OCR
Oxford Cambridge and RSA

GCSE

Chemistry B

Gateway Science Suite

General Certificate of Secondary Education **J264**

OCR Report to Centres June 2015

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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

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B741/01 Modules C1, C2, C3 (Foundation Tier)

General Comments

There was no evidence that candidates did not have enough time to finish the examination paper.

The mean mark for the paper was 35 and the mark range covered showed that Centres had been quite successful with their entry policy. Nevertheless there were some candidates that might have successfully taken the Higher Tier rather than the Foundation Tier examination paper.

The examination paper allowed candidates of all abilities to show positive achievement. Candidates often wrote a great deal in the 'six mark' questions but sometimes did not actually address the question that was set. The quality of written communication was generally quite good but at times candidates failed to use the correct chemical terminology.

Performance over the three sections was fairly even though there was evidence that candidates found the quantitative questions more difficult than the qualitative questions. In terms of calculations, candidates did not always include sufficient working to enable error carried forward marks to be awarded.

The ability of candidates to answer questions that assessed evaluation skills has improved over previous sessions and candidates were able to use information included in graphs and tables.

Comments on Individual Questions

Question 1

This question was about the homologous series of alkanes.

(a) Many candidates recognised that a molecule of hexane contains 20 atoms. A common misconception was to choose icosane which has a molecule with 20 carbon atoms.

(b) Many candidates appreciated that a hydrocarbon contains hydrogen and carbon but not all the candidates stated that these were the only elements present. Common misconceptions included referring to hydrocarbons as elements or mixtures or that they contained carbon and hydrogen molecules.

(c) Candidates often recognised the pattern of increasing density from the table but some were not able to predict the density of icosane. Those candidates that made a prediction often gave values between 0.79 to 0.84 g/cm^3.

(d) Those candidates who selected fractional distillation often gave the correct explanation in terms of different boiling points. All the other processes except polymerisation were chosen by candidates, and in particular cracking was a popular choice.

(e) In (i) some candidates recognised oxygen as the gas needed for combustion but a significant proportion of the candidates chose carbon dioxide. Candidates found the word equation in (ii) very challenging and rarely included water as one of the products. The toxic nature of carbon monoxide was well known. The idea that incomplete combustion releases less energy was not often mentioned by candidates. A significant proportion of the candidates did not attempt part (ii).

Question 2

This question was about polymers and plastics and included a question that assessed the quality of written assessment.

(a) Only a small proportion of candidates could name the polymer formed. The most common answers were propene or poly(propene). A significant proportion of the candidates did not attempt this question.

(b) Some candidates could deduce that a molecule of propenenitrile had nine covalent bonds. The most common incorrect answers were four or five covalent bonds.

(c) Many candidates did not understand the meaning of the term biodegradable and as a result found this six mark question quite challenging. Candidates often referred to biodegradable plastics being recyclable and not very strong. Some candidates gave disadvantages that were typical of non-biodegradable plastics such as problems of disposal in land-fill sites or incineration. Only the very best answers appreciated the problems of using a biodegradable polymer in terms of it breaking down before the plastic bottle was thrown away. Other candidates stated there would be less pollution but did not attempt to explain why. Many candidates struggled with the correct use of chemical terminology.

Question 3

This question was about food additives.

(a) The most common food additive stated was a food colour however some candidates did not really explain why food colours were added to foods. Other candidates gave the names of specific food additives and where appropriate these answers were given credit. Those candidates that mentioned sweeteners rarely mentioned that this was a low calorie option. Candidates rarely stated preservatives or antioxidants. A significant proportion of the candidates did not attempt this question.

(b) This question assessed the skill of evaluation and most candidates were able to choose emulsifier C and give two reasons for their choice of answer.

(c) The test for carbon dioxide was known by some candidates although some referred to a test with a burning splint. A significant proportion of the candidates did not attempt this question.

Question 4

This question was about building materials.

(a) In (i) many candidates were able to recognise granite as a rock used in buildings. Candidates in (ii) often gave vague answers referring to big holes or pollution and did not focus on the actual environmental consequences. The best answers mentioned noise pollution, pollution by dust or the destruction of plant and animal habitats.

(b) In (i) many candidates could give two reasons but some did not include the importance of having the highest strength. Candidates often struggled to give a definition for the term alloy in (ii). Some candidates made reference to a material that does not corrode and others just a mixture of materials without referring to metals.

Question 5

This question was about sodium chloride (salt).

(a) Some candidates just referred to sodium chloride being used in food without explaining why it was used. Only a small proportion of candidates referred to treating icy roads.

(b) The idea of solution mining was not well known and many candidates just referred to drilling or digging for salt.

(c) Candidates often correctly identified the ions and the molecule from the list.

Question 6

This question was about the corrosion of metals.

(a) This question assessed the skill of evaluation. Candidates found this question demanding and rarely were awarded both marks for the question. Many candidates just repeated the conclusions and did not quote information from the table. The best answers appreciated that with nitrogen there was no corrosion and that with acidic air the metal was covered with more solid on the surface than with damp oxygen.

(b) The equation was often correct in terms of formulae but some candidates did not attempt to balance the equation. A common misconception was to have the formula for copper oxide as CuO_2. Candidates also need to be careful to insure that they use the correct case when writing the symbol for Cu and avoid writing CU

Question 7

This question focused on the fertiliser ammonium phosphate.

(a) Most candidates could recall that plants absorb minerals through their roots.

(b) In (i) some candidates could complete the table of information about the number of atoms in the formula. The most common errors involved the number of nitrogen and hydrogen atoms. A significant proportion of the candidates did not attempt (i). The names of the two essential elements in ammonium phosphate were given by some candidates in (ii) but often phosphate or ammonium was given instead.

(c) This question also assessed quality of written communication and involved aspects of the preparation of ammonium phosphate. Most candidates were not able to give the names of either the alkali or the acid needed. A common error was phosphorus acid. The use of the colours obtained when indicators are added to solutions of different pH values was well known although candidates did not always give the name of Universal Indicator. A significant proportion of the candidates did not attempt this question.

Question 8

This question was about hydrogen peroxide. Candidates found (b) and (c) challenging and often left the question blank.

(a) Candidates often appreciated that the formula showed two different types of atoms or two different elements and this was sufficient to be awarded a mark. A common misconception was that the formula contained two molecules.

(b) In (i) many candidates could write the balanced symbol equation. Only a very small proportion of the candidates changed the formulae either writing H or O or having the product as H_2O. The definition of 100% atom economy in (ii) was not well known and many candidates gave a definition that was more appropriate for the conservation of mass. Candidates used a variety of approaches in (iii) to show that 100g of hydrogen makes

1700g of hydrogen peroxide. The best answers worked out how much 1g of hydrogen would make and then multiplied this answer by 100. Many candidates in (iv) could calculate the percentage yield as 90%.

(c) In (i) some candidates missed out the question but others were able to calculate the relative formula mass as 98. Most candidates could not calculate the atom economy as 12.7% and a significant proportion of candidates left (ii) blank.

Question Nine

This question focused on the rate of reaction between sodium hydrogencarbonate and hydrochloric acid.

(a) This question assessed both quality of written communication and evaluation. Almost all candidates realised that the data supported the conclusion made, however a smaller proportion of candidates quoted data from the graph to support their answer. The most common data quoted were reaction times from two different acid concentrations. Candidates rarely explained their answers in terms of collision theory.

(b) In (i) candidates often appreciated that the rate of reaction increased as the temperature of acid got higher but this did not address the question set which referred to reaction time. The best answers were that the reaction time decreases as the temperature increases. A common misconception was to refer to the reaction time being faster or quicker. Some candidates in (ii) could make a correct prediction the most common answer being 136seconds.

Question Ten

This question focused on the manufacture of a pharmaceutical drug in a batch process.

(a) Candidates often gave one factor but rarely were able to give three acceptable factors. Many candidates focused only on the factors related to research and testing. Other factors given included labour, energy and raw materials. Some candidates confused the terms raw materials and products.

(b) In (i) candidates often referred to the idea of side effects and only a small proportion of candidates appreciated that it is difficult to get the correct dosage if the drug is impure. Candidates found (ii) very challenging and often referred to testing with animals or human volunteers rather than the required chemical tests such as melting point or chromatography. Many candidates did not attempt part (ii).

Question Eleven

This question was about the properties of diamond. The idea that diamond was hard was well known but a common misconception was that diamond is strong. Other correct properties given by candidates included high melting point, insoluble in water and clear or transparent.

B741/02 Modules C1, C2, C3 (Higher Tier)

General Comments

The paper differentiated well and performance across the three sections of the paper appeared to be fairly consistent, allowing candidates to demonstrate their knowledge and understanding across Modules C1, C2 and C3.

The longer 6 mark questions, which were marked using a level of response approach, were generally well answered. Candidates usually appreciated the need to address **all** aspects of these questions to gain access to the higher levels. Questions addressing Assessment Objective 2 (apply skills, knowledge and understanding of science in practical and other contexts) and Assessment Objective 3 (analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence) were also well answered. Candidates increasingly understand the need to quote evidence to support conclusions.

Candidates used their knowledge and skills appropriately to respond to questions about food additives, perfumes, metals & alloys and rates of reaction.

Candidates did not seem to have the knowledge required to respond fully to questions about hydrocarbons, polymers, fertilisers, atom economy and energy transfers.

Candidates performed well in percentage yield calculations, but found the atom economy calculation more challenging. Most candidates took care when writing chemical formulae correctly (using the correct case and subscripts).

Overall, examiners felt that the question paper was appropriate to the ability range of candidates intended. There was no evidence of lack of time.

Comments on Individual Questions

Question 1

This question was about some of the hydrocarbons found in crude oil.

(a) Most candidates explained that propane is a hydrocarbon as it contains carbon and hydrogen only. When candidates did not gain credit it was usually because they referred to propane containing ‘only carbon and hydrogen *molecules’* or they omitted the reference to ‘only’ and therefore only scored one mark.

(b) Most candidates described a saturated compound as a compound that contains only single bonds. Answers that merely referred to propane having single bonds did not gain credit. A common misconception was that saturated compounds contain a double bond.

(c) Good responses to this question appreciated that hydrocarbons have different boiling points and explained that larger molecules have stronger intermolecular forces, and hence higher boiling points. Candidates who failed to gain credit often referred to melting points or focused on where the fraction was going to exit the fractionating column.

(d) Many candidates correctly balanced the equation. One mark was awarded for balancing the oxygen molecules and one mark for balancing the products. Where candidates scored only one mark it was usually for balancing the products.

(e) Many candidates appreciated that incomplete combustion produces carbon monoxide and/or carbon in addition to water. Candidates who failed to gain credit usually included carbon dioxide as a product or used the word ‘fuel ’instead of hexane.

Question 2

This question was about polymers

(a) Most candidates appreciated that propanenitrile contains 9 covalent bonds, although 5 was a common misconception.

(b) This 6 mark question was targeted at all grades up to, and including, grade A* and discriminated well. At level 3 (5 - 6 marks) all aspects of the question needed to be addressed and candidates were required to explain why the polymer has a low melting point and suggest and explain two other properties that make it suitable for use as a fizzy drinks bottle. When candidates did not gain full credit it was usually because they gave properties of the plastic which were not relevant or did not fully explain the low melting point of the polymer in terms of weak intermolecular forces between polymer molecules that do not need much energy to overcome. A common misconception was that the low melting point resulted from the polymer only having single covalent bonds or not having many covalent bonds.

Question 3

This question tested ideas about food additives.

(a) Good responses to this question displayed an ability to interpret the data about which substance is most suitable to be used as an emulsifier in food and identified substance B because it is not poisonous and does not have a smell. Candidates who did not gain full marks usually identified D as the most suitable but still noted that it isn't poisonous so gained 1 mark.

(b) Most candidates correctly drew a diagram of an emulsifier molecule in part (i), labelling the hydrophilic head and the hydrophobic tail. One mark was awarded for a diagram that labelled a hydrophilic tail and a hydrophobic head as candidates had some appreciation of the structure of an emulsifier molecule. Good responses in part (ii) explained that cooking potato ruptures the cell wall and allows the starch grains to swell up resulting in a loss of rigid structure or softer texture. Candidates who failed to gain credit usually wrote about heat causing protein molecules to denature.

Question 4

This question was about perfumes and animal testing.

The majority of candidates recognised that harming animals was morally wrong and/or cruel and that the results would not necessarily be the same as with humans. Candidates who failed to score both marks usually discussed alternative ways to test cosmetics or why cosmetics weren't essential for humans.

Question 5

This question was about construction materials.

(a) Most candidates knew that cement is made when limestone and clay are heated, although 'limestone and sand' and 'sand and clay' were common misconceptions.

(b) Good responses to part (i) explained why reinforced concrete is a better construction material than non-reinforced concrete in terms of the combination of the hardness of concrete and the strength and the flexibility of steel. Candidates who simply compared reinforced and non-reinforced concrete, stating that reinforced concrete is stronger, gained only 1 mark. Most candidates were able to interpret the data in part (ii) and correctly chose steel C, with two reasons to support their choice.

Question 6

This question focused on metals and alloys and required candidates to interpret data.

(a) Good responses to this question displayed an ability to interpret the data and appreciate that hastelloy is actually more resistant to corrosion at higher concentrations of acid, but all three metals are indeed more resistant to corrosion at lower concentrations of acid. When candidates did not gain credit it was often because they did not focus on the conclusions separately and tried to link the trend between both temperature and concentration, particularly when interpreting how concentration affected the resistance to corrosion. Many candidates also focused on individual metals rather than looking for overall trends.

(b) The majority of candidates correctly identified 0.6 cm^3/hour as the highest rate of production of hydrogen gas in part (i). In part (ii), pH 6 was usually correct.

(c) This question required candidates to write a balanced symbol equation for the reaction of aluminium with sulfuric acid. One mark was awarded for the correct reactants and products and 1 mark for the correct balancing. The balancing mark was dependent on the correct formulae, but 1 mark was allowed for a balanced equation with a minor error in subscripts or formulae. When candidates did not gain marks it was often because they tried to balance the equation by writing Al_2 or H_23SO_4.

Question 7

This question tested ideas about electrolysis.

(a) Most candidates correctly identified gas X as hydrogen. Hydrogen chloride was the most common misconception.

(b) Good responses to this question appreciated that the chlorine gas produced in the electrolysis of sodium chloride may react with the electrode. When candidates did not gain credit it was usually because they suggested that the electrodes would react with the sodium chloride solution. A common misconception was also that inert electrodes would 'make the current flow better'.

(c) The majority of candidates correctly balanced the equation in part (i). The most common errors were balancing with the number '4' or completing the gaps with 'Na' and 'C*l*'. In part (ii) most candidates explained that the reaction was oxidation because electrons are lost. Candidates who failed to gain credit often suggested that the wrong species was losing electrons, e.g. chlorine, or chlorine ions, loses electrons'.

Question 8

This question was about fertilisers.

(a) Many good responses to this question were seen with candidates describing that fertilisers increase crop yield but cause eutrophication. Answers in terms of rising world population, resulting in the need to produce more food, were less common. When candidates did not gain credit it was usually because they described fertilisers as 'adding nutrients' or 'making plants grow better'.

(b) Most candidates were successful in deducing the number of each type of atom in the formula $(NH_4)_3PO_4$ in part (i). The 6 mark question in part (ii) focused on how ammonium phosphate can be made and was targeted up to grade A. At the simplest level, candidates who stated the name of the acid and the alkali needed to make ammonium phosphate, or who attempted to describe how ammonium phosphate can be made, scored Level 1. To gain Level 2 candidates needed to give the name of the acid and the alkali and attempt to describe the method. A complete description of the method, including the names of the acid and the alkali, was required to gain credit at level 3 (5 - 6 marks). Common errors

were naming the acid as ‘phosphorus acid’ and the alkali as ‘ammonium’. A significant number of candidates did not mention repeating the titration to obtain consistent results, or repeating the titration without the indicator. Some candidates described the Haber process for the procedure.

Question 9

This question tested aspects of quantitative chemistry, including atom economy and percentage yield.

(a) Good responses in part (i) appreciated that the process has 100% atom economy because there are no waste products. Candidates who failed to gain credit gave answers in terms of conservation of mass. In part (ii) good responses explained that high atom economy makes industrial processes more sustainable and reduces waste products. When candidates did not gain credit it was usually because they simply stated that high atom economy reduces waste or stated that there would be less waste reactants.

(b) Candidates who understood the idea of reacting masses were able to correctly show that the predicted yield of hydrogen peroxide is 1700g in part (i). In part (ii) most candidates correctly calculated the percentage yield as 90%.

(c) Responses to this atom economy calculation were better than the similar calculation on the 2014 paper. Incorrect responses usually resulted from 34 divided by 233 (ie the mass of the waste product only) or 34 divided by 534 (ie the mass of the reactants and the products). Incorrect rounding of 12.7%, to give an answer of 12%, was penalised.

Question 10

This question was about rates of reaction

This 6 mark question was targeted up to grade A and required candidates to draw conclusions based on evidence and to explain a scientific process using the reacting particle model. Candidates who gave good responses supported their answers with clear reference to the experimental results and could explain why the results supported Fatimah’s conclusion using ideas about collision frequency. Answers that did not refer to experimental evidence or only mentioned the idea of collisions, rather than collision frequency, did not gain credit beyond Level 2.

Question 11

This question focused on the batch process used to make pharmaceutical drugs.

(a) Most candidates appreciated that pharmaceutical drugs are not in high demand or are needed according to seasonal demand. Many candidates illustrated their answers by reference to specific drugs, e.g. flu vaccines. The idea that batches can be traced and recalled was also commonly seen by examiners.

(b) In contrast to part (a), fewer candidates could explain why it is expensive to manufacture and develop a pharmaceutical drug. Good responses described ideas such as the length of time to research or test the drug, the rarity of the raw materials and the idea of high wages for skilled workers. Vague answers, which just listed the costs involved in any manufacturing process (eg energy, wages, raw materials etc), did not gain credit.

Question 12

This question tested ideas about energy transfers.

(a) Many candidates correctly calculated the final temperature of the acid as 37.2°C. The majority of candidates scored at least 2 marks for calculating the temperature change as

15.2°C, but some then subtracted this from the initial temperature of 22.0°C. Using the mass of magnesium (0.5g) instead of the mass of acid (25.0g) in the calculation was also a common error. A significant number of candidates were penalised for not expressing their answer to one decimal place.

(b) Candidates found this question very challenging. Good responses described that bond breaking is endothermic, bond making is exothermic, and that more energy is given out during bond making than is taken in during bond breaking. When candidates did not score marks, it was usually because they simply stated that bond breaking is exothermic or gave an answer in terms of the number of bonds broken or made.

Question 13

This question was about graphite

(a) Most candidates correctly stated that graphite is slippery. When candidates did not gain credit it was usually because they referred to 'weak covalent bonds between layers' or referred to 'weak intermolecular forces' without reference to layers.

(b) The majority of candidates correctly explained that graphite conducts electricity because it has delocalised or free electrons. Candidates who did not gain this mark usually suggested that ions or atoms move.

B742/01 Modules C4 C5 C6 (Foundation Tier)

General Comments

It was clear that some candidates prepared well and were successful as a result. A significant number of candidates (about 10%) would have been better served by entry to the higher tier paper. These were candidates who scored over 50 marks. The 6 mark questions were marked using a level of response approach. Candidates attempted to answer these questions and therefore almost always gained some credit. Question 3 concerning deductions about the reaction of rubidium and water was targeted at all grades up to and including grade C. About a sixth of candidates gained level 3 (5 or 6 marks) on this question. Question 6(b)(ii) concerned interpretation of graphs of time versus total volume of gas produced for the reaction of a strong acid and a weak acid with calcium carbonate. This question was also targeted at all grades up to and including grade C. Very few candidates gained level 3 (5-6 marks), however about a third gained level 2 (3-4 marks). Question 13(b) was concerned with interpreting data about methods of rust prevention. It was targeted at grades E, F and G. About two thirds of candidates scored level 3 on this question.

Candidates continue to perform well in calculations and most candidates took care with writing chemical formulae correctly (using the correct case and subscripts).

Candidates performed well on the data response question in section **D**. They need to remember to quote data in support of their conclusions.

Overall, Examiners felt the question paper was appropriate to the ability range of candidates intended. There was no evidence of lack of time.

Comments on Individual Questions

Section A

Question 1

1(a) Part (i) was better answered than part (ii). '2' was a popular incorrect answer in part (i). In part (ii) a number of candidates calculated the relative formula mass of copper carbonate and failed to score.

1(b) Part (i) was poorly answered. Most candidates did not realise that copper oxide was the solid and stated

copper carbonate $\longrightarrow$ carbon dioxide + solid

and failed to score. In part (ii) just under a half of candidates understood what is meant by thermal decomposition. A number thought that it was a change of state or that elements were broken down and so failed to score.

1(c) Most candidates scored on this question. 'Strong' and 'hard' were popular correct answers.

Question 2

2(a) Both parts of this question were well answered. A number of candidates offered 'N' in part (i).

2(b) Most candidates could use the periodic table correctly to identify 12 as the atomic number of magnesium. A few quoted 24 and failed to score.

2(c) Less than a fifth of candidates understood the term mass number. Most thought it was the relative atomic mass of nitrogen. A number realised it was the number of particles but then lost the mark by stating, for example, 'the number of protons and electrons in the atom'.

2(d) Common correct answers were that magnesium is on the periodic table or that the symbol only has one capital letter.

2(e) The development of the periodic table continues to be an area that candidates find challenging. Very few candidates scored on this question. Common incorrect answers included Einstein, Darwin and Newton.

Question 3

Most candidates could predict at least two observations, with many offering far more. Better candidates talked about how the reactivity of the elements increases as Group 1 is descended and hence predicted reaction times of less than 7 seconds. Far fewer candidates named the products even with the hint that a gas was given off that burns with a 'pop'. It was rare to see rubidium hydroxide mentioned.

Question4

4(a) Better candidates frequently scored both marks correctly referring to filtration and the use of chlorine. Weaker candidates thought that heating the water would bring about the necessary purification.

4(b) This question was common with the higher tier paper and was poorly answered. Most candidates had little knowledge or understanding of analytical tests and could not relate the colour of the precipitates formed on the addition of sodium hydroxide to the ions present. A common answer was to state that Pete was wrong because copper sulfate would give a brown precipitate with sodium hydroxide solution.

Section B

Question 5

5(a) Almost two thirds of candidates scored this mark. '111' was seen which takes no account of the number of each type of atom.

5(b) Again two thirds of candidates scored the mark in part (i). Part (ii) allowed for error carried forward. A number of candidates worked out the percentage using the molar mass of K_2FeO_4 and the relative atomic mass of oxygen. Full credit was given for this approach with the answer being 32.32%.

5(c) The concept of empirical formula is not well understood except by better candidates. Many candidates gave numerical answers, calculating molar masses.

Question 6

6(a) The most common incorrect answer was 'carbon monoxide'. 'Nitrogen' and 'propane' also featured regularly.

6(b) In part (i) significant numbers of candidates thought that the method needed was a titration and drew burettes and pipettes. Credit was given for a diagram resembling a gas syringe provided it was clear that it was graduated even when the apparatus was drawn disassembled. In part (ii) few candidates accessed level 3 (5-6 marks) as their answer did not include a particle model explanation. Many candidates gained level 2 (3-4 marks) often by stating that nitric acid reacted more quickly as it was a strong acid. Only better candidates could adequately explain why the gas volumes were the same at the end of the reaction.

Question 7

7(a) Less than half of candidates understood that (g) is the state symbol for a gas. 'Grams' was a very common incorrect answer.

7(b) This question was well answered with most recognising that ⇌ means that the reaction is reversible.

7(c) In order to gain the marks on this question, candidates needed to clearly state the relationship between increasing the pressure and percentage yield and increasing the temperature and percentage yield. Merely stating that Paul was right about pressure but wrong about temperature was insufficient.

Question 8

8(a) Few candidates correctly stated that the colour change was from blue to red. 'Colourless' and 'orange' featured quite prominently. Pink was an acceptable alternative to red.

8(b) In part (i) just over half of all candidates scored 1 mark for constructing a table which included all three titrations but without units, titres or numbers. Very few candidates scored both marks. Part (ii) was poorly answered. Only the best candidates selected titrations 2 and 3. 'All three' was a common incorrect response, although error carried forward was employed in that case for the second mark. Many candidates calculated the mean using burette readings rather than the titre.

Question 9

Better candidates usually scored both marks. The idea that medicines needed to be diluted to avoid overdose was a common answer gaining 1 mark. Understanding that foods such as cordials need to be diluted to avoid too strong a taste was less well understood.

Section C

Question 10

10(a) The role of enzymes in removing food and/or blood stains was not well understood. 'To remove stains' was insufficient to score. Another common incorrect answer was 'to remove dirt'.

10(b) About two thirds of candidates scored 1 or 2 marks on this question usually for the idea of less energy or electricity used and the idea that the clothes don't shrink. Answers such as 'cheaper' were insufficient to score.

Question 11

11(a) Only about a quarter of candidates correctly stated hydrogen from the diagram. 'Coal' and 'petrol' were commonly stated.

11(b) The equation was generally well answered with stronger candidates scoring both marks for a fully correct equation and others 1 mark for the correct formulae for reactants and product. Weaker candidates often wrote H_2O_2 rather than H_2O.

11(c) Only better candidates scored this mark. They recognised that water was the product. Weaker candidates thought that hydrogen or oxygen were the products and failed to score.

11(d) The most common answers were that the astronauts could drink the water and that the fuel cell was compact. Answers such as 'efficient' or 'reliable' were insufficient to score.

Question 12

12(a) Just under half of all candidates scored 2 marks on this question, correctly selecting sample **Y** and stating that it used most soap. '**X'** was the commonest incorrect response.

12(b) Over two thirds of candidates correctly identified sample **Y** and recognised that the volume of soap used was the same before and after boiling.

12(c) The action of soapless detergents on hard water was not well understood. Many were reacting soapless detergents with soap or thought that there was no lather with soapless detergents.

12(d) Methods for softening hard water were not well known. It was rare to see the use of washing soda or an ion exchange resin. Distillation was an acceptable answer. Most candidates thought that heating permanently hard water would soften it.

Question 13

13(a) Most candidates recognised that the untreated iron would be used as a comparison or as a control. 'As a fair test' was a common unacceptable response.

13(b) Rusting was well understood. Most candidates could rank the treatments in the correct order and explain how they had done it. Explanations about how painting protects iron were less precise. The idea of a barrier to both water and oxygen was required.

Question 14

14(a) Almost half of candidates could identify formula **C** as unsaturated. Far fewer could explain their selection by talking about carbon to carbon double bonds. Many just stated '**C** has double bonds without realising there were carbon to oxygen double bonds in all the molecules. Statements such as carbon double bond or double carbon bond were insufficient to score the second mark.

14(b) About a quarter of candidates scored 1 mark on this question usually for mentioning oil and water. Answers frequently described the role of emulsifiers rather than an emulsion.

Section D

Question 15

15(a) Part (i) was the best answered question on the paper with very many candidates correctly interpreting the graph to state 2000. Most candidates correctly identified the trend in part (ii) but fewer could suggest an acceptable reason. The most common suggestions revolved around increased public awareness.

15(b) Most candidates correctly identified Germany in part (i) with many calculating the mass as 2320 tonnes or suggesting that Germany had the largest population. Part (ii) was less well answered. Better candidates usually scored both marks because they detailed those countries that did not match the trend and explained why, often quoting amounts from the table. Weaker candidates lacked the precision required in their answers. In part (iii) only about a third of candidates performed the calculation correctly. Often incorrect values were selected from the table. Most candidates found part (iv) difficult. Parts (iii) and (iv) were common with the higher tier. The comparison between the two percentages was often vague or candidates stated that the percentage of the population and the percentage of ammonia were similar which was insufficient to score.

B742/02 Unit 2 Modules C4 C5 C6 Higher Tier

General Comments

The mean mark for the paper was 46 and the marks covered almost the whole of the mark range. The examination paper allowed candidates of all abilities to show positive achievement. There was a small proportion of candidates that would have been better suited to taking the Foundation Tier instead of the Higher Tier examination paper.

Many candidates wrote extensively in the six-mark questions and often needed additional sheets to complete their answers. Candidates need to ensure that they address the question set rather than include lots of irrelevant information. The quality of written communication in these questions was generally quite good but some candidates failed to use the correct chemical terminology.

There was a fairly even performance over the four sections of the examination paper. Candidates were often able to answer the quantitative evaluation questions in Section D but found the qualitative questions in this section much more demanding.

Centres should remind candidates of the importance of organising their answers to quantitative questions so that the working out is clearly shown. This will allow, where appropriate, the award of error carried forward marks.

Candidates did not always include labels when they drew diagrams as part of their answers and Centres should remind candidate of the importance of labelling diagrams.

Comments on Individual Questions

Question 1

This question was about electronic structure and bonding.

(a) In (i) many candidates recognised that **W** forms a positive ion, with **Z** and **Y** being the most common incorrect answers. The noble gas structure of **Z** was recognised by many candidates in (ii). **W** and **Y** were recognised as atoms that combine by forming an ionic bond in (iii). Some candidates actually identified the elements by name although this was not needed in the mark scheme.

(b) There were many examples of correct ‘dot and cross’ diagrams for ammonia. Candidates did not need to show the lone pair as electrons next to one another. The most common misconception involved having more than two non-bonding electrons in the outer shell of nitrogen or including an extra electron in the outer shell of hydrogen. Only a small proportion of the candidates drew ionic ‘dot and cross’ diagrams.

(c) Many candidates referred to electrons rather than ions in their answer to this question. Good answers appreciated that ions did not move in the solid but would move in the aqueous solution.

Question 2

This question was about sub-atomic particles.

(a) Only a small proportion of the candidates were able to get all four entries in the table correct. Candidates found filling in the information about the chlorine atom easier than that for the oxide ion. Many candidates did not take account of the charge on the oxide ion when calculating the number of electrons.

(b) Candidates found this recall question quite challenging. Candidates often referred to the 'plum pudding' model when describing J.J. Thomson's contribution. Most candidates failed to appreciate that J.J. Thomson discovered the electron. More candidates were able to describe Bohr's contributions and referred to electron shells or electron orbits. Some candidates referred to the discovery of the Periodic Table or to the 'gold leaf' experiment. A significant proportion of candidates left this question blank.

Question 3

This question involved the chemistry of the alkali metals and also assessed quality of written communication. Most candidates could predict a reaction time for rubidium although some forgot to include the unit in their answer. Candidates found writing the symbol equation and naming the products much more demanding. Candidates often wrote the incorrect formulae and/or the incorrect products. The most common answers involved the formation of rubidium oxide and hydrogen.

Level 3 was only available for candidates that could write the balanced symbol equation and gave the names of the correct products.

Many candidates also included lots of extra material, for example explaining why rubidium reacted faster in terms of electron loss. Candidates must take care that they address the question that is set and not waste time including irrelevant material.

Question 4

This question was about water purification and water purity.

(a) Many candidates appreciated that the fertilisers dissolved in water. Some candidates just mentioned that their particles were too small to be separated from the water without mentioning anything about their solubility in water. A common misconception was that fertilisers were not killed by chlorination.

(b) Candidates often mentioned the idea that distillation requires lots of energy and as a result that the purification of sea water would be expensive. Candidates often repeated the information in the stem of the question in terms of using a large amount of water.

(c) Candidates found this question very challenging and often they just repeated the information in the table without making any real evaluation of the data. Candidates had to decide if the two statements about **A** and **B** were correct and then justify this answer in terms of the results. Candidates had to mention the reagent, the result and the ion that was being tested in order to score a mark. As an example many candidates just stated that **A** was copper sulfate because it gave a white precipitate with barium chloride and a blue precipitate with sodium hydroxide but failed to state that the blue precipitate was due to presence of copper ions and the white precipitate as a result of sulfate ions being present.

Question 5

This question involved various calculations.

(a) Many candidates could calculate the molar mass as 239 g/mol.

(b) Many candidates could calculate the percentage of oxygen as 33%. Good answers showed the working out to show that the mass of oxygen in the sample was 0.33g. However a significant proportion of the candidates did not show any working out so they could not be awarded any error carried forward mark if they gave an incorrect percentage.

(c) Candidates often deduced the correct empirical formula as C_2H_5 although some candidates gave the molecular formula and others worked out the molar mass.

(d) Candidates found this empirical formula calculation very challenging. Even candidates who calculated the mole ratio often rounded the ratio incorrectly to end up with FeO_2 or stated the formula was $FeO_{1.5}$. Common misconceptions included using the mass ratio rather than the mole ratio or using atomic number to calculate the mole ratio rather than the relative atomic mass. A significant proportion of candidates left this question blank.

Question 6

This question was about strong and weak acids and rate of reaction.

(a) Candidates need to take more time when drawing diagrams of apparatus in order to avoid silly errors and mistakes. Most candidates decided to use a gas syringe, although some forgot to show the graduations on the gas syringe. Candidates were often able to draw a diagram to show the use the gas syringe as part as a workable method. Other candidates used a burette and a measuring cylinder but they often did not include them as part of a suitable diagram, for example did not collect the gas by displacement of water. A common misconception was to show the apparatus but not set up as a working method.

(b) This question which assessed the quality of written communication was very demanding and many candidates used poor and imprecise chemical terminology. Candidates rarely described the difference between a strong and a weak acid in terms of the dissociation to form hydrogen ions. Most candidates could describe why the shapes of the graphs were different in terms of strong and weak acids using simple ideas such as 'the graph for nitric acid was steeper because the acid was stronger and reacted faster'. This type of comment allowed the award of level 1. To go beyond level 1 candidates had to describe the difference between a strong and weak acid or to explain their answer in terms of collision theory. Only the very best answers referred to both collision frequency and hydrogen ions.

(c) In (i) many candidates did not understand the relationship between volume, molar volume and moles and as a result did not get the correct answer of 0.0025 moles. A typical incorrect answer was 1.44 moles. Many candidates could not use the relationship between molar mass, moles and mass in (ii) and as a result did not multiply the answer to (i) by 100. A significant proportion of candidates left (ii) blank.

Question 7

This question is about chemical equilibria.

(a) Most candidates did not choose both of the correct answers. The answers to the last two boxes were common errors.

(b) This question that assessed evaluation skills was extremely demanding. Candidates had to apply their understanding of le Chatelier's principle to decide if the statements were supported. Many candidates were not able to relate the pattern shown by a graph to the correct statement and then decide if the pattern supported the statement.

Question 8

This equation focused on precipitation reactions and aspects of How Science Works.

(a) Most candidates did not appreciate that the collision frequency of ions must be very high if the reaction is fast. Many candidates stated that the collision frequency would increase but this was not sufficient to be awarded a mark.

(b) Candidates often mentioned that spectator ions do not take part in a reaction.

(c) Some candidates answered the wrong question, namely why do scientists publish their results when the question asked about how publishing her results would help the scientist. The most common answers related to peer review or that other scientists could help her

but some candidates included the idea that it would help her get funding or to get recognition for her work which were both allowed in the mark scheme. A common misconception was that the scientist used the journal as a diary.

Question 9

This question was about the hydrogen-oxygen fuel cell.

(a) Many candidates could write the balanced equation for the reaction of hydrogen and oxygen to make water.

(b) Candidates found this question about an energy level diagram very demanding. Many candidates had no idea what an energy level diagram looks like and drew straight lines from the origin. To get full marks candidates had to have the two energy levels correctly positioned and then have the energy levels correctly labelled as reactant and product. Some candidates gave excellent answers with more information than was required in the mark scheme. For example they gave the displayed formulae of the reactant and products and showed an activation energy with atomic oxygen and hydrogen.

(c) A very large proportion of the candidates referred to the fuel cell forming drinking water. Only a very small number of candidates referred to no pollutants being formed and this was not sufficient to be awarded a mark.

(d) The most common answer referred to the poisonous catalyst although many candidates gave vague answers relating to manufacture and/or disposal.

Question 10

This question was about hardness in water.

(a) Candidates were often able to identify the hardness in samples **X** and **Y** but found **Z** much more demanding since it contained both types of hardness. Many candidates understood that temporary hardness is removed when the water as boiled but permanent hardness is not removed. Some candidates referred to the different volumes of soap solution needed to form a lather in their explanations.

(b) Candidates were often unable to explain how washing soda removes hardness in water. A common misconception was to describe a type of ion-exchange resin rather than describe the formation of insoluble calcium carbonate. Some candidates were imprecise and referred to the removal of calcium rather than of calcium ions, calcium salts or soluble calcium compounds from the water.

Question 11

This question focused on rust prevention and partly assessed both evaluation and the quality of written communication. Candidates often achieved level 3 in this six-mark question. Candidates used the data provided to give disadvantages and advantages for each rust prevention treatment. Some candidates missed out how magnesium prevents rust. Other candidates just mentioned sacrificial protection without explaining how this works in terms of the magnesium being more reactive than iron. A common misconception was that magnesium acted as a protective barrier. A significant proportion of candidates referred to magnesium rusting in their answers.

Question 12

This question was about fats, saponification and detergents.

(a) Many candidates recognised that fat **C** was unsaturated however not all were able to explain precisely why this was so. Answers had to refer to the presence of carbon-carbon

double bonds not just double bonds since the molecule also contained a carbon-oxygen double bond.

(b) The best answers gave a word equation to describe saponification. Some other candidates were able to list the products made by saponification. A significant proportion of candidates left this question blank.

(c) Good answers gave labelled diagrams showing how a detergent could remove an oil stain. Candidates could often label the hydrophobic end of the detergent molecule but sometimes in their explanations they confused the tail with the head of the detergent. Most candidates referred to the hydrophilic head bonding with water molecules and the hydrophobic tail bonding with molecule of fat. Centres should advise candidates to ensure that diagrams are fully labelled to ensure full credit can be given.

Question 13

This question assessed evaluation and did not need any prior knowledge. The question focused on the analysis of data about air pollution within the European Union.

(a) Many candidates recognised that the oxides of nitrogen showed the greatest change in mass between 1990 and 2000. To get full marks candidates had to support this answer with data taken from the graph. Many candidates stated that the graph was steeper here or gave the actual value of the decrease (190 tonnes). Some candidates used data from the whole of the graph from 1990 to 2015 rather than from the period asked for in the question.

(b) Many candidates could calculate the percentage as 1.44% in (i) but were not always able to explain its significance in (ii). Candidates were expected to state that Sweden makes less ammonia that would have been expected from the EU average.

Many candidates in (iii) could calculate the mass of sulfur dioxide per million of population made in Poland as 25 tonnes. Some candidates ignored the comment in the stem about quoting the answer to 2 significant figures. Candidates in (iv) were not always able to explain the significance of this answer in terms of Poland making more sulfur dioxide than expected from the EU average. Candidates often just mentioned that Poland made lots of pollution.

Many candidates made general comments in (v) without quoting any data from the table to support each of the two statements. The best answers chose countries and compared population and amount of pollutants for example Estonia has a smaller population than Sweden but makes more sulfur dioxide.

B743 Controlled Assessment

General Comments

Overall, centres are coping well with the controlled assessment process and some excellent work with good clear marking has been submitted.

Most centres submitted work that was well organised and easy to follow with all of the appropriate documents enclosed and clear annotations explaining why particular marks had been awarded. This aided the process of moderation and centres are thanked for the effort involved.

Some centres, however, are still submitting work with errors of various kinds:

- There have been a number of clerical errors where marks submitted to OCR differ from those on the work sent to the moderator. Centres are advised to double check the marks on scripts before sending them to the moderator. In particular, if internal moderation has taken place and marks are changed, it needs to be clear which mark is being submitted.
- A significant number of centres have submitted the wrong task for the year. Tasks are only valid for one year and it is not permissible for centres to submit work either using tasks from previous years or from the next year. Any centres that used a task from next year are reminded that they will not be allowed to use this task again in the coming year.
- A number of centres also gave more support to their candidates than is acceptable. No form of writing frame, table grid or guidance notes, other than those provided as part of the task, are allowed to be given to the candidates. Use of such material can reduce the marks available to candidates as their own work has not met the marking criteria.
- Centres are reminded that in signing the CCS160 (Centre Authentication) form they are guaranteeing that the work submitted is each candidate's own unaided work.

Previous reports have given considerable guidance on the application of the marking criteria, how to avoid common errors and the requirements for the award of high marks. Centres are advised to consult the reports written in 2012, 2013 and 2014 in addition to the notes given below.

Comments on each Skill quality

Research: Work submitted was generally of a high standard. Candidates frequently demonstrated that they were aware of the need to produce a full bibliography with full URLs when referencing internet sites. Few candidates made use of resources other than those on the internet, but when a text book is referenced then page numbers should be given. The range of sources used was generally suitable and relevant to the tasks.

Some candidates put a lot of effort into an analysis of the sources commenting on their likely reliability and accuracy and giving reasons for their decisions. This is not a requirement of the marking criteria and candidates could be advised to use their time to better effect. The main issue for the award of high marks lies in the candidate’s ability to “select” relevant information from the sources. This needs to be specific to the bullet points in part one and to be scientifically correct. It is rarely possible to effectively fulfil this requirement by simply cutting and pasting from web sites as it usually means that irrelevant material is copied alongside relevant material.

Planning: This was also generally tackled effectively by the candidates. The methods now often include a diagram which helps to explain the plan and detailed information that can easily be followed by someone else. The most common weakness in this skill quality is an insufficient

consideration of how errors can be minimised. This is required at all marking points above 2 with the difference between 3 and 6 being in the depth and detail given by the candidates.

Candidates need to produce a suitable hypothesis. This should be based on the information given in part 2. Candidates make it more difficult for themselves when they choose to investigate something which is not really what the task was asking for. For higher marks candidates need to provide a detailed scientific justification for their hypothesis.

Candidates should clearly indicate any changes they might have made to their plan For example, candidates need to select a suitable number and range of data points as part of their plan. If the number in the plan differs from the number used in the actual experiment then an explanation of the change should be given.

Collecting: This was one of the highest scoring of the Skill qualities. Candidates generally produced clear tables with full headings and units and quoted data to an appropriate and consistent number of decimal places in line with the equipment they had chosen. Some centres penalised candidates for inconsistency or errors in processed data such as averages. Marking in this Skill quality needs only be applied to raw data. Some centres over marked by giving high marks when all of the raw data had not been recorded and processed data was shown instead. For example, initial and final temperatures should be recorded and not just temperature change.

Candidates are not allowed templates to use in these tasks. If candidates have been given a table to complete then it is unlikely that they would be able to get many, if any, marks for this Skill quality.

Managing Risk: This was also a high scoring Skill quality but some centres are still being too generous. The following comment was made on last year's report and bears repeating, as some centres are still failing to take it into account when giving high marks.

The criteria for 5/6 marks state 'All **significant** risks in the plan **evaluated**'. The risk of having a heart attack whilst squeezing a clothes peg is not significant. Too many times candidates invent spurious risks. 'Evaluated' means that the candidate needs to appreciate and state whether it is a low risk or a serious risk.

The criteria also state '**Reasoned** judgements made to reduce risks by **appropriate specific** responses'. The highlighted words speak for themselves.

Processing data: Graphs were well drawn by most candidates. However, some centres are still giving high marks when candidates have inappropriate scales on one or more axes. A graph does not need to have the point (0,0) on the scale in all cases. As a general rule the data points should cover at least half of the available space.

Some of the tasks have been designed with the opportunity for more able candidates to use more complex mathematical techniques that are relevant to the task, for example, calculating an energy change. However, candidates do not need to carry out an additional complex mathematical technique in order to get high marks if there is not a process which is relevant and adds to the understanding of the task. For example, calculating a gradient may be irrelevant and provide no additional useful information, particularly when candidates do not understand what the gradient shows.

Without some form of processing of uncertainty then full marks are not available in this Skill quality. Range bars are generally the most accessible method for candidates to use.

Analysing & Interpreting: There were some tasks this year in which candidates failed to obtain data that supported their hypothesis or the hypothesis given. For example, in those who undertook the portable stoves experiment, some candidates failed to control the amount of fuel used in each experiment, by either burning a fixed mass of fuel or calculating a temperature change per gram, and obtained data which showed no real trend at all. Candidates should not

try to force their hypothesis on to the data. There were some candidates who were given high marks for stating that a trend was supported when only 2 out of four data points followed this trend. They may then have commented that the other two data points were anomalies. This is not good science and is not worthy of high marks. Candidates may obtain high marks by pointing out that the data does not show a clear trend, comparing this to data from secondary sources and making appropriate comments to explain the differences.

Evaluating: Although often marked well by the centres this continues to be a Skill quality that candidates find difficult. This is partly because candidates need more space to answer question 4 of part 3 than is available on the standard version. Centres may provide candidates with a reworked version of part 3 with more space available for answers if they choose to, as long as the wording is identical to that provided in part 3. This can be easier for candidates than using additional paper.

Question 4 of the task requires candidates to evaluate their method, their data and to make comments about risk. Many candidates fill the space available but focus primarily on just one of these issues and consequently can only score low marks.

To obtain high marks candidates need to make a “detailed and critical consideration” of the data. This is rarely seen. Although range bars are often included as part of processing, many candidates do not understand the significance of them and how they relate to the quality of the data. Where data is of poor quality, candidates need to try to link this to their method and explain why their plan gave rise to data that did not match their expectations or where there were a number of anomalies. Suggestions for improvement should ideally be derived from this rather than chosen almost at random.

Comments about risk do not contribute significantly to the mark for analysis but can be used to further support the mark awarded in the risk Skill quality.

Conclusion: As with analysis and evaluating, the conclusion should be based on the actual data obtained. In most cases candidates are justified in saying the data supports the hypothesis but in some cases this is not the case and candidates should say so and go on to explain why.

There is also the requirement in this Skill quality for candidates to clearly link their research to their own experiment and to appropriate scientific knowledge and understanding. Question 6 of part 3 provides an opportunity for this but it is to be remembered that evidence for any of the marking criteria can be obtained from any part of the candidates’ work. Annotation helps considerably if marks awarded are related to work from elsewhere in the task.

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