OCR
Oxford Cambridge and RSA

GCSE

Chemistry B

Gateway Science Suite

General Certificate of Secondary Education **J264**

OCR Report to Centres June 2014

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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.

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General Certificate of Secondary Education

Chemistry B (Gateway) (J264)

OCR REPORT TO CENTRES

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

General Comments:

This was the first time this examination paper had been taken by candidates as part of a terminal assessment. There was no evidence that candidates did not have enough time to finish the examination paper.

The examination paper allowed candidates of all abilities to show positive achievement.

There was a small proportion of candidates that might have successfully taken the Higher Tier rather than the Foundation Tier examination paper.

The three six mark questions were often well answered and candidates were able to construct clear answers. The quality of written communication was generally quite good but at times candidates failed to use the correct chemical terminology.

Candidates found Section A the least demanding section and found Section C the most demanding.

The ability of candidates to answer questions that assessed evaluation skills has improved over previous sessions.

Comments on individual questions:

Question One

This question was about the properties and use of perfumes.

(a) Many candidates were able to give one reason often relating to either toxicity or irritation of the skin. A common misconception was to refer to the smell of the perfume when the question was asking about testing before the perfume could be permitted to be used.

(b)(i) This question assessed the evaluation of data. There was not a mark for the choice of perfume; all the marks were awarded for the reasons given. Candidates were often able to explain their choice of perfume referring to the lack of solubility and the need for a low boiling point so the perfume would evaporate easily. A common misconception was that a perfume with a high volatility would have a high boiling point.

(b)(ii) A wide range of answers were accepted for this question, either relating to the perfume itself or issues relating to the manufacture of the perfume. A small proportion of the candidates gave reasons given in the table and these answers were not given credit. The most common correct responses were the smell, the ingredients and safety issues.

Question Two

This question was about the burning of coal.

(a) Many candidates gave imprecise definitions for the term non-renewable fuels. In particular they referred to fuels that were used up rather than mentioning the rate of production of the fuel being much less than the rate of use. Candidates that referred to the finite nature of a non-renewable fuel were awarded a mark.

(b) Most candidates could write the word equation. There were very few examples of answers where the candidate attempted a symbol equation.

(c) The environmental effects of acid rain were well known by the candidates. The most common correct answers involved the killing of plants or aquatic animals or the erosion of rocks, buildings and statues.

(d) Candidates found this question very challenging. A significant proportion of the candidates changed the formulae given for example writing H_2O_2 rather than H_2O.

(e) The test for carbon dioxide was not well known and a significant proportion of candidates did not answer the question. A common misconception was to refer to carbon dioxide extinguishing a lighted splint.

Question Three

This question involved the interpretation of displayed formulae.

(a) Many candidates could interpret the displayed formulae and recognise that **D** and **E** both had five atoms in a molecule.

(b) Candidates found this question much more demanding than (a) and did not recognise that the molecules had to contain a carbon-carbon double bond. Only a small proportion of the candidates wrote **A** and **F**.

(c) Candidates often gave very good explanations as to why **B** was hydrocarbon and **C** was not. The idea that hydrocarbons contain only hydrogen and carbon was well known. A common misconception was to refer to the presence of carbon and hydrogen molecules in a hydrocarbon.

Question Four

This question was about the use and disposal of polymers.

(a) This question assessed quality of written communication in the context of the properties and uses of polymers.

Candidates were often able to explain why the plastic was suitable for making the container for sandwiches. In terms of non-biodegradable candidates often referred to the plastic not rotting or decomposing. Candidates that referred to recycling were not given credit. Many candidates appreciated that if the polymer was insoluble in water then water could not enter or leave the container.

Candidates could often explain an extra property the polymer would need but did not always identify the name of the property. For example candidates mentioned the sandwich box should not change shape easily without naming the actual property. Typical properties described were flexibility, permeability to air, and transparency.

(b) Most candidates were able to describe two ways of disposing polymers, typically recycling, land-fill or burning.

Question Five

This question was about rocks and the structure of the Earth.

(a) Most candidates could identify at least one layer but often struggled to name all three layers. Some candidates referred to an inner and outer core and others referred to the magma rather than the mantle. Some candidates labelled the crust as the lithosphere and this was given credit.

(b) Candidates needed to identify rock **B** and explain why it would have bigger crystals. Good answers appreciated that the crystals in rock **B** were big so that the molten rock must have cooled slowly.

(c) Many candidates could interpret the formula given and deduce that it contains three different elements. Some candidates gave answers that referred to the number of atoms in the formula instead.

Question Six

This question was about fertilisers.

(a) Many candidates recognised that the element nitrogen was present. The use of nitrate was not given a mark since it is not an element.

(b) The acid needed to make ammonium sulfate was well known. Nitric acid and ammonia were two incorrect answers given by candidates. The most common misconception was to refer to sulfur acid rather than sulfuric acid.

(c) Many candidates were able to give a benefit and a disadvantage of using fertilisers. The idea that plants grow faster or give a greater crop yield was well known. Other candidates referred to the presence of extra plant nutrients. In terms of disadvantages candidates often used the term eutrophication or described some of the processes involved with eutrophication. It was not sufficient to describe that fertilisers could be washed away. A common misconception was that fertilisers kill other animals on the crop and act as pesticides.

(d) This question assessed the quality of written communication in the context of the cost of making nitric acid from ammonia. Answers were often well constructed and started with the word equation and then went on to describe different costs.

Many candidates could construct the word equation but there were some errors in which water was also given as one of the reactants.

The different costs of making chemicals were well known and sometimes candidates went beyond the mark scheme in terms of explaining how the process could be made cheaper. Typically the most common costs were that for maintaining the pressure and temperature, the raw materials, and labour costs.

A small but significant proportion of the candidates did not attempt this question.

Question Seven

This question was about the materials used to make a car.

(a)(i) Most candidates appreciated that the material needed to be transparent.

(a)(ii) Many candidates referred to the property given in the stem and so were not awarded a mark. The most common correct answer was to refer to aluminium not rusting. Candidates that referred to aluminium not rusting easily were not awarded a mark since aluminium may corrode but does not rust since it is not a ferrous metal. Any reference made by candidates to cost was ignored.

(b) Most candidates could evaluate the information in the table and recognise it was important that PVC is a non-conductor of electricity and that it is flexible.

Question Eight

This question was about chlorine and chlorine compounds and it was the most challenging question in Section B.

(a) Candidates found balancing the equation for the reaction between sodium and chlorine very demanding. Candidates often changed the formulae given and used Cl instead of Cl_2, $NaCl_2$ instead of $NaCl$. Some candidates even use diatomic sodium, Na_2, in their equations.

(b)(i) Most candidates could recall that chlorine was used in swimming pools although most candidates did not explain why. Candidates did not often refer to chlorine sterilising water and often referred to cleaning water instead.

(b)(ii) The chemical test for chlorine was not well known. The use of litmus or other indicators was not recalled by candidates. Candidates often gave tests for other gases such as lime-water or a glowing splint.

(c) This question assessed the evaluative skills of the candidates. Many candidates found it difficult to express their answer clearly and often just referred to each metal having different properties. The best answers appreciated that the conclusion was correct and illustrated their answer by quoting which metal would be best for each substance to be stored. Candidates did not often state clearly that the metals could not be used if they corroded rapidly.

Question Nine

This question was about the allotropes of carbon and was the most demanding question in Section C.

(a) Many candidates recognised diamond.

(b) Candidates often gave one property of graphite but were less likely to give two properties. Candidates that referred to graphite as strong or hard were not given credit. The most common correct properties were that graphite had a high melting point and conducts electricity but all the other properties in the mark scheme were seen by the examiners. Some candidates referred to the presence of layers or the idea of weak intermolecular forces between the layers. Since these are not properties of graphite they were not given credit in the mark scheme.

(c) The use of fullerenes as a drug delivery system was not well known by candidates. Most candidates did not appreciate that the drug molecule could be trapped inside the fullerene.

Question Ten

This question was about the rate of reaction of magnesium ribbon with dilute hydrochloric acid.

(a) This question assessed quality of written communication, evaluation and the ability to apply collision theory. Although candidates often appreciated that the conclusion was not supported by the results they did not refer to the experiment numbers to help their explanation. The best answers referred to experiments 1 and 3 where the volume changed but the reaction time did not.

Candidates often appreciated that the difference in reaction times in experiments 3 and 4 was because the concentration of the acid had been changed. Only the best answers related this to collision theory and described an increased collision frequency or more crowded particles in the more concentrated acid.

(b) Many candidates could predict a reaction time of less than 30 seconds but they did not always explain why. It was sufficient to state that the reaction was faster to be awarded the explanation mark. Some candidates gave explanations involving collision theory.

Question Eleven

This question was about the manufacture of ethanoic acid.

(a)(i) Many candidates did not understand the concept of atom economy and as a result could not explain what 100% atom economy means. Very few candidates referred to either the formation of just one product or all of the atoms ending up in the desired product. Many candidates just referred to the same number of atoms before and afterwards which does not necessarily mean 100% atom economy. Many candidates did not attempt this question.

(a)(ii) The answer of 14 tonnes was calculated by some candidates, but others did not attempt the question.

(b) Candidates found this question more difficult than (a)(ii) because it involved the use of a ratio. Candidates rarely showed the working out used to get to the correct answer of 6.0 tonnes.

(c) Many candidates struggled to clearly describe a continuous and a batch process. These candidates often used the words continual or batches in their answer rather than trying to explain what they meant. The best answers referred to a 24/7 process compared to one that is done several times on demand. Other candidates referred to making chemicals all the time or making them on demand.

(d) Some candidates did not quote their answer to two significant figures and so did not get both marks for the question. The best answers showed the working out and then had the answer correctly rounded to 46% at the end. Some candidates inverted their numbers and obtained a percentage yield above 100%. Other candidates left the question blank.

Question Twelve

This question was about calorimetry.

(a) Many candidates recognised the description for an exothermic reaction.

(b) Candidates found this a demanding question and even if they drew a diagram were not awarded any marks. Centres should advise candidates to ensure that the pieces of apparatus and the substances they contain should be labelled. A common misconception was to use a Bunsen burner to heat a container of paraffin; often the thermometer was used to measure the change in temperature of the paraffin.
Other candidates did have a spirit burner below a container of liquid but did not label the liquid so it was not possible to tell if the liquid was water.
Some candidates used gas syringes to collect some of the gases produced.
A significant proportion of the candidates did not attempt this question.

(c) Many candidates obtained an answer between 2.4 and 2.6 (g) and were awarded full marks. Candidates were often able to correctly plot the points and draw a line of best fit.

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 generally 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 carbon compounds, the different materials used to build cars and the uses of metals and alloys.

Candidates did not seem to have the knowledge required to respond fully to questions about polymers, the structure of the Earth and the structure and properties of graphite.

Candidates did not perform as well in calculations as in previous sessions. 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 compounds containing carbon.

(a) The molecular formula for compound B was usually correct.
(b) Most candidates explained that compound B is a hydrocarbon as it contains carbon and hydrogen only. They appreciated that compound C was not a hydrocarbon as it contained an oxygen atom. When candidates did not gain credit it was usually because they referred to B containing 'only carbon and hydrogen *molecules'*.
(c) A and F were usually correct.

Question 2
This question was about emulsifiers and cooking.

(a) Most candidates correctly labelled the hydrophilic head and the hydrophobic tail in part (i). Good responses in part (ii) described that the hydrophilic head is attracted to, or bonds with, water and that the hydrophobic tail is attracted to, or bonds with, oil. Error carried forward was allowed if the labels were the wrong way round in part (i).
(b) Most candidates knew that egg yolk contains protein molecules, which change shape when the egg is cooked. To gain both marks in this question candidates needed to explain that the protein molecules change shape *permanently*.

Question 3
This question required candidates to interpret data and draw conclusions based on evidence.

(a) This question required candidates to write a balanced symbol equation for the complete combustion of methane in oxygen. 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 wrote an incorrect formula for water, e.g. H_2, or failed to balance the oxygen atoms on the left hand side of the equation.
(b) Good responses to this question displayed an ability to interpret the data about limestone and sea water and decide, with reasons, which method would be more suitable for removing nitrogen dioxide from the waste gases of the power station. The mark scheme allowed candidates to choose either limestone or sea water, provided their choice was clearly justified.

Question 4
This question focused on polymers

(a) Many candidates drew the displayed formula for poly(ethene), rather than for poly(propene). To score the marks candidates needed to draw the basic covalent structure of the polymer, including the correct use of brackets and 'n' to indicate many repeat units. Credit was also given to candidates who drew 2 or more repeat units. Candidates need to ensure that they include the bonds at the side in the polymer structure to gain credit. Structures containing double bonds or only 3 bonds on carbon atoms did not gain marks.
(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 poly(propene) is flexible and suggest and explain two other properties needed by a plastic used to make a lunchbox. 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 flexibility of poly(propene) in terms of weak intermolecular forces that are easy to overcome, allowing the polymer chains to slide over each other.

Question 5
This question was about paints and pigments.

(a) Most candidates were able to use ideas about absorbing energy in the light, and then releasing the energy in the dark, to explain why phosphorescent pigments glow in the dark.
(b) Many candidates correctly described the oxidation of the oil. Candidates who failed to gain credit usually merely repeated information from the stem of the question.

Question 6
This question was about the materials used to build a car.

(a) Most candidates suggested that glass for a car windscreen needs to be transparent in part (i). Good responses to part (ii) described that aluminium corrodes less than steel. Candidates who failed to gain credit often described that aluminium does not rust as easily as steel.
(b) Good responses to this question used the data to explain that PVC is used for covering electrical wiring as it is flexible and a poor electrical conductor.

Question 7
This question was about fertilisers.

(a) Most candidates were successful in deducing the number of each type of element in the formula for ammonium sulphate. Candidates who did not gain credit usually either gave the relative atomic mass of each element or calculated the mass of the element in the formula.
(b) Good responses to this question correctly stated that sulphuric acid and ammonia / ammonium hydroxide are needed to make ammonium sulphate and described how the acid and alkali are used to make a neutral solution. It was not necessary to describe a titration method to gain full credit, but candidates did need to suggest the controlled addition of acid to alkali rather than merely adding the acid to the alkali.
(c) This 6 mark question focused on the conditions used in the reaction to manufacture nitric acid and was targeted up to grade A*. At the simplest level, a candidate who described an advantage or a disadvantage of the conditions used, or who gave an unbalanced equation for the reaction, scored Level 1. To gain Level 2 candidates needed to give a correctly balanced symbol equation for the reaction. Alternatively candidates could describe an advantage and a disadvantage of the conditions used, although marks scored in this way were rarer. As in the other 6 mark questions on the paper, candidates had to address all aspects of the question to gain credit at level 3 (5-6 marks). Many candidates gained credit at Level 3 in this question.

Question 8
This question tested ideas about the structure of the Earth.

(a) Most candidates appreciated that it is difficult for scientists to study the structure of the Earth because the crust is too thick to drill through.
(b) Part (i) assessed the 'How Science Works' aspect of the specification and required candidates to identify the stages in the development of the scientific theory of plate tectonics. Good responses described Wegener's suggestion of continental drift theory, which was not accepted until later evidence, such as sea floor spreading, was obtained. Many candidates gained credit for suggesting evidence such as continents fitting together, even if they did not explain a subsequent stage in the development of the theory. In part (ii) good responses appreciated that subsequent research has supported the theory.

Question 9
This question was about metals.

(a) Most candidates were able to use the data in the question to suggest and explain which metal is the most suitable for making the bicycle. Candidates could gain full credit for justifying the choice of either stainless steel or titanium as the data presented suitable reasons for both.
(b) Many candidates scored both marks. Candidates who only scored 1 mark usually correctly identified the electrolyte as copper sulfate solution.

Question 10.
This question tested ideas about redox reactions.

(a) Most candidates correctly balanced the equation.
(b) Most candidates explained that oxidation is loss of electrons. Candidates who did not gain credit either stated that electrons were gained, or suggested that the wrong species was losing electrons, e.g. bromine loses electrons.

Question 11
This question was about graphite.

(a) Good responses to this question explained the suitability of graphite for making pencils in terms of the layers in the structure sliding over one another so that the graphite leaves a mark which can be seen on the paper. A common omission was not to describe the slippery / layered structure.
(b) Most candidates explained the electrical conductivity of graphite in terms of free or delocalised electrons in part (i). In part (ii) many candidates appreciated that graphite contains strong bonds that need to be broken. The second mark for the idea of graphite having a giant structure or **many** covalent bonds was, however, rarely awarded. Candidates who failed to gain credit in part (ii) often described graphite as having strong intermolecular forces or bonds.

Question 12
This question focused on rates of reaction.

(a) 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 data and could explain why experiment 4 was faster than experiment 3 using ideas about collision frequency. When candidates did not gain credit it was usually because they did not refer to experimental evidence. Some candidates compared experiments 2 and 3, where both the mass of magnesium and volume of acid changed.
(b) Most candidates scored 1 mark for explaining that at higher temperature the particles would have more energy or move faster. Good responses also explained that this resulted in more *successful* collisions.

Question 13
This question tested aspects of quantitative chemistry.

(a) Good responses 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.
(b) Candidates who understood the idea of reacting masses were able to correctly calculate the mass of ethanoic acid as 6g in part (i). Some candidates tried to calculate a percentage yield or atom economy. Few candidates scored 1 mark for correct working out. Candidates found the atom economy calculation in part (ii) challenging.
(c) In part (i) most candidates correctly calculated the percentage yield, but many did not give their answer to two significant figures and therefore scored only 1 mark. Good responses to part (ii) appreciated that a low percentage yield wastes reactants. Most answers were expressed in terms of a large amount of waste products.

Question 14
This question was about measuring the energy released when fuels burn in air.

This experiment was obviously familiar to most candidates who were able to describe using the paraffin to measuring the temperature rise when heating water in a suitable container. Most candidates chose to draw a diagram to illustrate their answer and many would have scored more marks if their diagram had been correctly *labelled*.

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 4(a) concerning deductions about aluminium was targeted at all grades up to and including grade C. About a third of candidates gained level 3 (5 or 6 marks) on this question. Question 9 concerned deductions about the effect of changing temperature and changing pressure on the percentage yield in an equilibrium mixture. This question was also targeted at all grades up to and including grade C. Over half of candidates scored level 2 (3 or 4 marks) but less than 10% gained level 3. Question 13 concerned with hard and soft water proved the most demanding of the 6 mark questions. About half of candidates scored level 1 (1 or 2 marks).

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:

Question 1

(a) Most candidates correctly identified a group 2 element. Calcium was the commonest correct answer. Sodium was the most frequent incorrect answer.
(b) Again this question was well answered. Sodium was the commonest correct answer, although aluminium and chlorine also featured. Confusion between groups and periods was seen from a minority of candidates who offered calcium.
(c) About half of candidates failed to score on this question. Many candidates scored 1 mark for correctly identifying group 2. Fewer also identified the 3rd period. A common misconception was period 2.

Question 2

(a) Most candidates scored at least 1 mark on this question with many scoring 2 marks and a few all 3 marks. The colour of chlorine was not well known. ‘Yellow’ and ‘blue’ were common incorrect answers. The majority of candidates knew that bromine was a liquid. The commonest use of iodine was as an antiseptic although ‘making medicines’ was a common acceptable answer.
(b) Most candidates could successfully write the word equation.

Question 3

(a) Most candidates could describe at least one correct property of metals with many giving two. ‘Hard’ was a common correct answer. Incorrect answers included ’lightweight’ and ‘a solid’.
(b) This question was well answered. Candidates could identify the necessary properties and many offered explanations for why the property was needed e.g. ‘strong to carry his weight’.

Question 4

(a) About a third of candidates scored level 3 (5 or 6 marks) on this question. They could identify the mass number and atomic number and work out the number of protons, neutrons and electrons. The best candidates could work out the electronic structure and state that aluminium was in group 3. Just over a third of candidates gained level 2 (3 or 4 marks). They either identified mass number and atomic number or stated the number of protons, neutrons and electrons.
(b) Candidates found this question difficult. Where a mark was scored, it was usually for mentioning the discovery of electrons, although this was rarely attributed to J. J. Thomson. Many candidates confused the work of Rutherford and J. J. Thomson with Mendeleev’s work on the development of the periodic table.

Question 5

(a) Most candidates could interpret the bar chart to state that the volume of sea water taken had increased. Only better candidates could infer that this may be because of increased power generation. Many confused this with rising sea water levels and suggested it was due to global warming.
(b) This question was poorly answered. Few candidates could recall fertilisers or lead compounds. Common answers included ‘dust’, ‘chlorine’ and ‘dirt’.

Question 6

(a) Just under half of candidates could recall one of the colours correctly and a further quarter correctly identified both. ‘Green’ was the most common correct answer.
(b) Less than half of candidates could identify a burette in part (i). Common incorrect answers included ‘measuring cylinders’, ‘pipettes’, ‘test tube’ and ‘measuring tube’. In part (ii) the most common safety precautions were to use goggles, gloves or protective clothing. Few candidates mentioned the use of a pipette filler. The idea that these precautions are necessary as the liquids used are corrosive, harmful or irritants was not well understood. In part (iii) most candidates mentioned a colour change and scored 1 mark. Fewer stated the sudden nature of the colour change or gave the correct colours for before and after neutralisation for the second mark.

Question 7

(a) Just over half of candidates gave the correct answer of 72 in this question. Others either omitted the question or added up the numbers incorrectly.
(b) About two thirds of candidates correctly gave the molecular formula of butyne as C_4H_6.
(c) Just under half of candidates understood what was meant by an empirical formula and gave C_2H_2 and C_6H_6. Incorrect answers frequently involved methane, CH_4 and ethene, C_2H_4.
(d) About half of candidates correctly calculated the percentage by mass of carbon in methane as 75%. Some candidates calculated the percentage of hydrogen as 25% and failed to score.

Question 8

(a) Better candidates correctly wrote this word equation. A significant number of candidates lost the mark as they included '+ heat' on the left hand side of the equation.
(b) Most candidates could correctly calculate the mass of water by subtraction. A small number followed the pattern of mass of water and stated 0.27 and 0.36 and lost that mark. Many also stated that, as the mass of copper hydroxide increases the mass of water produced also increases, and gained the second mark. Few gained the third mark for recognising that the relationship is a direct proportionality.

Question 9

Most candidates could state the relationship between the temperature and the percentage yield and between pressure and percentage yield and gained level 2 (4 marks). If only one of these relationships was given then level 1 (1 or 2 marks) was achieved. Few candidates could describe how the percentage yield was linked to the position of equilibrium which was necessary to reach level 3 (5 or 6 marks)

Question 10

(a) Only better candidates realised that the mass would decrease as a gas was given off which could escape from the flask. Many candidates thought that the mass would increase as the gas would not escape. The ideas around conservation of mass are not well understood by a significant number of candidates.
(b) This question was poorly answered by all but the best candidates. Better candidates recognised that the reaction with ethanoic acid would be slower because ethanoic acid is a weak acid. Many thought that ethanoic acid would react faster as it would react more strongly. Others just said that the reaction would be different because the reactants are different.

Question 11

(a) The majority of candidates correctly gave 52%.
(b) This question was well answered. Most candidates identified carbon, hydrogen and fluorine in part (i). Occasionally chlorine was incorrectly stated. Most identified 8 atoms in part (ii). Weaker candidates attempted to calculate the relative formula mass.
(c) Most candidates scored at least one mark on this question, usually for skin cancer. Many scored a second mark, often for sunburn. A few candidates misunderstood the question and stated global warming or other non-medical problems.

Question 12

(a) The vast majority of candidates could correctly read $5cm^3$ off the graph in part (i). About half of candidates scored 2 marks in part (ii) for correctly identifying 44^oC and stating that this temperature produces the greatest volume of carbon dioxide after 10 minutes. A common misconception was to identify the steepest part of the curve i.e. around 30^oC
(b) The best candidates invariably scored 2 marks on this question. They gave a correctly balanced symbol equation. Weaker candidates either failed to score or gave the correct formulae with either no attempt at balancing or incorrect balancing and scored 1 mark.

Question 13

Many candidates found this to be a difficult question. Few candidates could place the water samples in order of hardness. This was usually because they thought that if some or all of the hardness could be removed by boiling then the water sample must be softer than one where hardness was not removed by boiling. This gave an order of **B**, **C**, **A** which

limited the response to level 1 (1 or 2 marks). Better candidates identified sample **A** as permanently hard water and sample **C** as temporary hard water. Very few noted that sample **B** contained both temporary and permanent hardness. Correct identification of the type of hardness in one of the samples with a correct reason scored level 2 (3 or 4 marks). Correct identification of the type of hardness in two of the samples with no explanation also scored level 2. To gain level 3 candidates needed to rank the samples correctly in order of hardness and identify the types of hardness in two of the samples with correct reasons.

Question 14

(a) Most candidates scored 2 marks on this question. A common incorrect substance was 'salt'.

(b) This question discriminated well across the ability range. Most candidates could state one or two methods of protecting iron from rusting. Painting, oiling and galvanising were common correct answers. Better candidates gave good explanations of how the methods worked. Weaker candidates suggested keeping the iron inside away from water.

Question 15

(a) Better candidates answered this question well. They realised that both solvents **A** and **D** were required and that they did not damage clothes. Weaker candidates thought that they had to find one solvent that could remove both stains and said that this was not possible.

(b) This question was well answered by the majority of candidates. Occasionally candidates thought that enzymes did the cleaning and lost a mark. 'Optical brightener' was almost always matched to 'gives a whiter than white appearance'.

Question 16 (data response)

(a) Most candidates could correctly identify electricity generation in part (i). They also correctly interpreted the data to recognise three other patterns in part (ii). Part (iii) was more challenging, but was well answered by better candidates. Occasionally the number of zeroes involved proved a stumbling block for some candidates who often then attempted to manipulate the answer to 30.95%. About a third of candidates correctly identified an increase in part (iv). Many stated that the percentage did not change, presumably because the question states that the volume does not change, failing to recognise that the total volume used had fallen.

(b) This question required candidates to process information from two graphs and use it to support a prediction. Most candidates identified that the number of homes with water meters was increasing and that the population was rising. Only a few candidates could make the final step to say that these two changes would balance each other out for the third mark.

B742/02 Unit 2 Modules C4 C5 C6 Higher Tier

General Comments:

This was the first time this examination paper had been taken by candidates as part of a terminal assessment.

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.

All three six mark questions were answered and candidates were often able to construct clear answers. Many candidates wrote extensively and needed additional sheets to complete their answers. The quality of written communication was generally quite good but some candidates failed to use the correct chemical terminology.

Candidates found Section C the least demanding section and found Section B the most demanding. However there was a fairly even performance over the four sections.

There was an improvement on the last session in terms of the ability of candidates to do questions that assessed evaluation skills. In particular candidates were able to use the data provided in Section D to construct their answers.

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. As in last year's examination paper candidates are still uncertain about the use of significant figures.

Candidates often illustrated their answers with diagrams but they need to be careful that the diagrams are fully labelled and that apparatus is drawn as accurately as possible within the time frame of an examination.

Comments on individual questions:

Question One

This question was about some of the elements in group 1 of the Periodic Table.

(a) Many candidates could use the data provided to estimate the melting point of sodium and the atomic radius of rubidium. Candidates found the melting point of sodium less demanding than the atomic radius. Some candidates missed out this question possibly because they did not see the gaps in the table.

(b) Although many candidates could construct the balanced equation for the reaction between sodium and water there was a significant proportion of candidates that did not attempt to balance the equation. Only a small proportion of candidates tried to change the formulae of the reactants or products.

(c) Many candidates appreciated that all the elements in Group 1 had one electron in the outer shell. A small proportion of the candidates stated that the elements had the same number of electrons in the outer shell and this was also accepted in the mark scheme. Some candidates only referred to the elements losing one electron from the atom but this was not sufficient unless the answer referred to the formation of a stable outer shell. Other candidates made no reference to the outer shell electrons and just stated that the elements had similar properties

(d) Most candidates attempted to draw an ionic rather than a covalent 'dot-and-cross' diagram however some neglected to include the charges on the ions. Other candidates did not show the full electronic structures which were required in this question. Candidates should be advised not to show the charge on the ions in the nucleus but should show the on the outside of the structure. Another misconception was to draw the electron transferred twice both in the shell of the sodium atom and in the outer shell of the fluoride ion.

Question Two

This question was about the structure and bonding of compounds.

(a) The relative charge on an electron was well known but the relative mass of a neutron was less well known.

(b)(i) Many candidates appreciated that the melting point of sodium chloride was high but could not name the particles present in carbon dioxide. Many candidates wrote atoms, ions or electrons and only a very small proportion of candidates gave the correct particle, a molecule.

(b)(ii) Many candidates appreciated that the low melting point of carbon dioxide was due to a weak force but a significant proportion had this as a weak force between atoms rather than between molecules. The best answers referred to weak intermolecular forces.

Question Three

This question was about the structure of the atom and was the most demanding in Section A.

(a) This question assessed the quality of written communication in the context of the interpretation of an atomic symbol.

Candidates often gave very good answers where they made deductions about the atomic structure of aluminium that included an explanation for the deduction. Candidates were able to deduce the number of subatomic particles in the aluminium atom and also the electronic structure. Many used the electronic structure to state the group number and the period number for aluminium.

One common misconception was the mass number represented the relative atomic mass. Some candidates referred to rows and columns in the periodic table rather than periods and groups. If candidates gave a group number it was invariably correct but a small proportion of the candidates gave the period number as 2 rather than 3.

(b) Only an extremely small proportion of the candidates could describe the correct experiment or appreciate that the results of the experiments were unexpected. Many candidates were awarded a mark that the experiment was connected with the discovery of the nuclear atom. A significant proportion of the candidates did not attempt this question.

Question Four

This question was about the structure, bonding and properties of metals.

(a) Many candidates could evaluate the data in the table and suggest, with reasons, the letter of a metal that could be used to make the base of a saucepan. There were no marks for the choice of metal; all the marks were awarded for the explanation. Most candidates appreciated the importance of both a high thermal conductivity and a high melting point.

(b) Many candidates illustrated their answers using a diagram, but often the diagram was not labelled so it was not possible to tell if the positive particle was a metal ion or a proton. Good diagrams were fully labelled and showed electrons interspersed between closely packed positive ions. The idea that the electrons could move resulting in electrical conductivity was well known.

Question Five

This question was about the titration of dilute nitric acid with sodium hydroxide solution and was the most demanding question in Section B

(a) Many candidates appreciated that universal indicator showed many colours or had a gradual colour change. Some candidates did not mention the word colour in their answer and only referred to a slow change. This was not sufficient to be awarded a mark.

Only a small proportion of the candidates appreciated that universal indicator was a mixed rather than a single indicator.

(b)(i) Although many candidates appreciated that titre 1 was an anomaly or an outlier they did not always go on to state that the other three were used to calculate the mean. Only a small proportion of the candidates commented on the closeness of the last three titres. The best answers indicated why titre 1 was not used and then showed how the other three titres are used to get the mean titre. A common misconception was that 25.2 cm^3 was used as a titre because it was the mid-range value of the three best titres.

(b)(ii) Many candidates could not calculate the amount in moles as 0.0015. The most common misconception was to forget to convert cm^3 into dm^3 and calculate the number of moles as 1.5.

(b)(iii) A significant proportion of the candidates did not attempt this question often because they could not do (ii). Only the very best answers showed the working out for the calculation. Centres should advise candidates that it is important to show the working out to allow examiner's to award error carried forward marks. Many candidates did not quote the final answer, 0.0595 mol/dm^3, to three significant figures as required in the question and gave the answer as 0.06 mol/dm^3.

Question Six

This question was about different types of formulae of hydrocarbons.

(a) Many candidates could calculate the molar mass of pentane as 72 g/mol.

(b) Although many candidates gave the molecular formula as C_4H_6, some gave partial structural formulae instead.

(c) A significant proportion of candidates chose the two correct hydrocarbons.

(d) Candidates found this empirical formula calculation very challenging and only the best candidates were able to get the answer CH_4. Typically candidates did show their working out for this question and this often showed up their misconceptions. One misconception was that candidates used the atomic number rather than the relative atomic mass to calculate the mole ratio of carbon to hydrogen. Other candidates did not use the mole ratio at all and used a mass ratio instead getting an answer of C_3H. A significant proportion of the candidates did not attempt this question.

Question Seven

This question was concerned with the evaluation of data.

Many candidates could calculate the missing column in the data table. However a common error was to quote the mass of water as 0.9 rather than 0.09 in experiment 1. Candidates could either state that the data supported the prediction or that it did not. The best answers used data from the table to support their answers for example from experiment 1 to 2 the mass of copper hydroxide doubled and so did the mass of water. Alternatively candidates could compare results with experiment 5 to show that the prediction was not supported. Other candidates calculated the constant of proportionality that linked the mass of copper hydroxide and the mass of water and compared this value for different experiments.

Some candidates only described that the mass of water increased as the mass of copper hydroxide increased without reference to specific data.

Question Eight

This question was about the factors that affect the position of equilibrium.

(a) Candidates often focused too much on the interpretation of the data regarding percentage yield. The command word used in the question was describe and all candidates had to do was describe how increasing pressure or increasing temperature changed the position of equilibrium. Candidates needed to explain the effect of adding extra carbon dioxide to the position of equilibrium and in this case had to use Le Chatelier's principle to explain why the position of equilibrium moved to the right.

Most candidates could interpret the tabulated data but this only gave them level 1. Only the best answers could explain why adding carbon dioxide shifts the position of equilibrium to the right.

Some candidates confused shifting to the left or to the right with the change in percentage yield.

(b) This question assessed how science works and most candidates could give one reason why scientists should work in terms and many candidates gave a second reason. The most common reasons involved sharing ideas, more efficient working and easier peer review.

Question Nine

This question was about the reaction of marble with dilute acids.

(a) Candidates often referred to ethanoic acid being only partially dissociated. Other candidates referred to the lower concentration of hydrogen ions or less collisions.

(b) Most candidates used a gas syringe to collect the carbon dioxide produced although some collected the gas by displacement of water from a measuring cylinder or an upturned burette. Candidates must take sufficient time when drawing diagrams to ensure that they are fully labelled and that the system is gas tight.

Question Ten

This question was about different alcohols and was the least demanding question in Section B

(a)(i) Candidates had little difficulty interpreting the graph and often quoted values between 12 and 13 cm^3.

(a)(ii) Candidates often quoted a temperature between the accepted values of 42 to 45^oC. The normal reason given was that the temperature gave the greatest volume of carbon dioxide. A small proportion of the candidates explained that the temperature quoted was the optimum temperature for the enzymes which was allowed in the mark scheme. Candidates that gave other temperature values often looked at the gradient of the graph rather than the actual volume of carbon dioxide produced.

(b) Many candidates could construct the balanced equation. Only a small proportion of the candidates changed the formulae of either the reactant or the product.

(c)(i) Many candidates could use the general formula to calculate the formula for propanol.

(c)(ii) Candidates often drew a correct displayed formula. The mark scheme allowed candidates to write the –O—H group as –OH but Centres should advise candidates that a proper displayed formula shows all of the bonds. Some candidates included pentavalent carbon atoms and others had oxygen atoms with a double bond. Another misconception was to have the –OH bond in the wrong order having C—H—O.

Question Eleven

This question was about detergents.

(a) Many candidates were able to evaluate the data and suggest that detergent **C** contained an enzyme. The best answers referred to the removal of blood or food stains.

(b) The best answers to this question included a labelled diagram although many of the diagrams did not include the idea that the hydrophobic tail was attracted to oil and the hydrophilic head was attracted to water. The term hydrophilic was well known and used in the correct context.

(c) A significant proportion of the candidates misinterpreted this question and described how to test for a fat rather than how to test for unsaturation. Those candidates that did chose bromine often gave the correct result for an unsaturated fat and the number of candidates using clear rather than colourless has reduced from previous sessions.

Question Twelve

This question assessed the quality of written communication in the context of hardness of water.

Many candidates made good attempts at answering the question and often found it easier to compare the three water types rather than describe how sodium carbonate softened water. Candidates made good use of the data to conclude that water sample **A** contained permanent hardness and sample **C** contained temporary hardness. Candidates found it much more difficult to explain that sample **B** contained both types of hardness. The idea that temporary hard water is softened by boiling was well known.

Candidates found describing how sodium carbonate softens hard water very challenging and rarely mentioned the formation of insoluble calcium or magnesium carbonate. The most common misconception was that hard water contained calcium carbonate. Only the very best answers included an equation to show how the water was softened.

Answers were often well organised with the identification of water samples followed by the water softening by sodium carbonate.

Question Thirteen

This question was about CFCs.

(a) Many candidates did not describe the initial increase in the concentration of CFCs but focused only on the decrease in concentration that occurred after 1995. The idea of a ban in the use of CFCs was well known and some even gave names of the appropriate international agreements.

(b) Only the very best answers gave detailed answers about how the scientists' attitude changed. Candidates often only described ozone depletion and the subsequent ban but did not mention the initial enthusiasm for CFC based upon the inert nature of CFCs. Some candidates did mention the initial uses for CFCs such as aerosol propellants.

Question Fourteen

This question assessed evaluation skills and was concerned with water use and consumption. Candidates did not need to have any subject knowledge and only had to interpret the data provided in the questions.

(a)(i) Most candidates appreciated from the bar chart that less water was being used for electricity generation. Some candidates mentioned the increase in use of methods to generate electricity that did not use water such as solar power or wind turbine.

(a)(ii) Candidates often showed clearly the working out of the required calculation. Almost all candidates could interpret the bar chart to appreciate that the total daily volume of water was 42000 megalitres. Most candidates showed that 13000 was 30.95% of 42000, however some candidates showed that 30.95% of 42000 was 12999 (13000) instead. Centres must advise candidates that in calculations such as these the marks are awarded for the working out, and so all the working out has to be fully shown

(a)(iii) Some candidates did a second calculation to work out the percentage of water used for public water supply and therefore show that it had increased. Other candidates used a more qualitative approach in terms of the volume of water used for public water supply being constant but the total decreasing.

(b) Candidates were often able to use the data provided to make a comment about the volume of water needed for public water supply in terms of the population increase, number of water meters and the amount of water loss. Candidates found the data about water loss the most difficult to interpret because it did not really change. The question asked for a prediction and many candidates did not make an overall prediction and so were not awarded full marks.

(c)(i) Many candidates chose Albania.

(c)(ii) Candidates chose a variety of different countries including the United States, China and Bangladesh even though the data only supported one country namely Niger. The best explanations compared the amount of water available with the population and found that Niger had the smallest amount of water available per person.

B743 Controlled Assessment

General Comments:

The addition of 'Extended Science' to the range of options available proved popular with some centres.

Centres are, in general, coping more efficiently with the system and some excellent work accurately marked was seen particularly in the separate sciences.

There were, of course, some exceptions and a number of centres used tasks from last year or from next year in error. This mistake will not disadvantage candidates but the centres concerned will be forbidden to use the same tasks for next year's assessment.

There seemed to be fewer large adjustments to the marks given by centres as a result of moderation though, of course, there were still some which marked over-generously.

Most centres annotated candidates' work to show/explain where marks had been awarded. This aided the process of moderation and centres are thanked for the efforts involved in this annotation.

Most centres also submitted samples of work which were well organised and securely fastened together. Moderators are grateful for this as, again, it makes the process of moderation more straightforward.

Centres are reminded that in signing the CCS160 (Centre Authentication) form they are guaranteeing that the work submitted is the candidate's own unaided work.

There was a small but significant number of centres where too much assistance had clearly been given to candidates. In a few cases two or more candidates were found to have completely identical work.

In previous years comments on individual skill qualities have concentrated on how centres could avoid common errors in the interpretation of the criteria. Centres which feel the need for such guidance should consult the reports written in 2012 and 2013.

This year the report will deal with strategies to ensure that candidates score well in each skill quality. Some of the points made will, of course, be the same.

Research
Candidates should focus on the bullet points from stimulus sheet 1. They should deal with each of these points separately and ensure that each question posed is answered fully. It should be clear from references within the text where the information was sourced from.

It is not necessary to produce extensive research notes. The inclusion of material which is not relevant to the bullet points reduces the mark available as the candidate has not demonstrated their ability to 'select' the information which is relevant. Quality is much more important that quantity.

Planning
A hypothesis, where appropriate, should start with the prediction and follow it with a scientific explanation of the reasons for making it. It need not be unnecessarily long.

Whilst not being essential, it is helpful if the variables which are part of the task are listed and an explanation of each including control where possible is given.

It is also helpful if apparatus to be used is listed and the reasons for choosing are given. This allows candidates to fulfil the criteria of 'ensuring accuracy' and 'avoiding errors'.

A plan should be detailed and step by step. Details of how to set up apparatus should be given where appropriate (a diagram can be helpful here).

The plan should give details of the range of values to be investigated and of the number of replicates to be attempted.

If the planned method is changed the reason for this should be given.

The plan should always be designed to produce numerical data which can be displayed as a graph (see Processing data).

Collecting data
Structure is more important than neatness. A very neat table which is confusing or incomplete is not worth the highest marks. A table laid out logically with appropriate headings and units clearly showing how the data relates to the task and including all the raw data is worth high marks even if it is not very neat.

If all the data is there, well organised, easy to understand and with correct headings and units, centres should not be afraid to give full marks.

Managing risk
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 are made to reduce risks by **appropriate specific** responses'. The highlighted words speak for themselves.

Processing data
To gain the higher marks a graph is essential and all tasks are designed so that they produce data suitable for graphing. Key words in the 5/6 criteria are 'scales and axes selected'. These should be selected so that the correct data is accurately plotted to produce a graph which fills at least half of an A4 sheet of graph paper (this is the graph not the grid which it is plotted on). A line of 'best fit' is usually a straight line or a smooth curve. Neither should be artificially forced to go through the origin, which is not usually a point.

A treatment of uncertainty such as range bars is essential for 6 marks.

If a plan does not aim to collect a sufficient range of data then a suitable graph cannot be drawn and the higher marks are not accessible.

Analysing and Interpreting data
A correct description of the trend is required. This should be the trend shown by the data not the one predicted by the hypothesis (though they should be the same). This description should be linked to data (or the graph). Some scientific explanation for the trend is required though this could be credited if it present in the conclusion.

Secondary data should not merely be mentioned but ‘links between primary and secondary data evaluated'. Reasons for any differences should be explored. There should also be an analysis of 'the treatment of uncertainty'. Scoring 6 marks here is not straightforward and additional space may be required (see comments below).

Evaluating
A relevant comment about the data is essential. No data is perfect; candidates should refer to their range bars if present. They should comment on difference between replicates and how the points drawn relate to their best fit lines. Too many candidates seem to think that they gain marks from having accurate data, That is not the case in this skill quality.

Once weaknesses in the data have been identified remedies need to be suggested. It is not sufficient to say what went wrong. How to do it better next time is what is needed.

A simple statement such as use of video camera of use a data logger is not sufficient. Why would this be better?

Consider the words 'detailed and critical consideration' and 'suggestions for improvements justified'

Justifying a conclusion
Here the words 'critical analysis of the data' make it clear that a simple statement such as ‘my results support the hypothesis’ is not sufficient. Is there any doubt? Could they be interpreted differently? Please note also the words 'from research and investigation'. This is where the answer to Q6 comes in.

However the most important words are 'clearly linked to relevant scientific knowledge and understanding'. The science used in the explanations in questions 5 and 6 must be known and understood not just half remembered from an earlier lesson. Good focussed research notes help here.

Comments
Candidates should not feel constrained by the space allocated in the part 3 answer booklet. They can, of course continue on additional sheets which they should label unambiguously. However, candidates are pre-programmed to write sufficient to fill the space provided and so another solution is to create a Centre version of the booklet. As long as the front page is retained and the wording of the questions are identical, the space allowed for answers can be as large or as small as you wish. Such an answer booklet does not count as a writing frame as no guidance as to what to write is given.

Problems with individual candidates

If a candidate is absent for the research section of the task and there is no time for the task to be completed before part 3 is undertaken then the candidate will have to work without research notes and will be disadvantaged particularly in answering question 6.

If the candidate is absent for the planning stage then they may be given the plan of another candidate (but not a teacher plan). They will score zero for planning but can access all other marks.

If a candidate's plan is so poor that it will not work or is dangerous, they can again be given the plan of another candidate. Their own plan should be marked and they keep that mark for planning but, thereafter, marks may be based on the alternative plan.

Much the same applies to a candidate whose results are very poor. They should be given a mark for their own results under collecting data but can then be given the results of another candidate to use for processing etc. It is recommended that such candidates use their own results for the evaluation section.

If a candidate is absent for the session where the investigation is carried out then they can be given the results of another candidate (but not teacher results). They will score zero for collecting data but can still access all other marks.

There are a number of documents available to assist centres with the application and administration of these tasks.

- **The specification for Gateway Science**
- **Gateway Science Suite Guide to Controlled Assessment**
- **Exemplar tasks with marked candidate's work on the OCR website**
- **Candidate guidelines for controlled assessment** (section H of the guide to controlled assessment) also available separately from the website. These guidelines may be used by candidates in all parts of the controlled assessment.
- **The assessment criteria**. These may be given to candidates but the wording may **not** be simplified or changed in any way. Issuing the additional guidance to candidates is strictly forbidden.

Centres are thanked for the many hours of work put into running the assessments, marking the assessments and preparing the sample for submission. In the majority of centres this work resulted in a moderation process which was accomplished without too much trouble.

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