GCSE

Chemistry B

Gateway Science Suite

General Certificate of Secondary Education **J264**

OCR Report to Centres June 2016

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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:

The examination paper allowed candidates to demonstrate positive achievement and discriminated well. There was a small proportion of candidates that may well have been better suited to taking the Higher Tier paper.

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

Candidates made good attempts at two of the six-mark questions but they struggled with the question about the extraction of pharmaceutical drugs and this question was often not attempted.

Comments on Individual Questions:

Question 1
This question was about the displayed formulae of some carbon compounds.

Some candidates in (a) could recognise that molecule **A** contains 8 carbon atoms. All the other options were popular incorrect responses.

Many candidates could identify the alkene as compound **E** in (b). A common misconception was to give compound **D**.

In (c) some candidates recognised that compounds **C** and **F** had the same molecular formula although some candidates chose **A** and **B**.

Some candidates gave the correct name of the polymer in (d) although poly(ethene) was a common incorrect answer.

Question 2
This question was about the use of esters in cosmetics.

In (a) many candidates could explain why esters were not hydrocarbons. Some candidates just referred to esters containing oxygen while other candidates gave a definition for a hydrocarbon.

Many candidates were able to identify the molecular formula as $C_7H_{14}O_2$ in (b), some wrote their answers on the answer line and other candidates wrote it in the table. Unless there was a contradiction a mark was awarded wherever the molecular formula was written.

In (c) most candidates could evaluate the data in the table and decide that ethyl ethanoate was the best choice. Candidates generally gave two correct reasons for their choice. Some candidates neglected to include the name of the ester.

Question 3
This question on carbon dioxide and oxygen in the air was used to assess the quality of written communication in a six-mark question.

Candidates could often not recall the percentage of oxygen and of carbon dioxide in air and typically gave values for carbon dioxide in excess of 20%. However many candidates could describe the three processes combustion, photosynthesis and respiration in terms of their effect on the levels of oxygen and carbon dioxide in the air. One common misconception was to refer to breathing rather than respiration and other referred to plants breathing instead of photosynthesis.

Question 4
This question used the context of the London Olympic flame to assess aspects of combustion.

In (a) candidates often gave one or two factors that needed to be considered but rarely gave three acceptable factors. Typically these were related to cost and pollution. Candidates often gave imprecise and vague answers rather than giving the specific factors that affect the choice of a fuel.

Many candidates in (b) thought that the flame was yellow because there was too much oxygen rather than a shortage of oxygen. Only a very small proportion of candidates gave an answer that referred to incomplete combustion.

Question 5
This question was about paints and their constituents.

In (a) and (b) candidates had to choose the best way to present data. Candidates found both questions very demanding and did not often get the answers correct. The most common answer in (a) was a bar-chart and in (b) a pie-chart the exact opposite of the correct answer.

Some candidates in (c) chose **C** but they did not always give a correct reason. A common misconception was to choose **D** because it had the most oil.

Good answers in (d) described the differences between a thermochromic pigment and a phosphorescent pigment. The idea that phosphorescent pigments glow in the dark was well known and some candidates even described the absorption of light and subsequent release of light.

Question 6
This question was about metals and alloys.

Candidates in (a) were rarely able to classify the four materials into alloys and metallic elements. Often candidates managed to get two correct but often one of the alloys was classified as an element. Some candidates put the same material is both columns.

The idea that reduction involves the loss of oxygen was often used in (b) to explain why copper oxide was reduced. Only a very small proportion of the candidates gave answers that used the gain of electrons.

Most candidates in (c) chose steel as the best material to make an aeroplane quoting its high strength as their reason. Candidates rarely appreciated the importance of both low density and strength and so seldom gave duralumin as the answer.

Question 7
This question was about rusting and corrosion.

In (a) candidates had to evaluate the results of an investigation on rusting. In part (i) Many candidates did not appreciate the importance of the experiments where rusting did not take place. Instead they often just stated the results from experiments **B** and **C**. Most candidates in (ii) were able to conclude that salt speeds up rusting.

Some candidates in (b) could balance the equation but a common misconception was to change the formula of the aluminium oxide. Almost all correct answers had equations balanced with integers rather than fractions.

Question 8
This question was about the manufacture of ammonia by the Haber process.

In (a) (i) many candidates recognised that air was the source for nitrogen. Some candidates on (ii) thought that unreacted nitrogen and hydrogen was recycled but others stated it was vented into the air.

Part (b) was a six-mark question that involved date interpretation. Many candidates could interpret the information in the graphs and gave a possible temperature and a possible pressure to get the highest yield. Most candidates chose figures from the graphs although some gave lower temperatures and/or higher pressures instead. The other part of this question involved stating possible costs of making ammonia by the Haber process. Typically candidates were able to give one or two costs. Some candidates ignored the stem to the question and gave costs that were related to the energy e.g. maintaining the pressure or temperature, these answers were not given any credit.

Question 9
This question was about fertilisers.

In (a) candidates often appreciated that fertilisers were used to increase crop yield although some candidates gave vague answers such to get better crops and this was not given credit in the mark scheme. Some candidates confused pesticides with fertilisers.

Some candidates in (b) did not give the names of the essential elements in the fertiliser and gave the names of all the elements or included hydrogen and/or oxygen in their answers.

Candidates found writing the word equation in (c) (i) challenging and often could write the left hand side but could not name the correct products. In (ii) the use of Universal Indicator was well known and candidates often appreciated the need to check against a colour chart. Some candidates described the use of litmus or methyl orange indicators rather than Universal Indicator.

Question 10
This question was about the thermal decomposition of sodium hydrogencarbonate.

Most candidates in (a) were able to show how to calculate the relative formula mass of sodium hydrogencarbonate.

Candidates in (b)(i) did not often appreciate that sodium hydrogencarbonate made a gas when it is heated and that this explains why there is a loss in mass. Even when candidates appreciated that a gas was made they often called the gas hydrogen. Some candidates in (ii) were able to use simple ratios to work out that 5.3 g of sodium hydrogencarbonate would be made. Candidates found part (iii) very challenging and many gave very vague answers about making incorrect measurements. Candidates did not mention that the reaction was incomplete and/or that it was not heated for sufficient time.

Question 11
This question was about pharmaceutical drugs.

The six mark question (a) was a common question with the higher tier examination paper and candidates found it very challenging. Most candidates were not able to use the melting point or chromatography data to explain why the sample was impure. Candidates did not appreciate that the two spots on the chromatography paper indicated two compounds. In terms of describing how the drug is extracted from a plant most candidates gave the name of a process but were not able to give an accurate description of what happened with the process. A significant proportion of the candidates made no attempt to answer the question.

In (b) candidates often appreciated that the drug must be tested to avoid side-effects. Better answers suggested that the drug had to be tested to see that it actually worked. Very few candidates mentioned the need to get the drug as pure as possible.

Question 12

This question focused on calorimetric investigation involving burning fuels.

In (a) almost all the candidates were able to identify the thermometer.

Candidates often referred to a fair test in (b) although some candidates stated that the experiments would be more reliable which was not given any credit.

Candidates were able to interpret the experimental results and deduce that fuel **D** released the most energy in (c).

The term exothermic in (d) was well known by many candidates although some candidates did give the opposite term i.e. endothermic.

Question Thirteen

This question was about the reactions of zinc and iron with hydrochloric acid.

Most candidates could write the word equation for the reaction between zinc and hydrochloric acid in (a).

Candidates in (b) (i) had little difficulty interpreting the two graphs and could describe two differences focusing on the difference in the rate of reaction and the total volume of gas being made at the end of the reaction. The idea that a powder has a larger surface area was well understood in (ii) and some candidates also referred to more collisions. In (iii) candidates often gave at least two ways of speeding up the reaction. The most common answers were adding a catalyst or having a higher temperature. Candidates sometimes explained the factor but there were no marks available in the mark scheme for explanations.

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 understand the need to quote evidence to support conclusions.

Candidates used their knowledge and skills appropriately to respond to questions about carbon compounds, fertilisers and corrosion of metals.

Candidates performed well in calculations about conservation of mass and percentage yield. Most candidates took care when writing chemical formulae correctly (using the correct case and subscripts).

Candidates did not seem to have the knowledge required to respond fully to questions about paints, pharmaceutical drugs and energy transfers.

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 correctly identified compound E as a hydrocarbon.
(b) Most candidates correctly worked out that compounds C and F have the same molecular formula.
(c) The molecular formula for X was usually correct.
(d) Many candidates drew the correct formula for the polymer. Common errors included the use of C=C or not showing the free bonds. A minority of candidates included hydrogen atoms in the formula instead of fluorine atoms.

Question 2
This question focused on esters as solvents and provided the opportunity for candidates to analyse scientific data.

(a) Most candidates explained that esters are not hydrocarbons as they contain an oxygen atom or do not contain carbon and hydrogen only. When candidates did not gain credit it was usually because they referred to esters containing 'oxygen molecules' or 'not only containing carbon and hydrogen *molecules'.*

(b) In part (i) many candidates correctly used the data to predict the boiling point for pentyl ethanoate. Good responses in part (ii) linked the melting point and boiling point of pentyl ethanoate to melting and boiling and correctly stated that pentyl ethanoate is a liquid at room temperature and does not evaporate easily.

Question 3
This question tested ideas about gases in the air and human influences on the atmosphere.

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 how photosynthesis and combustion and/or respiration keep the percentage of each gas constant. They also had to explain two possible changes in the composition of the air due to increasing population. When candidates did not gain full credit it was usually because they focused on just carbon dioxide without describing how the oxygen varied, thereby limiting their marks. The use of 'carbon' instead of carbon dioxide appeared in many answers as did 'breathing' instead of respiration.

Question 4
This question focused on incomplete combustion and required candidates to construct a balanced symbol equation to show the incomplete combustion of methane to make carbon. 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 usually because they failed to include carbon as a product; many just had carbon monoxide and water.

Question 5
This question was about different paints.

(a) This question, along with part (b), assessed the How Science Works aspect of the specification. Bar chart was a frequent misconception.
(b) Pie chart was a frequent misconception.
(c) Good responses described the two stages involved in the drying of oil paint. A common misconception was that the solvent in an oil paint is water.
(d) Candidates who gained credit in this question described that pigment particles in paint are dispersed within a liquid and are too small to settle to the bottom of the paint. When candidates did not gain credit it was usually because they wrote about hydrophilic and hydrophobic ends of molecules holding the ingredients together.

Question 6
This question focused on Gore-Tex®.

(a) Good responses to this question identified that the holes in the polymer membrane are too small to let water droplets through but are large enough to let water vapour pass through. When candidates failed to gain credit it was usually because they referred to water, water molecules or sweat rather than water droplets and water vapour.
(b) Candidates were told in the question that Gore-Tex® is breathable. In order, therefore, to gain credit here it was necessary to compare Gore-Tex® to nylon, which many candidates failed to do.

Question 7
This question was about alloys.

(a) Examiners saw a wide range of incorrect responses in this question.
(b) Many candidates were able to write the correct balanced symbol equation for the reaction of aluminium with oxygen to make aluminium oxide. 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 Al_23O_2.

(c) Most candidates successfully evaluated the advantages and disadvantages of the four alloys for making aeroplane wings in part (i). Marks were lost most commonly for writing ‘heavy’ instead of high density, or putting high density in the advantages boxes / low density in the disadvantages boxes. In part (ii) C was a common incorrect choice.

Question 8

This question was about the theory of plate tectonics.

Many candidates were able to score one mark here, either referring to the theory explaining a wide range of evidence or by giving a specific piece of evidence, of which there were many. The second mark for the idea that the theory has discussed and/or tested by other scientists was awarded less often.

Question 9

This question was about the conditions used in the Haber process to make ammonia.

This 6 mark question was targeted up to grade A* and required candidates to interpret information from the graph and to explain why the conditions giving the highest yield of ammonia are not used in the Haber process. Candidates who gave good responses extracted the conditions that give the highest yield of ammonia from the graph. They then explained that high pressures are expensive to maintain or require expensive equipment and that the rate of reaction at 350°C would be too slow. Candidates were required to discuss both the conditions of temperature and pressure to gain credit at Level 3.

Question 10

This question was about fertilisers.

(a) Candidates who failed to gain credit in this question gave answers that were not specific enough e.g. ‘so the fertiliser can be absorbed by the soil’ or ‘so the fertiliser can get to the roots’. A significant proportion of candidates wrote that the water is used to dilute the fertiliser or that it stops eutrophication from happening.

(b) The process of eutrophication was well understood by many candidates. A common misconception was that the ‘algal bloom’ was not only blocking sunlight but also oxygen from the air. Another was that the living organisms die as a result of the plants not being able to photosynthesise and provide them with oxygen. Some candidates limited their progress by not describing increased growth of water plants. The most able were able to discuss the bacteria removing all oxygen from the water which made this a good level of response question which discriminated well.

(c) Common misconception in this question were potassium nitroxide and nitrogen hydroxide as products of the reaction.

Question 11

This question focused on the corrosion of metals.

(a) Good responses to this question used the information from the table to identify that metal A does not corrode in damp air. Candidates who failed to gain credit gave responses that were not specific enough such as ‘it needs acidic conditions’.

(b) The word equation in part (i) was completed well by most candidates, with most incorrect responses failing to include one of the reactants. In part (ii) the most common correct response made reference to iron losing electrons. The mnemonic ‘OILRIG’ is well known.

Question 12
This question tested aspects of quantitative chemistry, including conservation of mass and percentage yield.

(a) Most candidates correctly illustrated that the mass on both the LHS and the RHS of the equation was equal to 168.
(a) In part (i) most candidates realised that 0.631 x 2.5 = 1.578g. Most candidates correctly calculated the percentage yield in part (ii). A common error was 45.0% where candidates calculated 1.124/2.500 x 100, incorrectly using 2.500g as the theoretical mass instead of 1.578g. A significant number of candidates were penalised for not expressing their answer to three significant figures.

Question 13
This question focused on pharmaceutical drugs.

(a) This 6 mark question focused on how drugs are obtained from plants was targeted up to grade C. Candidates were also required to draw conclusions about the purity of a drug from melting point and chromatography data. At the simplest level, candidates who described one stage in extracting the drug from plant material, or drew a conclusion using one piece of data, scored Level 1. Many candidates gained credit at Level 2 by describing two stages of the drug extraction. A description of two stages of the drug extraction and an explanation of why the drug is impure using both melting point and chromatography data was required to gain credit at Level 3. Of the two test results, the melting point was discussed correctly more frequently than the chromatography. A common misconception was that the drug was pure because the melting point was close to the pure sample.
(b) Good responses to this question described ideas such as the length of time to get results and that testing on humans or animals has ethical issues. When candidates did not gain credit it was often because they referred to cost and the need for skilled workers, as have been answers in previous exam papers to slightly different drug related questions. Many also commented on the testing on animals being banned or against the law rather than referring to it being unethical. The idea that drugs may react differently on animals to humans was also a common answer which did not gain credit.

Question 14
This question tested ideas about energy transfers.

(a) The most common incorrect answer here was 8000J indicating a misunderstanding of what the units J/g mean.
(b) Many candidates correctly substituted values into the equation and then rearranged it to calculate the rise in temperature. Candidates who substituted the mass of the fuel, rather than the mass of water, gained partial credit. Examiners allowed error carried forward from part (a).
(c) 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. Many candidates still refer to bond breading as exothermic and bond making as endothermic. A significant proportion of candidates contradicted themselves within their answers thus negating marks that they could have scored.

Question 15
This question focused on rates of reaction.

(a) Most candidates correctly constructed the balanced symbol equation.
(b) Many candidates correctly calculated the rate of reaction in part (i). $30 \div 44$ was a common error, as was misreading the volume of hydrogen as 42 cm^3. In part (ii) the most common incorrect response was 120 cm^3.
(c) Good responses explained the increase in the rate of reaction in terms of particles being more crowded / more particles in the same volume, hence more collisions. Candidates who did not score both marks often simply stated that there were more particles, but failed to describe within the same volume.

B742/01 Modules C4 C5 C6 (Foundation Tier)

General Comments:

The paper differentiated well and performance across the three modules of the paper appeared to be fairly consistent, allowing candidates to demonstrate their knowledge and understanding across Modules C4, C5 and C6. Candidates coped well with Section D, the analysis of data section.

Candidates demonstrated the ability to apply their knowledge and understanding of science to unfamiliar contexts. Candidates however seemed to find to analysing and evaluating evidence, making reasoned judgements and drawing conclusions based on evidence more challenging.

Candidates used their knowledge and skills appropriately to respond to questions about Group 1 elements, the Contact process, rates of reaction, and hardness of water.

Candidates did not seem to have the knowledge required to respond to questions about testing for ions, Group 7 elements, how to carry out a titration and CFCs.

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
(a) Many candidates correctly answered all three parts of this question, although examiners saw a wide range of incorrect responses.
(b) The meaning of isotopes was not well understood. Examiners saw a wide range of incorrect ideas.

Question 2
(a) Most candidates correctly gave the name of another Group 1 element.
(b) Good responses described several observations when sodium reacts with water. Most candidates scored at least one mark for stating that you see bubbles or fizzing. Centres are to be encouraged to advise candidates that a question worth two marks requires two points in their answer. Many candidates only wrote one observation.
(c) Examiners saw a range of incorrect responses.

Question 3
(a) Correct responses were usually seen in parts (i) and (ii). Helium was a common misconception in part (iii). A significant proportion of candidates did not gain credit as they wrote down the name of a transition metal, other than silver, thus failing to choose their answer from the list in the question.
(b) Good responses usually described how Mendeleev arranged elements in periods and groups. Many candidates, however, were unable to recall Mendeleev's work.

Question 4
This 6 mark question was targeted up to grade C. To gain credit at level 3 (5 – 6 marks) candidates needed to write the word equation for the reaction and to identify compounds A and B with explanations. Most candidates were unable to interpret the results to identify compounds A and B and only gained credit at Level 1 for the word equation.

Question 5
(a) Examiners saw a wide range of incorrect responses.
(b) When candidates did not gain credit in part (i) it was usually because they described the use of chlorine 'in swimming pools' or 'to clean water', which was insufficient. Many candidates were only able to give one use of chlorine. In part (ii) the use of iodine to sterilise wounds was not well known.

Question 6
(a) Good responses described the ideas of diluting medicines to avoid an overdose and diluting baby milk to avoid harming the baby.
(b) The mass of oxygen in the sample of vitamin C was usually corrected calculated as 96g.

Question 7
Very few candidates scored marks on this question with the tests for ions not being well known. Many candidates misinterpreted the question and, rather than using the results to identify the ions in water samples A, B and C, gave responses such as 'there are negative ions in sample B'.

Question 8
(a) Sulfur was usually correct.
(b) Many candidates were able to write the correct balanced symbol equation for the reaction of sulfur dioxide with oxygen to make sulfur trioxide. 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 the product as SO_4.
(c) Part (i) and part (ii) were both usually correct.

Question 9
(a) Most candidates correctly interpreted the graph and scored the marks in both part (i) and (ii).
(b) Good responses described the idea that the magnesium or the acid runs out.
(c) Many candidates correctly used the data to calculate the missing masses in part (i) and to calculate the mass of magnesium sulfate made from 10 g of magnesium in part (ii).

Question 10
To gain credit at level 3 (5 – 6 marks) candidates needed to give a complete description of a titration including detection of the endpoint and safety precautions. Very few candidates attained the higher levels on this question. Examiners saw many answers which made no reference to the use of an indicator or a pH meter to detect the endpoint; this restricted marks to Level 1.

Question 11
(c) Most candidates deduced the values for x, y and z in the formula in part (i). In part (ii) most candidates explained that glycerol is not a hydrocarbon as it contains an oxygen atom or does not contain carbon and hydrogen only. When candidates did not gain credit it was usually because they referred to glycerol containing 'oxygen molecules' or 'not only containing carbon and hydrogen *molecules'.*
(d) In part (i) identified the double bond as indicated that the fat was unsaturated. The chemical test for unsaturation in part (ii) was not well known by candidates. A common misconception was to burn the fat.
(e) Large scale uses of fats were not well known. Examiners frequently saw answers about 'providing energy' or 'keeping us warm'.

Question 12
This 6 mark question was targeted up to grade C. To gain credit at Level 3 candidates needed to give some properties of CFCs that make them suitable for use as propellants and to explain why CFCs have now been banned in the UK. Many candidates simply stated that CFCs damage the

ozone layer and only gained credit at Level 1. A common misconception was that CFCs cause global warming.

Question 13

(a) Good responses identified that copper and iron (II) sulfate do not react because the solution does not change colour.

(b) Most candidates were unable to interpret the data to predict the order of reactivity of the metals.

Question 14

Good responses appreciated that the prediction is not supported by the results because although the volume of lather decreases with hard water using soap there is no change with any results with washing-up liquid.

Question 15

(a) Most candidates correctly interpreted the graph and scored the marks in both part (i) and (ii).

(b) In part (i) the products were usually correctly identified as potassium and bromine. Bromide was a common error. A very common misconception in part (ii) was that molten potassium bromide can be electrolysed because the *electrons* can move.

Question 16

(a) Most candidates correctly interpreted the graph and scored the marks in both part (i) and (ii).

(b) Good responses described that world use of fertilisers is increasing and that both the UK and the world use less phosphorus containing fertilisers than nitrogen containing fertilisers.

(c) Most candidates scored two marks in part (i) for correctly identifying that country **E** uses the smallest amount of fertilisers and pesticides. Examiners saw a wide range of incorrect values calculated in part (ii).

(d) Most candidates correctly chose nitrous oxide and explained their choice because it is the largest source from farming.

B742/02 Unit 2 Modules C4 C5 C6 Higher Tier

General Comments:

This examination paper allowed the candidates to show positive achievement and it discriminated well, however there was some evidence that candidates had been entered for the Higher Tier when the Foundation Tier would have been more appropriate.

There was no evidence that candidates had run out of time and many candidates gave long answers to the six mark questions and used some of the blank pages for their answers.

Candidates must take care that they answer all the questions since a significant proportion of the candidates did not attempt questions involving filling cells in a table even when every other question was attempted.

Candidates found the two questions on qualitative analysis very challenging and often did not seem to have the basic knowledge of qualitative tests for anions and cations. This made it extremely difficult for candidates to interpret the results.

Candidates were able to write word and balanced symbol equations with little difficulty.

Candidates had some problems with calculations particularly those involving the mole concept. They were often unable to apply the relationship between:

- moles, volume of gas and molar volume
- moles, volume of solution and concentration of solution.

Candidates had less difficulty with calculations that involved simple ratios and often showed clear and logical working out in these type of calculations.

Comments on Individual Questions:

Question 1
This question was about atomic structure.

In (a) many candidates could interpret the table to get at least two entries correct. The most likely incorrect answers were to give the mass number of particle **Z** to be 6 and/or to give the incorrect electronic structure. Some able candidates did not attempt this question.

The term isotope was known by many candidates in (b) although a few confused this with allotrope. Another misconception was to call the two types of atom halogens. Candidates often gave the correct explanation even when they did not give the correct term. The best answers referred to atoms with the same atomic number but different mass number (or number of neutrons) however in the context of the question less precise explanations where allowed in the mark scheme.

Question 2
This question was about superconductors.

In (a) candidates often referred to the reduced energy loss in power lines but rarely mentioned their use in electromagnets. A common misconception was that electricity would run forever.

The major drawback of having to maintain a low temperature was given by many candidates in (b).

Question 3
This question was about trends in Group 7.

In (a) candidates often got one of the numerical answers correct but many candidates could not give the appearance of iodine as a grey/ black solid. Common incorrect answers included a brown liquid, orange liquid and a purple solid. Some candidates did not answer the question and it was not clear if they could not answer the question or that they had missed the question.

Candidates found (b) quite challenging and often referred to electron loss rather than electron gain. Other candidates used the wrong information from the table relating reactivity with melting and boiling point. The best answers referred to fluorine being the most able to gain electrons. Sometimes candidates gave higher level answers such as increased shielding down the group.

Question 4
This question involved the analysis of experimental observations concerned with qualitative analysis. Candidates were expected to make a conclusion and justify the conclusion based upon the experimental evidence.

Candidates could either identify the name of the compound present or the ions contained in the solution. In terms of the justification the test, the ion present and the result all had to be included for example compound **A** contained copper ions because it gave a blue ppt. with sodium hydroxide. In addition candidates had to construct one balanced equation having been given the formulae for each reactant and product.

Candidates had little difficulty constructing the balanced equation and some candidates only did this part of the question and as a result matched level 1.

Candidates found the identification of the compound or ions much more difficult and often only identified one compound or one ion with no justification for this conclusion. This type of answer matched level 2 providing the balanced equation was given.

The most able candidates were able to give a comprehensive and logical answer that explained the ions present and then deduced the name of the compound.

Question 5
This question was about chlorine and fluorine.

Many candidates in (a) could draw the ‘dot and cross’ diagram for chlorine fluoride. A significant proportion of the candidates drew the inner shell electrons even though this was not needed in the answer. Some candidates neglected to include the symbol for each element and this type of answer was given full credit. Only a very small proportion of the candidates attempted an ionic ‘dot and cross’ diagram.

Typically candidates referred to low melting and boiling point in (b) although some referred to the compound being a poor conductor of electricity. Answers that just stated that the compound was a gas or a liquid was not given credit unless there was a reference to room temperature and pressure. Only a small proportion of the candidates gave properties of a giant ionic substance. A significant proportion of the candidates mentioned weak intermolecular forces but did not give a property.

In (c) many candidates gave good answers about the Periodic table in terms of atomic number and outer shell electrons but did not realise that these were not discovered until much later than Mendeleev’s Periodic Table. The best answers referred to grouping according to chemical properties and the gaps in the table that Mendeleev left for elements still to be discovered. A significant proportion of the candidates confused Mendeleev's work with that of Newlands.

Question 6

Candidates found this question very challenging and many candidates did not understand the term negative ion and as a result identified barium chloride ions, lead nitrate ions or sodium ions as negative ions.

The test for halide ions was recognised by more candidates than that for sulfate ions and some candidates identified the sulfate ion as S^{2-}. Only the most able candidates were able to give all the correct ions present in the three solutions and provide at least one correct explanation.

Question 7

This question was about strong and weak acids.

Candidates found it difficult to give an accurate definition for either acid strength or for concentration in (a). Common misconceptions for acid strength were to refer to the number of hydrogen ions, the strength of the hydrogen ions or the pH of the solution. The best answers often gave an example such as ethanoic acid is a weak acid since it only partially ionises in solution. Another misconception was to refer to the hydrogen ions being ionised rather than the acid molecules. Candidates were more likely to be awarded a mark for acid concentration. Typical answers that gained credit included 'the amount of acid in a certain volume' or 'the mass in 1 cm^3'.

Part (b) (i) was targeted at grade C so that an answer that mentioned more collisions was sufficient to be awarded a mark, although many candidates gave higher level answers referring to an increased collision frequency. Answers that did not refer to collisions had to refer to hydrogen ions in their answer and it was sufficient to refer to more hydrogen ions present (since the volume was constant). Many candidates appreciated that the same amount of reactants was used and this was given credit in the mark scheme for (ii), however the same mass of acid and same volume were ignored.

Question 8

This question was about the Contact Process.

In (a) the need for a catalyst was well known but many candidates gave the name of the wrong catalyst for example iron or nickel. A small proportion of candidates referred to a high concentration as a condition.

In (b) there were many different marking points that could be accessed by the candidates. In terms of temperature the idea that the reaction would be fast and was low enough to keep the equilibrium on the right was sufficient – many candidates only mentioned the reference to rate. In terms of the pressure many candidates thought that the low pressure was to force the position of equilibrium to the right. Only the best answers appreciated that even at low pressure the position of equilibrium was on the right. Many candidates appreciated that a higher pressure would be more expensive. Most candidates appreciated that the catalyst increases the rate of reaction but the candidates did not often mention that the position of equilibrium was unaffected.

Question 9

This question assessed aspects of quantitative chemistry in the context of the reaction between magnesium and sulfuric acid.

In (a)(i) and (ii) most candidates could interpret the graphs. A significant proportion of the candidates did not answer (iii) and those that did rarely obtained both marks. A common misconception was to give a volume just below the original. Candidates need to make certain that they draw sketch graphs carefully so that the line does not ‘wobble’ too much.

Candidates in (b)(i) were often able to calculate the mass of magnesium sulfate made as 50 g and showed clearly how they got the marks. A small proportion of the candidates calculated out the mass for a different substance from the table but often their working out was sufficiently clear to be awarded a mark. Candidates found parts (ii) and (iii) very demanding and often got both questions incorrect. Many candidates gave the answer to (ii) as 0.16 moles rather than the correct answer of 0.08. An error carried forward mark was available for part (iii) but most candidates did not understand the concept of molar volume.

Question 10

This six mark question involved the interpretation of a pH titration curve and the calculation of an unknown concentration.

Many candidates achieved level 1 by stating one simple deduction from the graph for example 'as the volume of acid is added the pH went down.' Other candidates gave more detailed answers that described what happens to the pH at neutralisation. The term ‘end-point’ was not well understood and some candidates thought it was the value at the end of the titration rather than at neutralisation.

Most candidates either did not attempt the calculation or just wrote down some random numbers. Centres should advise candidates to write down the equation they are using, then substitute in the appropriate numbers and finally do a calculation. Either the use of moles = volume x concentration or concentration = moles/volume was considered an attempt at the calculation. A significant proportion of the candidates who attempted the calculation was not able to convert cm^3 into dm^3 and vice-versa.

To get level 3 the calculation had to be complete with a concentration of 0.08 mol/dm^3 or a calculation that had been completed but used the wrong volume (typically 40 cm^3 rather than 20 cm^3) along with one other deduction from the graph.

Question 11

This question was about fats.

In (a) many candidates gave the answer as alkenes rather than esters.

Many candidates in (b) could write a formula from the displayed formula but often it was a partial structural formula e.g. $C_3H_5(OH)_3$ rather than the molecular formula.

In (c)(i) candidates often referred to the presence of a double bond. In this example this was sufficient since the structure shown in the stem only had a carbon-carbon double bond. The chemical test for unsaturation in (ii) was well known and some candidates gave both the test and result and some explanation in terms of the dibromo compound formed. Candidates often could not recall how margarine was manufactured in (iii) and gave answers that referred to making emulsions or even pasteurisation. The best answers appreciated that there was a hydrogenation reaction and mentioned either one or both of the use of a nickel catalyst and a high pressure.

Question 12
This six mark question was about oxidation and reduction in a displacement reaction. Candidates had to construct both a word and a symbol equation and to obtain level 3 explain why the reaction involved both oxidation and reduction..

Many candidates could write the two equations but a common misconception was to refer to the element copper as copper(II) and use the oxidation numbers in the formulae writing 'Fe_2SO_4' and 'Cu_2SO_4'. The concept of OIL RIG was often well known but candidates had real difficulty applying this information
Candidates needed to be precise when explaining the species oxidised and the one reduced. It was important that it was the iron losing electrons and the copper ions gaining electrons. The best answers made this clear by the use of the appropriate half-equations.

Question 13
This question was about CFC and ozone depletion.

In (a) candidates often chose reaction 4 but reactions 1 and 2 were effective distractors.

Many candidates could not explain the formation of a chlorine atom from a CFC in (b). The idea that a C—Cl bond was broken was seldom mentioned and the idea of homolytic fission was poorly expressed.

Candidates did not always clearly indicate reactions 2 and 3 in (c) although the idea that there was a chain reaction was often included within the answer.

Candidates in (d) often appreciated that due to lack of technology it took a long time to link CFCs with ozone depletion. Other candidates focused on the problems that changing from CFC to alternatives or the problems of convincing a government to implement a ban. Some candidates merely focused on the properties of CFCs rather than addressing the question set.

Question 14
Candidates found this question demanding and often did not specify which sample was temporary hard water and gave general answers covering all of the results. The best answers compared the results with calcium hydrogencarbonate with distilled water both with soap and with washing-up liquid. Some candidate thought that magnesium sulfate caused temporary hard water and others that sodium chloride caused hard water.

Question 15
This question focused on the electrolysis of molten potassium chloride.

In (a) most candidates were able to interpret the graph and give an answer of 7.5 g.

Candidates were able to use their result in (a) to get an answer of 60.0 g in (b). Some candidates used Q=It in their answer and went through complex calculations even remembering 96500 to get the correct answer. Other candidates used the correct method of appreciating that the current was doubled and the time quadrupled so that overall the mass will be 8 times the original mass.

Question 16
This question assessed evaluation and analysis skills and was focused on the use of fertilisers.

In (a)(i) most candidates could interpret the graph and give a value between 36 and 35 millions of tonnes. Candidates usually referred to the decrease in the concentration of nitrate ions after 1977 in (ii) although some did mention the difference in gradient of the line before and after 1977.

In (b) candidates had to interpret a table of data. Many could calculate the mass of pesticides used in county **E** in (i). Only a small number of candidates gave the answer in standard form which avoided writing so many zeros. A small proportion of candidates divided the number by 1000 instead of multiplying it by 1000. In (ii) candidates often appreciated that the land available for agriculture was much less than in country **A** but were less likely to link this to the need to improve crop yield. Some candidates referred to country **B** having a large number of pests and this was also given credit in the mark scheme.

In (c) candidates had to interpret three pie charts. Candidates often chose nitrous oxide in (i) citing the evidence that it had the greatest percentage in the farming sector of the pie-chart. Some candidates in used an alternative approach stating that nitrous oxide contains nitrogen and many fertilisers contain nitrogen. The best answers in (ii) noted that all three gases (carbon dioxide, methane and nitrous oxide) had a larger percentage coming from farming than residential. Other candidates just quoted the data from the pie-charts without making any comparison; this was not given any credit. Some candidates added all the percentage of each gas from the three pie charts but again most candidates using this approach did not make a comparison of the numbers they had calculated.

B743 Controlled Assessment

General Comments:

Overall centres have shown a good understanding of the requirements of the controlled assessments in the science subjects. The marking criteria have been mostly applied appropriately and it is good to see a large number of centres putting annotations on the scripts in the appropriate places to show how and why they have awarded the marks. Work submitted for moderation was generally well organised with all of the required paperwork submitted by the centres for the moderators' consideration.

However, a minority of centres are still submitting work that does not meet the full requirements of the courses. In particular;

- It is very important that marks are carefully checked before they are submitted. Moderators have noted a number of clerical errors this year where the marks submitted are not the same as those on the scripts sent to the moderator. This not only causes delays in the process but, if not corrected can result in incorrect marks being awarded to candidates.

- It is important that centres send the marks to OCR and the work to the moderators within the time frame set by the board. Unfortunately some centres are failing to meet these deadlines.

- It is important that the cover sheet for the work is completed correctly and, in particular, that correct candidate numbers are shown on scripts.

- All controlled assessments are valid for one year only. This is clearly indicated on the tasks that can be downloaded from the OCR web site. Some centres have submitted tasks for the wrong year. Some have submitted work from a previous year and others from next year's tasks. It is important that all centres make sure that the tasks they are undertaking are for the current year. The only tasks that are valid for 2017 are available on the website and clearly marked.

- All centres need to provide a copy of the CCS 160 Centre Authentication form with the candidates' work. On this staff are declaring that they have conducted the tasks under the required conditions as laid down by the specification. Controlled assessments require candidates to research, plan, carry out and review the tasks set and, other than for the practical work itself, this needs to be done independently. Even if candidates work in groups for the practical task they must complete their written work on their own and not work collaboratively.

- The amount of support that can be offered to candidates by the centre is the same regardless of the specification, the type of centre or the ability level of the candidates. Writing frames of any kind are not permitted and there should be no opportunity for candidates to produce a draft for review followed by a final piece of work for submission.

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 previous reports in addition to the notes given below as many of the comments below repeat advice that has been given previously and which is still being overlooked by a few centres.

Comments on specific Skill qualities:

Researching: Candidates generally scored well on this Skill quality and the marking criteria were usually well applied. In the main candidates have used a wide range of sources in their research although, not surprisingly, the majority of these are from internet sources and few references are given from books. If web sources are used then full urls need to be provided so that these sources can be checked. If books are used then page numbers should be given as well as title and author.

In previous coursework, before controlled assessments were introduced, there was a requirement for candidates to consider the validity of sources. This **is not** part of the current marking criteria. Candidates are required to select information from their sources that is correct and relevant to the specific bullet points in task one that they are addressing and do not need to spend time considering where the information has come from.. They should not use wholesale cut and paste from the sites although they may quote specific points, if referenced appropriately in the text. The inclusion of irrelevant material will reduce the mark available. For high marks candidates are also required to show which sources are relevant to the different parts of their notes. The easiest way to show this is by numbering the sources and putting numbers in the appropriate places within the text.

Planning: This Skill quality often begins with a hypothesis, except in the science specification, together with supporting science to explain and justify the hypothesis. This is only one part of the marking criteria and centres need to bear in mind that the marking is best fit not hierarchical. However, for high marks it is expected that candidates will demonstrate a suitably high level of understanding of the underlying science behind the task. This year there was a significant amount of misunderstanding of the science associated with the cold packs task for additional science, further additional science and chemistry.

Candidates sometimes find it difficult to obtain high marks when they do not address the task set. For example in the aerobic exercise task candidates will clearly obtain lower marks if they plan a task involving anaerobic exercise.

The methods written by candidates are now often of a high quality and frequently contain diagrams to support them. However, an appreciation of possible sources of error and how to control variables is still a weak area for many candidates. This is particularly true in biology tasks where there are many variables to control, for example how to maintain a constant pace in an exercise task.

Many candidates also do not consider the resolution of the equipment they choose to use, as is required in the marking criteria for 5-6 marks.

Collecting Data:

This is often a high scoring Skill quality but some centres are still awarding high marks when there are errors in headings and units. In particular, for full marks, candidates should not put units next to each data point in the table but should include these in the headings. For the purpose of this Skill quality, the level of precision is taken to be an appropriate and consistent number of decimal places for the recorded data.

Occasionally there has still been evidence of centres penalising candidates for failing to present processed data correctly, for example, averages being shown to a varying number of decimal p-laces. Also some centres have awarded high marks when not all raw data has been included, for example, failure to record initial and final temperatures and only recording temperature change.

As mentioned above, writing frames must not be provided and, if provide, can result in only very low marks being available to candidates as they have not constructed their own data table.

Managing Risk:

Most candidates now appreciate what is involved in carrying out and recording a risk assessment for an experiment. The weakest aspect remains their ability to evaluate the risk associated with a task, as required in the 5-6 marking criteria. This is particularly the case when a task is very low risk. Candidates vary from writing virtually nothing to coming up with a range of highly unlikely risk scenarios. It was surprising to see a number of candidates referring to the risk of mercury from the use of a thermometer when most modern thermometers do not contain mercury.

In order to score highly need to identify some hazards that are specific to the task and not just generic, they then need to identify the risk associated with these hazards and suggest way to both avoid and deal with these if they occur. These suggestions need to be specific and appropriate hor high marks and not just comments such as "tell the teacher". The likelihood and severity of these risks should also be identified and. If a numbering system is given to the risks, then some key to explain what the numbers mean should be given. An overall comment about the level of risk for the whole task is important particularly for a very low risk experiment.

The level of risk should be realistic for example, not all risks should be graded as high otherwise the experiment would be too dangerous to do in a school context.

Processing data

Most candidates obtain averages for their data and produce graphs of varying quality. For high marks candidates need to produce a line of best fit and show a quantitative consideration of uncertainty. Although not penalised by the marking criteria, centres are encouraged to talk about range bars rather than error bars as error bars require a much higher level of processing than simply looking at the range of repeat values.

As mentioned in previous reports the marking criteria relating to scale in the graphs includes choosing a scale that maximises the size of the graph paper. Plotted points should occupy at least 50% of the graph paper. Candidates should be taught that graphs do not have to go through (0,0) if is not appropriate.

With regard to the use of complex mathematical techniques these are only part of the marking criteria "where appropriate". For example, calculation of an energy change is an appropriate complex mathematical technique in cold packs but calculating a gradient in the cheesemaking task is not.

Analysing and interpreting

Most candidates were able to identify trends effectively and to link these both to their own data and data from a secondary source. Anomalous points were usually identified if present although few candidates used levels of uncertainty to explain why they classified points as anomalous. Fo high marks candidates analyse the level of uncertainty and this should be linked to the trend, for example discussing whether the line of best fit (trend) goes through all range bars.

In some tasks the trend was not well linked to relevant scientific understanding, particularly in the cold packs task where there was often confusion between the temperature change and the energy change. The science needed to explain the trends must be of a high level to support the award of high marks.

Evaluation

Again this was well marked by most centres but overall tends to be a lower scoring Skill quality.

Candidates often need more space to answer question 4 of part 3 than is available on the standard part 3. 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.

The marking criteria require candidates to consider both the data and the method and for high marks these ideas should be linked. Suggested improvements to the method should be explained in terms of how they would provide better quality data.

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.

Although most candidates have learnt how to produce range bars from their data few understand what these range bars represent and how they relate to an evaluation of the data.

The marking criteria require candidates to consider both the data and the method and for high marks these ideas should be linked. Suggested improvements to the method should be explained in terms of how they would provide better quality data.

Comments about risk do not contribute significantly to the mark for evaluation but can be used to further support the mark awarded in the risk Skill quality but as a general rule it would be unlikely for a candidate to obtain more than two marks for the risk Skill quality if their only consideration of risk was in part 3.

Conclusion

Question five of part 3 requires candidates to link their data to their hypothesis, or the hypothesis given in a science task. Few candidates complete the question by explaining their answer. For high marks this should also show appropriate scientific knowledge and understanding.

Question 6 provides the opportunity for candidates to link their experiment to their research and a demonstration of this is required for high marks in this Skill quality.

Evidence for this Skill quality can be obtained from any part of the task. Centres are encouraged to clearly annotate the text to show where evidence is used from other sections.

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