 marks out of a total of 16.
- Q12** The definitions were disappointing. Students would be well advised to include the relevant unit with e.m.f. and standard electrode potential values. A variety of answers were given for part (d) including all combinations of -0.76V and $+0.32\text{V}$. Most values were incorrect. Typical grade A candidates were scoring 7 or 8 for this question.
- Q13** Most candidates coped well with parts (a)(i) and (a)(ii) with many giving cyclohexane as the answer for part (a)(ii). Part (a)(iii) proved to be very demanding but the top candidates got the structure correct. It was disappointing to see the incorrect use of the word “isomer” in part (b)(i). The fragment ion often had a negative charge and more often had no charge. The fact that the chlorine-35 isotope was present in the fragment ion was often overlooked. Most candidates scored full marks in part (b)(iii).

Many candidates at the E boundary only scored 3 or 4 marks out of a total of 12. Typical grade A candidates were into double figures.

- Q14** Part (a) was very well answered by most candidates. Common mistakes in the calculation were to calculate the percentage iron or percentage iron(II) sulfate rather than the percentage of hydrated iron(II) sulfate. The factor of 10 was often missed. The principle of carrying errors through allowed good scores even when mistakes were made. Candidates would be well advised to set their responses out in a clear and logical sequence. Parts (b)(i) and (b)(ii) proved to be very discriminating. The best candidates scored well here but too many of the equations exposed an inability to apply knowledge. The answers to part (c) demonstrated sound knowledge and understanding. Most A candidates scored in the high teens and very few grade E candidates reached close to double figures.
- Q15** Overall the answers to this question were very poor and, for many candidates, a lack of knowledge was exposed. The diagrams for before and after were very disappointing. The structure of methyl benzoate was not well known. Its mononitration at position 3 and the name and nature of the product proved too difficult for many candidates.
- Q16** The definition was not well known. The standard of ionic equations produced were very poor. In part (b)(i) many candidates had two oxygens on the left and none on the right. A good GCSE student would be expected to make a better effort. This was very disappointing at A2. With the exception of the top candidates, the preparation of potassium dichromate was not well known. Many candidates were “clutching at straws” in their answers. Typical grade E candidates scored zero for the chemistry. The calculation was well done by most with the most common error being the use of a 1:1 ratio.
- Q17** A small number of candidates gave one repeating unit in part (a). Many candidates gave the structure of both monomers in part (b). Most candidates scored well in part (c) but naming the monomer in part (d) proved too difficult for many. Typical grade E candidates scored 3 or 4 whereas most grade A candidates were scoring 9 or 10 marks.

Assessment Unit A2 3 Internal Assessment

- Q1**
- (a) There was a varied performance from candidates in this question. The mark scheme was amended and many candidates picked up an extra mark for accurately weighing out the correct mass of solid. A significant number added the solid directly to the volumetric flask which was penalised and many did not describe adding deionised water until the bottom of the meniscus was on the line. The word ‘bottom’ was frequently left out.
- (b) The different method of marking the titration table this year proved successful. The most common errors and omissions were an incorrect calculation of the average titre when three accurate titres were used, no units on the average titre was a common omission, and tables should have a border and clearly defined cells. Also, the rough titre should be greater than the accurate titres but not more than 2 cm³ above the lowest accurate titre value. Headings and row labels should be complete to gain full marks for the table.
- (c) (i) The balanced symbol equation proved problematic for some candidates with many leaving out the potassium sulfate.

- (ii) The ionic equation was well answered by almost all candidates.
- (d) (i) The most common omission in the calculation was not to multiply by 10 to calculate the mass in the 250 cm³ and hence in the sample.
- (ii) This was well answered but some candidates did not use 1.2 g and used 1 g instead.

Q2 Papers 1 and 2

Most candidates scored well in all observations in part (a)(i). There were few errors in part (a)(ii) with most correctly identifying the compound. The (II) was not essential after either nickel or cobalt. The complexes were well answered by the best candidates but errors occurred with the charge on edta and the resulting charge on the complex. Many put brackets round the Cl in [CoCl₄]²⁻. The omission of square brackets or a charge written as an oxidation number, i.e. -2 instead of 2- were penalised once. Many answers were given to part (a)(iv) but the main answer in terms of entropy was seen as this is new on this specification. No answer about stability constants was allowed as this is no longer on the specification. Candidates were awarded marks for understanding that the polydentate ligand would replace a monodentate ligand if they correctly identified them.

In part (b)(i) most observations were again recorded accurately by candidates and any description of the smell of the acid/aldehyde mixture or acid/ketone mixture was allowed. In part (b)(ii) some candidates were actually able to name the compounds present in the mixture. Some went for alcohols despite the question telling them they were compounds containing a carbonyl group.

Q3 Papers 1 and 2

The equation in question 3(a) was well answered apart from the omission of water there were only a few other errors. The calculation was well answered with the 37% in Paper 1 causing a few issues and also some incorrect calculations of the RFM of the derivative from the structure. Consequential marking was applied from the structure to the calculation. The answer “fume cupboard” was the only answer accepted in part (c). Buchner filtration was reasonably well answered with the mark scheme being amended to include reference to the Buchner funnel being attached to the Buchner flask and filter paper being placed in the Buchner funnel and suction being applied. A significant number of candidates placed the filter paper in the Buchner flask and suction was attached to the Buchner funnel. Marks were not awarded for a labelled diagram as this question was assessed in terms of Quality of Written Communication. The ‘drier and faster’ answer was well presented by candidates in part (d)(ii), though a few thought a higher yield was possible. The answer in part (e)(i) involving hydrogen bonds between molecules was accepted in place of the polar/non-polar argument. In part (d)(ii) the mark scheme was amended so that filtration was carried out after dissolving in a minimum volume of hot ethanol or methanol. This filtration must be gravity filtration and Buchner filtration was not permitted even with a preheated Buchner funnel as the cooling effect of the air would cool the solution and cause crystallisation lowering the yield. This would not be good practice. Amount/quantity were not allowed for the volume of the solvent. In many cases Paper 2 candidates used hot ethanol as opposed to methanol.

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