OCR
Oxford Cambridge and RSA

GCSE

Chemistry A

Twenty First Century Science Suite

General Certificate of Secondary Education **J244**

OCR Report to Centres June 2015

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

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

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OCR REPORT TO CENTRES

A171/01 Chemistry A Modules C1, C2, C3 (Foundation Tier)

General Comments:

Candidates have become significantly better at following command words and giving the correct number of responses required in each question. There were only a very limited number of instances where additional responses were given, such as 2 items circled instead of just 1.

The level of response questions were generally well responded to with very few omissions. The way candidates approach these styles of questions have improved greatly in recent years.

The timing of the paper seemed appropriate with candidates regularly completing all aspects of the paper. The overall attainment of the candidates seems to have improved from previous sessions.

Candidates who need more space for their answer are recommended to use any extra space available on a page before going to a supplementary answer book.

Comments on Individual Questions:

Question 1
1(a) This question was very well answered, with almost all of candidates identifying at least 1 material that is made of living things. Where candidates selected an incorrect response, it was often polythene.

1(b) Most Candidates could recognise that there are just 2 elements in a hydrocarbon.

1(c) Candidates could identify that copper was a pure substance and that crude oil was a mixture. The difficulty came with deciding on sodium chloride. Unfortunately, only a small number of candidates could recall that sodium chloride is a pure chemical.

Question 2
2(a)(i) A large number of candidates could correctly identify the diagram representing carbon dioxide.

2(a)(ii) Again a large number of candidates could correctly identify the carbon monoxide as the substance that is formed when there is a limited supply of oxygen for combustion.

2(b) Most candidates could give a different source of pollution to support Tanya's ideas. The most common responses included 'cars' or 'vehicles'. Fewer candidates were able to explain that as more coal was burned, the amount of pollution increased. Many simply repeated the ideas put forward by Joe. Very few candidates could go on to explain that the relationship between the amount of coal burned and pollution was a positive correlation.

2(c)(i) The majority of candidates could identify the true and false statements in the table.

2(c)(ii) This question proved difficult for some candidates. Where working out had been included in the response but the final answer was incorrect, there were errors in addition and the lack of division by six.

2(c)(iii) A significant number of candidates omitted this question. This could have been because the question was not directly underneath the graph and so was simply missed. For the candidates that did attempt this question, the success rate was high. The 'error carried forward' from the calculation of the mean did not impede candidates unless they had simply added their values together. This meant that the scale in the graph could not accommodate their bars.

Question 3

3(a) This was generally answered well, but the common misconception was that 'carbon dioxide' had the largest percentage abundance with 78%. This could be attributed to the fact that the consequences of pollution by carbon dioxide is considered in detail. Perhaps the actual percentage abundance of carbon dioxide can be emphasised in centres for future exam sessions. The percentage abundance of Argon in the air varied and included values that added up to more than 100% in total.

3(b) A significant number of candidates struggled with this question. The description of the changes to the atmospheres that were given in the table were not forthcoming in many responses. Candidates were able to use the information provided to comment on the changes in gases, particularly on Earth. Of those who were unsuccessful with this question, it was often because they discussed issues such as global warming, climate change and the effects of human activity on a modern Earth, but made no reference to the data provided. Photosynthesis and dissolving in the oceans were often identified as reasons for the decrease in carbon dioxide levels on Earth. The cooling of the Earth to form the oceans, removing water vapour, was discussed to a lesser extent. The quality of written communication was poor in some areas, particularly organisation of ideas. For example, it was often unclear through either poor grammar or a complete omission of a word, which planet the candidates were referring to. 'The atmosphere has decreased on Earth and increased on Mars' or 'the carbon dioxide went up' were typical responses that failed to score as candidates missed crucial marks to show they understood the data in the table.

Question 4

4(a) This question was generally well answered.

4(b)(i) A significant number of candidates correctly calculated that 26 and 14 added together equalled 40. Where incorrect responses were given, the common error was 10 (the number of rejected balls). Other common incorrect answers were 26 and 14.

4(b)(ii) An encouraging number of candidates scored both marks in this question. The 'error carried forward' here gave several candidates the reprieve needed from their responses to the previous question. The formula being given directly in the question could have helped the candidates follow the calculation through to completion. Evidence of candidates substituting numbers onto the formula in the box supported this view and were evident on a number of occasions.

4(b)(iii) This question was generally well answered. The reasons why we repeat experiments still seems to bring up the idea of 'fair testing'. Centres need to move away from this as a response and move towards the terms of accuracy, repeatability and reproducibility.

4(c) A significant number of candidates scored this mark. Misconceptions were centred around the distractor of 'refining' as this was the most common incorrect response given.

4(d)(i) Again a significant number of candidates scored this mark and correctly identified that diagram A represented the cross linking.

4(d)(ii) The majority of candidates scored at least one mark in this question. Usually 'harder' was the easier word to select to complete the first of the sentences describing cross linking. The plasticiser sentence appeared more challenging with a number of candidates choosing 'much stronger' where they selected an incorrect response.

Question 5

5(a) Responses to this question showed a lack of understanding of the properties that might be needed from a sailing rope. A large number of candidates identified the incorrect fibre. All fibres were regularly selected and for a variety of reasons. Where this was the case few candidates could link the properties to the purpose for their choice, or even why they were chosen over the other fibres. The idea of 'comparison' was often overlooked. Some candidates struggled to relate the words used to describe the fibres in the stem of the question and the words used in the table, such as strong, light, flexibility with stiffness, density, tensile strength, water absorbency and the ability to float or sink. There were however, many good responses in this question, the best responses being those where candidates had processed the data, explained the properties **and** compared the properties with other materials. For example, good candidates showed that they understood a low number for stiffness equated a high flexibility, and low density was desirable because it made the rope lighter. Marks were most commonly lost when candidates merely restated the stem of the question, choosing a material and stating that it was light and flexible. In some instances, candidates incorrectly interpreted the data and assumed that the high values were always the best.

5(b) A significant number of candidates scored at least one mark in this question. The most common of the correct responses was 'buying rope from other countries is expensive'. The second correct response was identified to a lesser extent.

Question 6

6(a)(i) Most candidates could give the correct response of '30' for the death from Typhoid in the year of 1890 but less were able to give the total number of deaths from Typhoid in 1930 as this required a calculation. Often, the answer put here was 5, thus indicating that the candidate had used the graph instead of inferring from the table that the population in the city was 200 000 and therefore requiring them to double their answer.

6(a)(ii) Many responses scored the mark for stating that the number of deaths from typhoid decreases. Most of these responses also gained a second mark for either saying that the deaths went down to zero in 1950 or there was a major decrease after 1910.

6(b) This question was generally well answered with the majority of responses scoring four marks or higher. Candidates were able to interpret the data, and explained how it showed that the use of chlorine was effective, and also how the chlorine killed bacteria in water. They gave dates and explained the differences before and after 1910. Weaker candidates became distracted with irrelevant information, such as harmful effects of chlorine, or ignored the effect of chlorine altogether. The general pattern of many answers was: 'Zac is correct, deaths lower after chlorination of 1910' often with a statement about the action of chlorine. Some candidates used poor language skills as they spoke of the chlorine 'getting rid of germs that caused typhoid' rather that the action of the bacteria being killed by the chlorine. Some candidates confused Beth's comment and argued solely for her, commenting that chlorination of water could be dangerous, with some mentioning the formation of THMs and the link to cancer. A lot of candidates seemed to think that this answer required a balanced view, stating that Beth was 'kind of right', yet failing to challenge the 'chlorine has no effect' comment. Other candidates that chose Beth as correct only referred to the first part of her comment ('the deaths from typhoid fell before chlorine was added') and again, failed to acknowledge the 'chlorine has no effect' comment.

Question 7
7(a)(i) A significant number of candidates could identify cereal D as the cereal that had changed from medium to low.

7(a)(ii) A large number of students correctly selected cereal C.

7(b)(i) The majority of candidates could identify 'Carlos' as the person speaking about correlation.

7(b)(ii) The majority of candidates could identify 'Ben' as the person speaking about risk and benefit.

7(c) This question was less well answered and with no discernible trend in incorrect responses.

Question 8
8(a) This question tried to identify the candidates understanding of the method of transportation of harmful chemicals into the food chain and then the consequential effects. Candidates were drawn to talk about health risks and problems such as asthma, lung disease, cancer and heart problems rather than how the issues arise or build up in the food chain.

8(b) Candidates struggled with this question and were often distracted into discussing the planet mercury rather than the poisonous metal. Candidates often spoke about the people not knowing the risks, despite being told in the stem of the question that people knew the metal was harmful.

A171/02 Chemistry A Modules C1, C2, C3 (Higher Tier)

General Comments:

This paper was well attempted with a high mean mark. It differentiated effectively allowing strong candidates to show their knowledge and understanding of the subject.

There were some very good responses to the 6 mark questions this year, though some candidates would have gained by planning their answers to these before writing. Almost all candidates showed very good knowledge and understanding when asked to process data. However, they found evaluating and drawing conclusions from data much more difficult. Candidates should be given plenty of opportunity to develop these skills throughout the course.

Candidates need to be specific in their written answers. There was a tendency for candidates merely to repeat the stem of the question which did not gain marks. There were also vague references to the environment or substances being harmful in answers. Such statements rarely score.

Almost all candidates made good use of their time and the number of no response answers was very small. Again, there were a few candidates who struggled to respond to the higher level questions. They would have been better suited to the foundation tier paper.

Candidates who need more space for their answer are recommended to use any extra space available on a page before going to a supplementary answer book.

Comments on Individual Questions:

Question 1
1(a) Most of this question was a common question with the foundation tier and proved to be a straightforward start to the paper. Almost all scored in part i, and in part ii higher candidates had no problem working out the mean of a set of data. Most gained two marks in part iii by correctly completing the chart. Part iv proved more difficult. Candidates need to take care not to repeat the question eg ‘the pollution is increasing. It is important that they use the data to explain the points made. Many did pick up on the short time period though some were vague stating ‘not enough tests had been done’ rather than focussing on the number of days.

1(b) This was a discriminating question with good candidates able to pick out the correct statements to explain the formation of solid carbon particles when coal burns.

Question 2
For many candidates the answer was very confused and they need to be guided to take a moment to plan their answer to these 6 mark questions. Rather than start with a gas and describe the change on each planet, or vice versa, the answers would meander through planets and gases with no really structure. As a result of this many candidates missed marks because they simply didn’t give a full answer, probably without realising it. However, marks were gained by good descriptions of the role of cooling temperatures and photosynthesis, in changes to the atmosphere on Earth. A significant number of candidates gave pollution and other effects caused by man as reasons for the changes to the Earth's atmosphere. These candidates usually then said that Mars' atmosphere had not changed as much as there is no pollution on Mars.

Question 3
3(a) Many candidates are still not clear about the formation of nitrogen dioxide in car engines. Some did not realise that high temperatures are needed for the reaction to occur and many thought that the nitrogen atoms come from the fuel.

3(b) They were also unclear what happens to nitrogen dioxide once it is in the air. All wrong answers were seen though the most common was that it is oxidised to nitrogen in catalytic converters.

Question 4
4(a) A very well answered question, with almost all correctly picking out that changing the surface affects the outcome.

4(b) In part (i) few candidates got this entirely correct, but most got 1 mark for finding the number of competition balls in the data. Those who did not score often failed to show the working to their answer. Part ii was well answered.

4(c) Understanding of how modifications affect the properties of polymers was weak with few candidates gaining marks. Weak candidates guessed answers randomly and some good candidates lacked the confidence to go with one statement per line: correct answers were crossed out so that an incorrect mix of statements was given.

Question 5
5(a) Many answered this well, but those who failed to pick up marks, or didn't achieve beyond level 1, had problems with knowing the significance of the properties - stiffness; density; and water absorbency. They saw high readings as a positive and Kevlar was often picked out as the best type of rope. Also candidates again need to take care that they do not merely repeat the question eg by saying 'polypropene because it's flexible and light', but show that they understand, and can interpret, the data.

5(b) This question was not well answered. Most gave a poorly stated argument based on relative availability. Others, who did not gain marks, wrote about the environmental impact of synthetic materials and biodegradability of natural fibres. There were also many attempts to write about the properties of the materials, rather than the issues of making ropes out of these materials.

6(a) This question about the boiling points of different compounds of crude oil was discriminating.

6(b) This question asked for two uses and it is important, when answering, that these are distinct and different. Giving two uses that are both fuels can only score 1 mark. Sometimes candidates would just write ‘plastics’, as if plastics were fractions, rather than indicating that fractions were used to make plastics.

6(c) Most candidates could recognise a balanced diagram for the splitting of pentane.

Question 7
7(a) There were some excellent answers to this question on why people should eat less salt and almost all candidates gained at least one mark.

7(b) In part (i) many candidates simply stated that they agreed with the FSA without using the data and showing any form of calculation. A few that did show the calculations stated that the FSA were wrong because the figures were not exactly 50%; which was missing the FSA’s point. In part ii many gained a mark for suggesting more cereals should be tested but the second marking point was rarely seen. Instead, many incorrectly suggested using samples of more than 100g, or using years other than those given.

7(c) Candidates found the calculation in part i difficult with all the wrong answers given equally. In part ii the main reply was that of risks not yet known. Few picked up on any health benefit as they did not seem to realise that less salt would be needed to get the same taste in our food. A significant number of candidates got this completely wrong and suggested that the risk of heart disease/high blood pressure would be 2000 times greater using nanoparticle salt as it is 2000 'saltier' than regular salt.

8(a) Answers to this question showed limited understanding of the topic. Many responses referred to continental drift; fossil evidence, the splitting up of Pangea and phrases taken from question 8b. Magnetism was often not referred to at all, and when it was, it was limited to magnetic pole flipping and magnetic stripes. Some candidates thought that the magnetic field of the Earth was responsible for the movement of Antarctica, describing an attraction between the land mass and the South pole. Some wrote at length about the magnetic field of the Earth, without stating that this produced a directional effect of magnetism in the rocks, as they formed.

8(b) This part of the question proved much more straightforward to candidates. Most were able to pick out why continents are able to move over the surface of the Earth.

Question 9

9(a) Some good answers were seen with air or water pollution as a common scoring point though candidates also used ideas about food chains and bioaccumulation.

9(b) Many scored one mark by explaining there was no alternative, at the time, to using mercury. It was rarer to see any of the other marking points. Some candidates made the point that people didn’t think that mercury was harmful, even though the question said they did know.

A172/01 Chemistry A Modules C4, C5, C6 (Foundation Tier)

General Comments:

The paper produced a good spread of marks with no evidence that candidates struggled to complete it on time. Most candidates attempted all the questions.

Candidates did not always think about all that the question was asking - some candidates gained a mark for a statement but not get a further mark for the required explanation.

Most candidates were able to tackle the six-mark extended-writing questions and many are trying to structure their answers. The best answers used a brief plan to ensure that their response would include all the required points. Other did not address all the parts of the question, just writing anything they knew that might be relevant which limited the level they could achieve. In order to access the higher marks responses must include more details and scientific points.

The significance of given experimental results were not always understood, for example, the significance of colour changes or the relationship between time taken, rate and reactivity.

Candidates who need more space for their answer are recommended to use any extra space available on a page before going to a supplementary answer book.

Comments on Individual Questions:

Question 1
(1)(a) Most candidates understood that the data showed that the reactions were getting quicker down the group but only the better candidates were able to relate this to increasing reactivity.

1(b) Responses to this question showed a good knowledge and understanding of the reaction between potassium and water. The significance of the blue colour with universal indicator was the best understood and the increase in temperature the least.

1(c) The role of oxygen in the dulling of the surface of potassium was well known. Nitrogen was the most common misconception.

Question 2
2(a) Many candidates understood that the main reason for using a fume cupboard is for the protection from dangerous gases and gave good responses to this question. Some candidates just referred to a range of hazards not related to the use of a fume cupboard.

2(b)(i) Most candidates could correctly name the second product as a chloride, with chlorine being the most common error although it did not appear as frequently as in previous examinations. Other incorrect responses were other halides, especially bromide.

2(b)(ii) Only the better candidates could identify the reaction as being a displacement. Combustion or neutralisation were the most commonly seen incorrect responses.

2(c) The best answers to this level of response question identified the given colour changes as a consequence of a displacement reaction of the fluorine with the halides. Some answers suggested that the reaction was between fluorine and potassium. Many candidates interpreted the colour changes as being the effect of pH on Universal Indicator and so answered in terms of neutralisation rather than displacement.

Question 3

3(a) Most candidates were able to identify at least one of the scientists that were carrying out a peer review and some went on to explain their choice using the information given. Others either gave a general description of peer review or simply quoted the information given in the question without explaining why this was peer review.

3(b) There were some good responses to this question which showed an understanding that the newly discovered elements fitted into the gaps left by Mendeleev. Many candidates just referred to elements going into the gap or referred to empty gaps without relating this to Mendeleev and his idea that new elements would be discovered with properties that would fit these gaps. The importance of matching properties was not well understood.

Question 4

4(a) Most candidates identified the production of carbon dioxide and the effect this would have on limewater. Some candidates only selected one answer when the question clearly asked for two.

4(b) Responses to this question showed that most candidates knew that solid materials are part of the lithosphere. The answer hydrosphere was the most common error.

4(c) There were some good responses to this question clearly linking the search for limestone with potential evidence for the presence of water and its consequences for the potential for life. Some thought that the search was to find a source of limestone for use on earth and others thought that it was to see if people could live on Mars. A few candidates thought that new types of limestone might be discovered that didn't need water.

Question 5

5(a) The state of nitrogen at room temperature and the formula for oxygen were well known. Some candidates thought that nitrogen was a liquid and others gave the formula of oxygen as O or O^2.

5(b) When answering this question most candidates correctly identify a molecule as being a small number of atoms bonded together. The most common misconception was that it is many ions bonded together.

5(c) Most candidates correctly identified water as the anomaly in the data given and they gave clear reasoning to explain their choice. Some responses were too vague, merely referring to parts of the data such as 'all are under 100'.

Question 6

6(a) Most candidates identified the loss of oxygen as being reduction. A few thought that it was reduction because too much carbon dioxide was formed or because the process was not efficient.

6(b)(i) Most candidates understood that using less energy reduced the cost by using less fuel and that the production of more pollutant gases by burning more fuel was damaging to the environment. The relevance of the link between energy and burning fuels was less well understood with many choosing that different fuels can be used instead.

6(b)(ii) The most common benefit of large scale metal extraction given in this question was the creation of jobs or the need for metals for specific uses. Responses focussing on the large scale aspect did not always make this clear and there were many vague references to less pollution or to make more money.

6(c) Most candidates were able to make some use of the data in this level of response question. Good answers linked the method of extraction chosen with both reactivity of the metal and the energy required. Responses at lower levels did not address all the parts of the question, especially by concentrating on the temperatures given without linking that to the energy needed. There was some confusion about what the reactivity was referring to with many describing increasing reactivity of the metal oxides rather than the metals.

Question 7

7(a) Most candidates gave a correct formula for water in this question, with many also giving a suitable name for the reactant, with the systematic name, hydrogen sulfate, appearing more frequently than sulphuric acid. Some lost a mark by clumsy representations of the formula for water e.g. H2O.

7(b)(i) When answering this question most candidates were able to use the graph in to find the mass of copper oxide needed. Others did not use the scale correctly to get an answer of 3.1 instead of 3.2.

7(b)(ii) There were some good responses to this question where candidates used ratios correctly to scale up to the required amount. Many struggled with the units, with the use of 100 instead of 1000 to convert from g to kg appearing frequently.

7(b)(iii) Many candidates could successfully identify the statements which explained why mass of product could be lower. The most common misconception was that the loss in mass could be caused by the rate of reaction being too fast.

Question 8

(8)(a) Most candidates correctly identified a pH meter as a method for measuring acidity with many also correctly choosing Universal Indicator. Some chose a measuring cylinder instead of the Universal Indicator and others only made one selection even though they were asked for two.

(8)(b) Most knew that 7 is the neutral pH. More chose values of less than 7, than values greater than 7.

(8)(c) Many responses showed an understanding that an increase in temperature was caused by a release of energy from the reaction. Some thought that this was because the reaction was endothermic or due to the higher rate when temperature increases.

8(d) There were some good responses to this question where candidates linked the fine powder with an increased rate that was caused by an increase in surface area. Some explained the rate increased due to the time needed to break up the lumps and others focussed on the idea of dispersion rather than rate of reaction. There was also some confusion between dissolving and reacting.

Question 9

9(a) Most responses to this question correctly described the effect of temperature on rate of reaction. How this was shown by the results was seen less often.

9(b) There were some very good attempts at this level of response question, with candidates using the data to conclude that the Group 1 ions do not act as catalysts and that the effectiveness of the catalyst is not determined by the charge on the ions used. Some responses had less detail in, for example, comparing the Group 1 ions with each other only rather than with the uncatalysed reaction or comparing the +1 ions with the +2/+3 ions rather than the higher charged ions with each other.

A172/02 Chemistry A Modules C4, C5, C6 (Higher Tier)

General Comments:

Candidates used their time well and were generally well prepared for the examination. Some individual candidates left questions unanswered but in general candidates attempted all questions.

Many of the questions on the paper involved the interpretation of data. Some candidates showed very strong data handling skills, extracting relevant data, using it to justify points and identifying full or partial trends. This shows a high level of both mathematical skill and understanding of Ideas about Science.

In answering questions, candidates need to take care that they do not merely repeat the question in their answer. This resulted in lost marks in questions such as 1(a), 3(b) and 5(b) (see below). In general, on the higher tier, candidates need to 'add value' to the information they are given by showing some processing skills in using, rather than repeating, data to support the answers that they give.

For the six mark questions, it is important that candidates read the question carefully and make sure that they address the entire task. To reach level three, there are often two or three aspects that need to be discussed. A common reason for only gaining partial credit was to only discuss some aspects of the question, for example leaving observations out of Q2(c) or not discussing energy in Q5(c).

Candidates who need more space for their answer are recommended to use any extra space available on a page before going to a supplementary answer book.

Comments on Individual Questions:

Question 1
(1)(a) Candidates needed to use the information in the table to make conclusions about reactivity. Many candidates interpreted the information well and presented their conclusions clearly. Most gained some marks. The most common reason that some candidates did not score was that they repeated the information in the table, for example saying 'the times get shorter' rather than interpret the information to make a conclusion about reactivity ('the elements become more reactive down the group'). Some candidates gained partial credit by spotting some, but not all of the three trends in the data.

1(b) Most gained a single mark. The second box, which stated that 'Each reaction makes a different metal oxide' proved most challenging, with many candidates classifying this statement as correct, even though the question was about elements reacting with water.

Question 2
(2)(a) Most knew that chlorine is a toxic gas. Candidates need to make sure that when asked about hazardous chemicals that they clearly identify the hazard. Those who said that chlorine is 'harmful' or 'hazardous' or 'will kill you' did not score; candidates need to identify the nature of the hazard. 'Toxic', 'poisonous' or 'corrosive' were all accepted.

(2)(b) Just under half of all candidates scored partial credit, usually for correctly giving the formula of either KBr or I_2. Common reasons for failing to score included representing iodine as 2I or potassium bromide as K_2Br_2.

(2)(c) The question asked for a statement and an explanation of what would be seen when chlorine was passed over solutions of potassium halides. In this type of question, candidates need to pause to think about what they need to include in their answer; in this case, a description of observations linked to an explanation. Many answers did not include observations; some gave observations but did not include an explanation for the changes. These answers were limited to the lower levels. Answers at level 3 both described the correct colour changes and explained these in terms of the reactivity of the elements compared to chlorine. Some candidates thought that all combinations would give a reaction, including chlorine with potassium fluoride. In answers which described observations, candidates knew some or all of the colours of the halogens. In this case incorrect statements of state e.g. bromine gas or liquid, were not penalised but were ignored. Similarly, correct colours for elements in states other than those in the question (for example purple linked to iodine) were also ignored.

Question 3
This question was an overlap question, in common with the foundation tier. It also tested Ideas about Science in the context of peer review.

3(a) Most candidates identified 2 and 5 correctly as the scientists involved in peer review. In this question, marks were given for a straight 'lift' of information from the question stem. Saying that scientist 5 was 'repeating experiments' was enough to gain credit. For scientist 2, candidates needed to explain that his peer review was based on his criticism, evaluation or assessment of Mendeleev's work. Candidates need to take care not to merely repeat the question. Answers which said that scientist 5 was 'reviewing' the work did not gain credit as they closely repeated the question.

Q3(b) The majority of candidates scored at least partial credit here. However, in this question, repeating the information in the stem or in the speech bubbles was not enough to show that candidates understood how Mendeleev's ideas were supported. Some candidates repeated information such as 'they discovered new elements which go in the gaps'. The strongest answers made it clear that the properties of the new elements matched Mendeleev's predictions based on the gaps he deliberately left for elements he expected to be later discovered.

Question 4
(4)(a) Most candidates knew that a covalent bond involves shared electrons. The effect of the attraction by the nucleus was less well known.

(4)(b) This type of question asks candidates to interpret information in the light of a claim made. Typically on the higher tier paper the trend in the information given is not straightforward. Some candidates identified a partial trend for the 'first three' elements, showing a good understanding of scale with respect to negative numbers, and also identified that water does not fit the trend and why. The question was very challenging, both because not all of the data fits the trend and due to the inclusion of negative numbers. These issues meant that many candidates did not score on this question.

4(c) In this case the trend was more obvious, and most gained at least one mark for identifying the correlation. The question asked for an explanation for 'the DIFFERENCE between correlation and cause'. In this type of question, candidates need to make sure that they engage with what the question asks for. A basic 'dictionary' every day statement that 'cause is what makes something happen' may be a true statement but is not enough to explain the difference between correlation and cause. Answers which gained two marks gave a clear explanation that an apparent link in the data does not necessarily mean that one results directly from the other.

Question 5
5(a) Both parts were well answered; candidates identified the oxidised and reduced element and identified the gas, carbon dioxide, as a waste product.

5(b)(i) Some candidates gave strong answers about the links between energy and finite fuel usage linked to air quality. The question stem included the phrases: 'costs and benefits', 'less energy', 'reduces costs to the company' and 'reduces costs to the environment'. In this type of question candidates need to take care that they add to these phrases when they reply in their answer. A common reason for a lower score in this question was that the candidate re-wrote these phrases without significantly adding anything of their own to the points. Candidates also need to take care to answer both sides of the question, in this case costs to both the company and the environment. Answers dealing with only one part of the question can only gain part of the available marks.

(5)(b)(ii) Most candidates gained a single mark, often for recognising that there would be more employment in the area near a large scale extraction. Candidates need to take care not to give 'cheaper' as an answer unless it is qualified by the reason for the reduction in cost. 'It is cheaper' alone is insufficient. 'Large scale metal extraction has cheaper fuel costs than many small scale extraction sites' is a better answer.

5(c) This was another overlap question, shared with the foundation tier. As the question was designed to discriminate up to grade C, most candidates on the higher tier scored high scores.

In this level of response question, the question asked candidates to discuss three key aspects: method chosen, reactivity and energy. Level 3 answers addressed all three aspects. Answers which addressed one or two aspects were limited to the lower mark levels. The information in the table did not give any information directly about energy, but this could be deduced from the temperature needed for extraction. The discussion of energy was the aspect most commonly omitted by candidates. Some very good answers were seen, some of which discussed the lowering in energy needed to extract reactive metals if electrolysis was used rather than carbon extraction.

Question 6

6(a) Candidates often knew one or other of the missing compounds. Those who knew the name of sulfuric acid did not always know the formula. Many thought hydrogen was the other product.

(6)(b)(i) Most were able to correctly read the graph to work out the mass of copper oxide needed.

(6)(b)(ii) Some candidates gave a fully correct calculation, with units, to gain both marks. Candidates need to take care in calculation questions that they give units if they are not provided. Some did not convert kg into g correctly. Conversion factors of 10 or 100 were often seen.

(6)(b)(ii) Most correctly calculated the relative formula mass for copper oxide. The relative formula mass of copper sulfate was more challenging.

(6)(b)(iii) Some very good answers were seen in which some candidates calculated and compared ratios of mass in the table with those on the graph. A relatively high proportion of candidates omitted this question, implying that they found theoretical mass a challenging area.

Question 7

(7)(a) About a third of candidates knew that H^+ ions cause acidity.

(7)(b) About a third of candidates knew that OH^- ions neutralise acidity. These statistics imply that the ions in acids and alkalis are not well known by candidates.

(7)(c) Almost all candidates knew that the size of the pieces of solid affect its surface area, but some thought that the surface area becomes smaller in a powder form. The idea of 'more collisions' was well known. Some very good answers discussed collision frequency.

Question 8

This was a complex level of response question, targeted at grades up to A*. Candidates were asked to make judgements about the interpretations of data by three people. In this type of question it is important that candidates give their views about who is right (and who is not) and then clearly present the evidence from the data to show who is (and who is not) supported. The question referred candidates to the 'results in the table'. Answers gaining 6 marks referred to the results of the experiment, relating these to whether or not each person had made a valid conclusion. Very good answers compared the times for the reactions with the control, experiment 1. Answers which only said 'works as a catalyst' or 'does not work' did not clearly relate to the data, only to the opinions of the people. Commonly, answers at levels 1 and 2 did not use the data in the table to justify whether or not the people's ideas were correct.

A173/01 Chemistry A Module C7 (Foundation Tier)

General Comments:

Candidates used their time well and were generally well prepared for the examination. Some individual candidates left questions unanswered but in general candidates attempted all questions.

Many of the questions on this foundation tier paper involved objective tasks where candidates made choices in tick box questions or chose words to complete sentences. These were very well attempted, showing that candidates have very good techniques at answering these questions.

Many of the questions on the paper involved the interpretation of data. Candidates showed very good data processing skills, using the data in the questions in their answers and extracting data from both tables and graphs to gain marks.

For the six mark questions, it is important that candidates read the question carefully and make sure that they address the entire task. To reach level three, there are often two or three aspects that need to be discussed. A common reason for only gaining partial credit was to only discuss some aspects of the question, for example in questions 4 (b) and 5 (a) (see below).

Candidates who need more space for their answer are recommended to use any extra space available on a page before going to a supplementary answer book.

Comments on Individual Questions:

Question1
1(a) Almost every candidate correctly interpreted the table to choose 'growing crops on farms' as the main route for fixing nitrogen.

1(b) Almost every candidate correctly identified that 50 million tonnes of nitrogen are fixed by the Haber process annually.

1(c) Most candidates correctly used the information to construct a fully correct word equation. Candidates need to read the information carefully to identify the reactants and products. Answers which did not score often had incorrect products, such as 'nitrogen hydroxide' or 'ammonia and water'.

1(d) Most knew that natural gas and steam are the source of hydrogen for the Haber process.

1(e) Most candidates gained at least partial credit. Some did not divide by two, implying that they had not read all of the information. Some who were unsure how to do the calculation showed good technique by trying different ways of multiplying and dividing the numbers until they reached a plausible number.

1(f) Some very good answers were seen which discussed both rate of crop production and eutrophication. There were two aspects to this question, how fertilisers are useful and how they cause pollution. A common reason for a partial score was to only address one of the aspects.

1(g) A full spread of marks was seen through the choices candidates made. Most identified at least one correct condition and many knew that enzymes worked as catalysts, although 'acids' was a popular incorrect choice.

1(h) Although some knew which chemicals were made on a large and small scale, some gave all of the answers the wrong way round. This may be because candidates think that food additives and fragrances are common products and so must be made on a larger scale than the two named bulk chemicals.

Question 2

2(a) Most knew that oils are used by plants for energy. The other choices were all seen.

2(b) A very large proportion of candidates correctly selected 'saturated' and 'unsaturated' as the correct terms to describe the molecules. A common reason for only gaining one of the available two marks was to put the two round the wrong way in the gaps in the sentences.

2(c) This level of response question was targeted up to grade D. A table of information was given and candidates were asked to identify the advantages and disadvantages of the enzyme and to say which catalyst is best. Some excellent answers were seen with a relatively high proportion of candidates gaining level 3. Best answers clearly classified the points about the enzyme into advantages and disadvantages and explained which catalyst was best by referring to the shortcomings of the other catalyst. In this type of question it is important that candidates consider carefully what they are asked to do. Common reasons for lower scores included not clearly identifying advantages and disadvantages. Merely copying out the information in the table does not show an understanding of which features are positive or negative. Candidates also need to make sure that they say which catalyst is best.

2(d) Most candidates correctly identified that A has a lower activation energy than B. However, the second mark was much less frequently scored. This was usually either because the candidate did not go on to make a second point or because the candidate thought that both reactions were endothermic. A common misconception seems to be that if products have less energy than reactants the reaction is endothermic.

2(e) Almost all candidates knew that carbon dioxide is produced by combustion of the compound. Although some knew that the other product would be water, hydrogen was a common incorrect answer.

Question 3

3(a)(i) Most correctly interpreted the formula to say that it contains three different elements. Both '4' and '2' were common incorrect answers.

3(a)(ii) Again, interpretation of the formula was very well attempted with most candidates recognising that the formula contains two carbon atoms.

3(a)(iii) Most knew that 'COOH' shows that the formula is a carboxylic acid.

3(a)(iv) About half of the candidates knew that a weak acid is less reactive than a strong acid. Some candidates thought that the acid was more dilute. The first statement was correct for the formula (it does contain carbon, hydrogen and oxygen) but does not answer the question. This was another popular incorrect choice.

3(a)(v) Although some candidates knew that weak acids have a higher pH, many chose the response that suggested that the pH of weak acids is lower.

3(b)(i) The majority of candidates knew that esters have distinctive smells. Some thought they were distinguished by their colour.

3(b)(ii) Almost every candidate knew the symbol for a reversible reaction.

3(b)(iii) Most knew that reactants and products are both present at equilibrium.

Q3(b)(iv) This question was well answered. Candidates showed very good data processing skills, commonly quoting correct numbers from the graph to support their answer. The most common reason for scoring less than full marks was that some candidates thought that the horizontal line on the graph meant that the reaction continued at a steady rate, rather than this shows that the reaction has finished.

3(c) Over half of all candidates correctly calculated the relative formula mass of ethanol. Candidates need to take care to look at the numbers of each type of atom in the formula before beginning their calculation (in this case there were two carbon atoms and six hydrogen atoms to be taken into account).

Question 4

4(a) Most candidates knew that the reaction was exothermic and that energy to start a reaction is activation energy. Candidates need to remember that breaking bonds involves energy being taken in, making bonds involves energy given out. Most inverted the two selections.

4(b) This level of response question had three aspects to the task. Candidates needed to discuss renewable, by-products and sustainability. To gain a level 3, candidates needed to address all three aspects. Commonly one was omitted. Most candidates knew and understood both what by-products are and that they can lead to a process being wasteful. The term 'renewable' was difficult for candidates to clearly explain. Explanations such as 'can be re-used' or 'can be re-made' or 'can be recycled' are not enough. Answers which gained credit included the idea of an unlimited supply, or a non-finite resource. Although many candidates used the word 'sustainable' in their answer only the very best answers made it clear that this meant that the process could continue in the future indefinitely.

Question 5

5(a) This level of response question asked for two aspects to be discussed; why there are two spots and why spot 1 is higher. In common with Q4 (b) it is important that candidates take a moment to make sure that they will address both parts of the question before they begin to write. Most knew that water or a mobile phase carries or moves the spots. A common misconception was that the distance moved depends on either the concentration of the ink or its relative mass. Fewer candidates clearly explained that the two spots come from different components or colours in the ink. The best answers made reference to the distance moved in terms of the solubility of the inks in the water. Some also discussed the affinity or attraction of the inks to the paper or stationary phase.

5(b) Almost all candidates correctly measured the distances on the chromatogram and correctly calculated the *Rf* for Spot 1. Those who did not usually gained one mark for at least one correct measurement from the chromatogram.

5(c) Although some knew that sometimes spots cannot be seen, in general the function of a locating agent was not well known. Common answers which were not enough to gain credit included repeating the question, 'to locate the spots' or to imply that the spots needed ' to be found'.

5(d) Most candidates gave at least one point to justify the approaches of Jane and Mike. There were three marks for this question. Candidates need to consider the number of marks when they make their answer to make sure that they make three clear points to gain all three marks.

A173/02 Chemistry A module C7 (Higher Tier)

General Comments:

This paper was well answered and all candidates were able to complete the paper in the time available. With one exception, Q4(a), fewer candidates than in previous years left any questions blank.

As always, candidates must take great care when reading the question. Examiners suspect that some candidates lost marks for this reason, especially on Q2(c)(i) and Q3(d).

Candidates who need more space for their answer are recommended to use any extra space available on a page before going to a supplementary answer book.

Comments on Individual Questions:

Question 1
1(a)(i) Most candidates knew that plant oils are used for energy. Those who didn't still chose sensible options such as 'for growth' or 'for repair'.

1(a)(ii) Many candidates had a clear sense of why molecule A was saturated, and the more able candidates went on to show precision in their thinking and expression and so gained credit. It was not enough to talk about single bonds and double bonds without identifying that the bonds were *between* carbon atoms. Both the molecules contained C=O bonds, so general statements such as "Molecule A has no double bonds" were not true.

1(b) This question and Q3(a) both covered equations, and were designed so that one would be slightly more challenging than the other. For this equation a large majority of candidates were able to give appropriate formula and also to balance the equation.

1(c) Candidates answered this question at a range of levels. Those who quoted information from the table without taking that information any further were able to score some credit. Those who commented on that information were obviously able to able to score much more.

Many candidates realised that the ability to coat the enzyme onto a solid surface would be an advantage. Answers which then explained *why* this might be an advantage were the hallmark of the most able. Suggestions that this was an advantage because it would obviate the need for a 'mixing in' stage were a common misunderstanding.

Fewer candidates understood why it would be an advantage for an enzyme to speed up the one reaction only. Many suggested that the sodium hydroxide would be more versatile because it catalysed a range of reactions.

Question 2
2(a)(i) Almost all candidates realised that the carboxylic acid group is –COOH.

2(a)(ii) The majority of candidates knew that weak acids are less reactive than strong acids. The most common mistake was to suggest that weak acids are more dilute than strong acids.

2(a)(iii) Most candidates knew that weak acids have a higher pH than strong acids. The most common misconception was, unsurprisingly, that they have a lower pH.

2(b)(i) Most candidates knew that the product of the reaction was an ester. The most common error was to suggest that it would be an alcohol.

2(b)(ii) Many candidates calculated the relative formula mass correctly, and many realised that the theoretical yield would simply be a tenth of the relative formula mass. Candidates who got the relative formula mass incorrect were still able to score this second mark.

2(c)(i) Good answers referred to 'a strong acid' as the catalyst, or named a suitable strong acid. 'Sodium hydroxide' was the most frequent incorrect suggestion, closely followed by 'iron', 'enzymes' and 'yeast'.

A minority of candidates appeared to mis-read this question as, instead of stating *what* catalyst was used, they wrote about what a catalyst is used *for*.

2(c)(ii) Able candidates were able to explain that a catalyst speeds up a reaction by lowering the activation energy, and some gained the third mark by mentioning that the lower activation energy was for an alternative pathway.

However, a large number of candidates found it difficult apply ideas about energy to the context of catalysis. A common suggestion was that catalysts speed up a reaction by giving the system more energy, causing an increase in collision rate.

Question 3

3(a) This question proved to be more stretching than question 1(b). Almost all candidates copied out the formula of ammonia correctly, but often struggled with the formulae of nitrogen and hydrogen molecules. A very common answer was $N+H_3 \rightleftharpoons NH_3$

Those who got the formulae correct were almost always able to balance the equation. The equilibrium sign was used in most cases.

3(b) The vast majority of candidates knew that the main use of ammonia is in the manufacture of fertilisers. The most common incorrect suggestions were 'hair dyes', 'cleaning products' and 'explosives'.

3(c)(i) The graph was interpreted correctly by almost all candidates.

3(c)(ii) In explaining why the amounts do not increase when equilibrium has been reached, many candidates were able to talk about the reverse reaction. The most able candidates took this further and stated that the two reactions had the same rate

3(c)(iii) That this type of equilibrium is called "dynamic" discriminated well at the lower end of the range.

3(d) The question asked candidates to explain how and why recycling the reagents affected the yield. Whilst most candidates addressed the 'why', a significant number did not address the 'how' and made general statements such as 'the yield would be affected' without suggesting what the change would be.

Question 4

4(a) This question was designed to allow candidates to show that they knew which distances to measure when calculating Rf values. To that end the diagram had seven horizontal lines and no fixed ruler. The working of most candidates indicated that they recognised that the two important measurements were the spot distance and the solvent distance, and almost all measured the spot distance correctly. However, a very significant number thought the solvent distance was the distance from the water surface to the solvent front.

A third of candidates who got the wrong answer scored at least one mark for showing their working. Many of these could have scored a further mark if they had written the general relationship for calculating Rf value.

An unusually high number of candidates did not attempt this question.

4(b) Examiners were pleased to see that the vast majority of candidates introduced the terms 'mobile phase' and 'stationary phase', and used these terms correctly. However, a minority missed the significance of the word 'attractions' in the question stem, and appeared to be writing out a general explanation of paper chromatography without reference to the specific cueing of the question.

Explanations in terms of density of the spots were not uncommon.

4(c) Most candidates were able to state either a similarity or a difference between the two types of chromatography. More able candidates provided both.

4(d) Candidates across the full range of the ability spectrum were able to make sensible comments about the two approaches to sampling.

Question 5

5(a) Most candidates knew that the liquid would be water, and many explained that it came from the reaction of the methane. Weaker answers tended to talk about 'condensation' without any further explanation, or suggested that the water vapour came from the air. The most common incorrect suggestion was that the liquid was methanol.

5(b)(i) As in other years, examiners noted that candidates' ability to state which bonds are made and which broken is often independent of their ability to do the thermochemical calculation. It was not uncommon for candidates who got Q5(b)(i) wrong to go on to give the correct answer for question 5(b)(ii).

5(b)(ii) It was gratifying to see that the majority of candidates realised that the energy change would be negative.

Question 6

6 Candidates tackled this question on sustainability with enthusiasm, though answers were often a little unfocussed. Explanations of renewability often mentioned 'protecting the environment' and 'less pollution', but did not explain what the term 'renewable' actually meant. A minority of candidates did not appear to recognise the term 'atom economy'.

A174 Chemistry A Controlled Assessment

General Comments:

Overview
This was the third session for the assessment of the 21C Science suites Investigation controlled assessment. It was a real pleasure to see how most centres had responded to advice and guidance from previous years. A significant proportion of centres still had their marks altered this session. The most common cause of significant changes to centres marks still relates to the hierarchical nature of the marking criteria, details of which are addressed below.

A serious cause for concern was the increase in malpractice cases. These nearly always involved centres who are giving too much guidance or feedback. They are giving too much guidance because all candidates are following same methods, same limitations and improvements, same references, etc.

Candidates' scripts from a small number of Centres were overly long, although timings indicated in the specification are for guidance only; it was clear that in some instances these had been exceeded markedly to the extent that in some instances this was malpractice. Candidates should not be allowed unreasonable amounts of time and it should be impressed upon candidates that producing reports is an exercise in conciseness.

Administration
A significant number of centres entered candidates for the wrong component, significantly delaying the requesting of manuscripts. Please note that the suffix /01 is for entry via the repository (i.e. electronic copies of candidates work) and the suffix /02 is for the normal postal moderation.

Documentary evidence of internal standardisation was also supplied in a large number of instances, but for many Centres, this was not provided. Much inconsistent marking seen suggested that internal standardisation procedures had not been applied by some Centres, and Centres are reminded of their obligations:

'It is important that all internal assessors of this Controlled Assessment work to common standards. Centres must ensure that the internal standardisation of marks across assessors and teaching groups takes place using an appropriate procedure.' Section 5 of the specifications suggests some ways in which this can be carried out.

In general the provision of samples was very good, with work sent promptly with all the correct administrative documents. When not correct the most common omission was the CCS160 Centre Declaration although a number of centres failed to attach the Coursework cover sheet to the front of each candidate's work, which always causes problems to the moderator. When submitting samples please do not use plastic wallets, the preferred method for holding a candidates work together is treasury tags. There were few clerical errors this session, but where they did occur they were nearly always the result of careless addition or transcription of marks.

Few Centres provided their Moderator with detailed accounts of how the tasks and levels of control were administered; where present, these aided the moderation process.

Annotation
Annotation of candidates' work was excellent in many instances, but variable from Centre to Centre, and sometimes within a Centre. The annotation ranged from *just a series of ticks here and there* to *the relevant skill area code written adjacent to where the point had been made, backed up by a supporting comment.* We would always encourage centres to adopt the latter of the two approaches. Please note that it is a requirement that 'each piece of internally assessed work should show how the marks have been awarded in relation to the marking criteria'.

Hierarchy
A significant number of centres did not treat the criteria as hierarchical. Where this was the case centres were often significantly out of tolerance. Each statement at a lower mark must be met before marks can be awarded at a higher level. So for example all the criteria at 1-2 marks need to be met before 3-4 marks can be awarded.

When marking the work each criterion should be annotated where it is met. Beginning with the lowest level and working up to the level where a criterion is not met. This will determine the level of marks awarded. If the candidate meets all the criteria a given level then the higher of the two marks is awarded. Where the candidate meets some of the criteria in a level the lower of the two marks must be awarded.

For example, in strand **Eb** a candidate who fails to make any comments about outliers is limited to a maximum of 3 marks no matter how well they consider the degree of scatter and general pattern of results. A consequence of this is that it is important that:

- candidates are taught to address lower level criteria as well as higher level criteria.
- teachers take care in identifying where the criteria are met otherwise quite large alterations in marks may result during moderation.

Particular criteria that have not been addressed by candidates are identified below

Interpretation of assessment criteria
Sa – formulating a hypothesis or prediction
For 21C Sciences a scientific hypothesis is a tentative explanation of science related observations or some phenomenon or event. The key point here is the idea of the explanation. A useful hypothesis allows a prediction to be made from it that can be tested experimentally.

The most common difficulties here were insufficient science used to develop the hypothesis. A common mistake was to provide 'a large chunk' of scientific knowledge but not relating this clearly to the development of the hypothesis.

Secondly, major factors were not considered <u>before</u> selecting a factor for the development of the hypothesis. It is not sufficient to state a factor, give a hypothesis and then list other factors as control variables. Candidates are recommended to structure their reports to make this process clear.

At the highest levels, 7-8 marks, it is important that candidates consider all relevant factors prior to selecting one. A quantitative predication must be derived or related to the hypothesis not simply an unjustified guess.

It is worth mentioning that work in this strand may not be credited for work in strands Ra or Rb which are carried out under conditions of high control.

Sb – Design of techniques and choice of equipment

In this session, this strand was often generously marked. It was often not possible to justify the centre marks because students limited themselves to a maximum of 5 marks by failing to explain their chosen range of data. It was disappointing to find that the range (of the independent variable) was rarely explained. Centres seemed to believe that just 'stating' the range was sufficient. This explanation can be pragmatic, 'there were only 5 different strength lens available', based on safety issues, 'the upper end of the range was limited to 2M as any more concentrated would be too corrosive' or based on prior knowledge/preliminary work 'from PE I know students cannot do step ups steadily for more than 3 minutes' or 'my preliminary work showed a reasonable change in the dependent variable of this range'. Note both ends of the range should be mentioned.

Good scientific justifications of the method, equipment and techniques selected must be provided for candidates to be awarded marks in the 7-8 mark level. Some candidates carried out preliminary work prior to the experiment proper. Although not a requirement, if it is practicable to do so in the allotted time, this can help to candidates to justify the method, equipment or range used. Justifications, however, were often weak, and the reasons for the use of a particular method, in particular, were often not provided. Many candidates produced tables, ostensibly to justify the equipment used, but these often listed every piece and simply described how they were used rather than justifying the choice. At this 7-8 mark level, candidates should be using terminology such as 'resolution', 'accuracy' and 'precision' in their justifications.

In this strand, candidates are also required to review aspects of Health and Safety, ranging from comments, through to producing full and appropriate Risk Assessments. These were sometimes absent, and where a high mark had been awarded, Centre marks had to be lowered significantly. It is suggested that there is no excuse for omitting Risk Assessments; this phase of the task is under limited control, and more importantly, a Risk Assessment is a prerequisite to any practical work being carried out. Risk Assessment proformas can be used, and these should include the chemical, organism, piece of equipment or activity that is likely to constitute a hazard, the hazard defined (using the appropriate terminology), the associated risk(s), and measures intended to reduce risk. Risk Assessments should pertain to the experiment in question and not to generic hazards and risks (though clearly, candidates are not penalised for the inclusion of these).

Please also note the hierarchy of awarding marks here; hazards must be identified for 3-4 marks, with 'some precautions' to minimise risk for 5-6 marks. While the word 'some' is used, it was not possible to support Centre marks where arguably the most important safety precautions are omitted e.g. the use of low voltage power supplies in electrical experiments. For 7-8 marks, for a Risk Assessment to be 'full', it must refer to *all* potential hazards and risks. This includes such things as using low voltage power supplies, limiting concentrations of solutions and the source of biological materials. Here, candidates should be encouraged to use statements such as 'low hazard' and 'limited risk'. Candidates should also consider hazards and risks of a final product of the experiment, e.g. the products of a chemical reaction or incubated agar plate. For a Risk Assessment to be 'appropriate', the hazard/risk must be appropriate to that for the chemical/equipment/activity used or undertaken. At this level they should ideally refer to PAT testing of electrical equipment, COSSH, Cleapps Hazard cards or other similar documents and show an awareness of who/where the first aider is in case of injury.

C – Range and quality of primary data
Errors in marking in this strand tended to be at the higher end. The '*correctly recording of data'* at the 5-6 mark level requires meaningful column headings, correct units and consistency in the number of significant figures/decimal places used. To match 6 marks, candidates need to show consistency both with the number of decimal places reported for their raw data and the actual measuring instrument as well as including all quantities and units in table headings.

In strand C there is no need to do more than 2 sets of results if there is close agreement between the two sets obtained. If they are not close, however, then there is a need to do a further repeat for this value –an intelligent repeat. The *regular repeats or checks for repeatability* criterion would then be matched and a possible outlier could be identified. In the new (2011/2012) specifications for Twenty First Century Science, statement 1.6 in the 'Ideas about Science' has clarified the definition and treatment of outliers (compared with the version in the legacy (2006) specifications) to state, *"If a measurement lies well outside the range within which the others in a set of repeats lie, or is off a graph line on which the others lie, this is a sign that it may be incorrect. If possible, it should be checked. If not, it should be used unless there is a specific reason to doubt its accuracy."* Potential outliers in data collected during a Controlled Assessment should be handled in accordance with this statement, with the expectation that at this stage the measurement will be repeated/checked.

Please note that experiments that 'pool' data from a class are not suitable for this controlled assessment. Strand **C** is based on the primary data collected by the candidate. Data collected by other candidates is secondary data. It is very likely that a student pooling data with other students in a class will be limited to the 1-2 mark level.

A – Revealing patterns in data
Overall, the quality of work in this strand was disappointing. Arguably, this should have been the strand of the Practical Data Analysis where candidates scored the highest marks, but it was here where often the largest discrepancies between Centre and Moderator marks occurred.

Some graphs seen were of poor quality. There was clear evidence that some Centres had not checked the plotting of points carefully before awarding marks. Graphs drawn without appropriate scales, e.g. where these were non-linear, or without one or more labelled axes, and poorly-drawn lines of best fit, were often, incorrectly, awarded high marks. If the scale is inappropriate, or points are plotted incorrectly, the candidate mark cannot exceed four. Likewise, if an inappropriate line of best fit has been applied, a mark above five cannot be awarded, irrespective of whether the candidate has drawn range bars. For marks to be awarded in the highest mark levels, range bars must be drawn accurately (in addition to there being minimal errors in the plotting of data). The scales chosen by candidates often made difficult accurate plotting of data, as did crosses drawn with unsharpened pencils, particularly where millimetre graph paper was used. Although it is not essential that graph scales should start at (0,0), where axes begin with a 'zig-zag' section it is important that candidates do not extend their line of best fit into this 'undefined' area. This bad practice was seen on a number of occasions.

Please note that if computer generated graphs are produced they will be marked in exactly the same way as hand drawn graphs. In particular the grid lines on the graph must allow the plotting to be checked to 2 significant figures.

In some instances, however, candidates that were awarded very low marks having drawn very poor graphs could be awarded three or four marks owing to their calculations of means, a point sometimes overlooked by Centres.

Centres are reminded that for candidates to be awarded marks at the 5-6 mark level and higher, graphs having gridlines should be produced. They should not be drawn on lined paper. Where computer software is used to generate graphs, these should have appropriate scales, appropriate labelling, and gridlines. For candidates to score high marks, lines of best fit and range bars should be drawn manually.

Ea – Evaluation of apparatus and procedures
This was generally well assessed by centres however the common errors consisted of over marking candidates who suggested improvements but did not consider the limitations, hence not meeting the criteria at 3-4 marks.

Some improvements mentioned were trivial or lacked the detail required for higher marks. In general doing more repeats is unlikely to be a significant improvement.

There was some confusion over improvements to the experimental procedure and apparatus which is addressed here in Ea and the additional data or methods which can be used to increase confidence in the hypothesis which falls in stand **Rb.**

Eb – Evaluation of primary data
A major stumbling point here was the requirement for outliers to be considered at level 3-4 marks. A significant number of centres ignored this requirement. In addition there appeared to be some confusion over what an outlier is, both amongst candidates and teachers. The criteria state *'individual results which are beyond the range of experimental error (are outliers)'*. Not all anomalous results are outliers, in particular averages are not outliers and a set of data points for a single value cannot all be outliers. In the new (2011/2012) specifications for Twenty First Century Science, statement 1.6 in the 'Ideas about Science' has clarified the definition and treatment of outliers (compared with the version in the legacy (2006) specifications) to state, *"If a measurement lies well outside the range within which the others in a set of repeats lie, or is off a graph line on which the others lie, this is a sign that it may be incorrect. If possible, it should be checked. If not, it should be used unless there is a specific reason to doubt its accuracy."*
Potential outliers in data collected during a Controlled Assessment should be handled in accordance with this statement. Candidates are permitted to draw a graph of their results during the (limited control) data collection stage of the Controlled Assessment task. This may help them to identify potential outliers. Ideally, any data points that look to be potential outliers should be re-measured, and this is easiest to achieve if they are identified during the data collection session i.e. strand **C**.

For 5-6 marks, although there were some often good discussions of spread of data, 'repeatability' was not always discussed. Candidates should discuss the spread of data qualitatively at this level, and quantitatively to obtain the highest marks at the top mark level at 7-8 marks. Candidates' evaluations were often very long, but many covered the pertinent points in the first few sentences.

Ra – Collection and use of secondary data
This strand was poorly addressed by many candidates.

The intention in Strand Ra is that candidates should do some research and find their own examples of secondary data. The OCR data in the 'Information for candidates 2' document is only provided as a back-up for those who fail to find any relevant secondary data from their own research.

Generally candidates are limited to 5 marks in Strand Ra if all they use is the OCR data and/or results from another candidate or group. In order to access 6 or more marks in Strand Ra candidates must present a 'range of relevant secondary data', which means that some data from the candidate's own research must be included and the source(s) of the data must be fully referenced. Guidance on referencing can be found in the 'Guide to Controlled Assessment' handbook for Unit A154 / A164 / A174 / A184 (Practical Investigation). The direct download link is http://www.ocr.org.uk/Images/77479-guide-to-controlled-assessment.pdf

Secondary data can be of different types:

- the data provided by OCR in the 'Information for candidates 2' document;
- data collected by other candidates doing the same (or a similar) investigation;
- data from other sources (e.g. textbooks or the internet).

Data do not necessarily have to be quantitative; they can be qualitative. Students do not necessarily have to find a table of numbers that looks exactly like the one they have generated from their own experiment; graphs, descriptions of trends, conclusions, mathematical relationships, relevant constants, models and simulations can all be presented as secondary data.

It is helpful to the moderator if candidates included copies of the secondary data that they discuss in their report. This could be cut and pasted into the report (so long as it is clearly identified as third-party material), or may be attached to the end of the report. The material included should be carefully selected and cropped to show only the relevant parts, rather than comprising swathes of irrelevant material indiscriminately printed out.

Rb – Reviewing confidence in the hypothesis

This strand was also over-generously marked by some Centres. Candidates should be encouraged to re-state their hypothesis at the beginning of the review section to provide focus for this strand. Candidates often discussed findings but did not refer the hypothesis at all, or say if their data supported it. All candidates should make at least a statement referring to whether the hypothesis has been supported (or not), and the extent to which the data support the hypothesis.

At the 3-4 mark level upwards, candidates should make reference to some science when explaining their results. This was rarely done. It is not sufficient to merely refer to science used in Sa, as Sa is carried out under conditions of low control whereas Rb is done under high control conditions. At level 5-6 the science must be used to support the conclusion about the hypothesis.

When giving an account of extra data to be collected this must go beyond simply suggesting improvements to the procedure used, which is assessed in Ea. Different techniques or experiments that will provide additional data to assess the hypothesis are required for this strand.

Sources of Support

OCR offers several avenues of **free** support, including:

- A 'Guide to Controlled Assessment' handbook for Unit A154 / A164 / A174 / A184 (Practical Investigation). The direct download link is http://www.ocr.org.uk/Images/77479-guide-to-controlled-assessment.pdf
- INSET training events for 2013-14 are available details may be found on the OCR website at http://www.cpdhub.ocr.org.uk
- We offer a Controlled Assessment Consultancy service, in which candidate work that you have marked will be reviewed by a senior moderator prior to moderation.

To make use of this service, post photocopies of three marked pieces of work to the following address: *Michelle Hawley, Science Team, OCR, 1 Hills Road, Cambridge, CB1 2EU*.

Typically, we encourage Centres to send work which covers a range of attainment or which illustrates particular points of concern. The Controlled Assessment scripts should be marked and annotated before being photocopied. Please include a covering note on Centre-headed paper, and give a contact email address. A senior moderator will look at the work and will write a report on the Centre marking, which we will email or post back to you within 6 weeks. You can then make adjustments to your marking, if you wish, before submitting marks for moderation in May.

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