OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry A

Twenty First Century Science Suite

General Certificate of Secondary Education **J244**

OCR Report to Centres

June 2013

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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

Overview

All components of the chemistry specification differentiated well across the wide ability range entered. Both stronger and weaker candidates were able to show the extent of their knowledge and understanding of all seven modules. In general candidates engaged well with the papers, providing responses that demonstrated an improved level of understanding across the ability range compared with the last session. Many of the stronger candidates performed very well and some excellent answers were seen.

As in previous sessions, the six-marks extended-writing questions proved to be a challenge for many candidates. Almost all candidates made an attempt to answer these questions, often writing at length. Some good answers were seen from more able candidates, with many gaining Level 3 marks for some of the questions. Answers from weaker candidates did not always address the entire task but most were better structured and more coherent than in previous sessions.

For these and other questions that required longer responses, some candidates wrote at greater length than necessary whilst others lost marks because they gave short and incomplete answers. Where two or three marks were available it was common for candidates to express only one idea, hence scoring only one mark.

Most candidates were able to make sensible selections from the information given, but found explaining some of the information, manipulating data and using data to make and justify decisions more challenging. Weaker candidates could perform simple numerical manipulation, but only the stronger candidates could successfully perform more complicated mathematics. Where candidates were asked to draw a graph the plotting of points was generally well done but drawing a line of best fit is clearly an area for improvement

Only a relatively small number of objective style questions are set on the papers. Few candidates left these questions unanswered and most followed the rubric. For many weaker candidates sitting higher tier papers they provided the larger part of their score.

The suite of papers gave the stronger candidates the opportunity to score highly whilst allowing weaker candidates to score a reasonable number of marks. Few questions were left blank with no attempt at an answer and there was no indication that candidates were short of time to complete the papers.

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

Section 1 – General comments:

Candidates engaged well with the paper, providing responses that demonstrate an improved level of understanding. The six-mark extended-writing questions were well answered, although further improvements can still be made in linking ideas to enable candidates to access levels 2 and 3 more readily. Answers appeared to be more coherent and with better structure. Further training can be given by centres to ensure all aspects of the question are covered.

Candidates did appear to follow instructions for most questions but there were definite areas where the instructions were ignored or explanations were not given.

Recall of formula and the names of chemicals were disappointing. The learning of facts cannot be overlooked. These facts are the basis of the application of knowledge within examinations.

Graph drawing skills were tested for the first time in this paper. Drawing a simple line of best fit is an obvious area for improvement although plotting of the points was generally very well done.

The understanding surrounding intermolecular forces remains an area for development as candidates show little comprehension of this area of the specification content.

Where data was involved in a question the information could be accurately extracted from a table by candidates but their manipulation of data for the purposes of providing a response was weak along with their application of knowledge to a range or a mean.

Most questions differentiated well.

Section 2 – Comments on individual questions:

Q1(a)(i) and (a)(ii) These questions involved plotting accurate points and drawing a line of best fit, which in this case was a smooth curve. Whilst most candidates could plot the points with reasonable facility, surprisingly few candidates could produce an acceptably drawn smooth curve. The lines drawn were often doubled in sections or ‘dot to dot’ style multiple lines had been drawn with or without a ruler.

Q1(b)(i) This was generally well answered, with candidates expressing the correlation shown by the graph. Most candidates used increases/decreases as expected but many others used acceptable alternatives.

Q1(c) Candidates struggled to identify factors that could affect measurements taken, with most failing to score even one of the two marks available. Despite ‘wind’ being in the stem of the question and ‘**other’** alternatives being requested, many candidates referred to the wind changing, showing a lack of attention to the question. There were many references to other power stations being nearby or scientists getting the measurement wrong. Those candidates who scored tended to get the mark for ‘rain’ and only a few realised that the power station output could vary and so burn more/less coal was rarely seen.

Q1d(i) Candidates could identify ‘oxygen’ as an element within the atmosphere but few candidates identified ‘water’. Common incorrect responses were carbon dioxide and nitrogen. These responses show a very poor understanding of the elements within a formula of a compound when given its name.

Q1d(ii) Very few candidates scored both marks here. The formula of nitrogen dioxide was poorly recalled and poorly expressed with numbers often superscript rather than subscript. Where candidates offered the formula, it was often accompanied by an incorrect attempt to write an equation. This was another example of where candidates didn’t respond to the requirements of the question.

Q2(a) This is the first of the six-mark extended-writing questions. Candidates were poor at responding to the command within the stem. Candidates often repeated the information in the stem rather than offering any new science to explain the observations made by Sam and Amy. They also appeared stumped when told that the information was correct and when asked to justify this. Responses were limited to Level one marks by the fact that they mentioned either Sam or Amy but not both.

Q2b(i) The majority of candidates failed to score either of the 2 marks here. Where they did score, it was only 1 mark for most candidates. The mark scored was for correctly drawing a molecule of carbon dioxide using one black circle, with 2 white circles, one on either side, which touched the back circle but not each other (linear shape). Other common mistakes included using small circles that were representative of hydrogen atoms and a lack of shading. Only the stronger candidates realised they needed to add an oxygen molecule to the left hand side of the diagram to balance the equation.

Q2(b)(ii) This was answered well with most candidates scoring at least 1 mark. Candidates were more able to demonstrate they understood that carbon monoxide was a product of incomplete combustion.

Q3(a) This six-mark extended-writing question gave the best responses by candidates with most scoring Level 2 or Level 3 marks. Information about the materials was given in a table. Candidates were expected to extract the relevant information and make appropriate choices for 2 sections of a shoe. Level 2 responses could clearly identify the essential properties from the table but fewer candidates added linking sentences to describe why their chosen material was fit for purpose. Some candidates only mentioned one material but could still access Level 2 marks as they gave full descriptions of one relevant material and offered links to its purpose. Relatively few candidates chose unsuitable materials. This was a good differentiating question, with very few candidates omitting the question. It was pleasing to see lots of writing here. Preparation of candidates for such questions has clearly been developed.

Q3(b)(i) This question was very well answered with almost all candidates scoring at least one of the two marks available.

Q3(b)(ii) This question was very well answered with almost all candidates recognising that vulcanisation makes the rubber more hard wearing or durable and hence scoring the mark available.

Q3(b)i(ii)Very few candidates scored both marks available here. Two correct responses were needed to score one mark and all three were correctly needed for both marks. The box that gave the biggest problem for candidates was the decision between range and mean.

Q4(a) A reasonable number of candidates correctly chose pentane, but where an incorrect choice was made it appeared to be random.

Q4(b)(i) This was poorly answered, with only the stronger candidates accessing the mark. The problem was the understanding of an alternative word for 'larger'. The word 'higher' was frequently used incorrectly as an alternative. This was not suitable as the first space referred to the size of the molecule and then compared this to its boiling point.

Q4(b)(ii) Almost all candidates failed to score on this question. This area of the specification is not easily accessed by foundation candidates as linking the ideas between intermolecular forces and energy appears to be conceptually difficult. This question would have been more easily accessed if it Q4bi had been answered more successfully. A common misconception was to link 'force' to the 'time' taken to boil. Ideas about energy required to separate molecules was not seen.

Q5(a) This question was generally well answered. Those candidates who gave an incorrect answer tended to calculate the difference between successive values rather than the difference between the original value and the stretch value for the load of 500g.

Q5(b) Many candidates could recognise that the molecules were aligned across the bag but few recognised the link to the ease of the ability of the molecules to slide over each other rather than separate up and down. The vast majority of candidates thought that stretching was due to the elongation of the molecule rather than the molecules sliding past each other.

Q5(c) It was surprising how many candidates did not score in this question. Where candidates did attempt to respond the issue may have been that the question was a little too open for the weaker candidates. The identification of the materials used to make everyday items was poor, for example, few candidates mentioned specific, new materials such as 'carbon fibre' or 'kevlar' for the items mentioned, often preferring to use a generic term of 'plastic' (instead of polythene), 'synthetic fibres' (instead of nylon, polyester etc.) or 'cloth' (instead of cotton, wool or silk). Candidates were also limited to 2 marks rather than 3 when they did not mention a specific item for the replacement material. It was important to say what the item was when plastic replaced wood or wood replaced brick. The question gave a context to the replacement and was essential to determine if the replacement made sense.

Q6(a) This question was well answered with most candidates scoring at least one mark. Most candidates could identify B and D as the correct sentences but also added E.

Q6(b)(i) This question was poorly answered with few candidates scoring even 1 mark. A common misconception was that the 'salt evaporated' rather than the water evaporating to leave the solid salt behind. The idea of the salt being buried by subsequent layers of sediment was rarely seen. Candidates incorrectly gave the impression that the salt was found beneath the surface for the Earth due to plate tectonics.

Q6(b)(ii) This part of the question was answered more successfully. A reasonable number of candidates correctly identified continental drift or the movement of tectonic plates as the cause of the salt moving. The biggest misconception here was that the oceans would carry the salt from place to place.

Q6(c)(i) This question was poorly answered. Where candidates did score, coal was better known than limestone as an available raw material. Random incorrect responses were very varied from 'fish' to 'brick', showing little idea of the process being discussed.

Q6(c)(ii) This question often gave part responses that were not enough to score the marks. The question asked the candidate to identify a specific group of people who benefited or were harmed and explain why they were affected. Where candidates attempted an answer they often identified the group of people but they did not give a suitable explanation to enable the mark to be awarded. The stem of the question gave the information they needed for the explanation. Candidates needed to simply link the information given to the group of people. For example where 'local people' were identified the idea that they were affected by poisonous gas was not included.

Q7(a) The majority of candidates scored 1 mark here for the identification of 'green' in the correct box. Yellow and red were invariably given the wrong way around. Most candidates did not calculate the value in the table to 100g, but instead they used the value in the second column at face value to make a judgement of colour coding.

Q7(b) The final six-mark extended-writing question was attempted by almost all candidates. This was an overlap question with the higher paper. Candidates' responses were mostly limited to Level 1 marks and the lower part of Level 2 as explanations for Mary and Joe largely repeated the stem of the question. Many candidates were able to identify that there were health problems associated with a high salt diet a scored well when Sally's ideas were discussed.

Q7(c) Most candidates scored at least one mark here for the ideas of not knowing or not caring as the main scoring point. Some candidates tried to discuss medical conditions that might justify a high salt diet such as 'low blood pressure' so did not score this mark.

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

General comments:

As in previous sessions, the stronger candidates showed a broad knowledge and understanding of modules C1, C2 and C3. The stronger candidates could apply this knowledge and understanding successfully to the majority of questions on the paper, including free response and other styles of question. Most of the weaker candidates showed sound ability in some areas but weakness in others. A smaller but significant number of candidates showed a general weakness across all three modules. Common areas of weakness included the interpretation of data, calculations and the drawing of best-fit graphical lines.

The majority of candidates followed instructions carefully most of the time, though in some questions particular details in the rubric were ignored by some. Interpretation of simple data was often good, but many candidates became confused when presented with more complex data or asked to make and justify decisions. Extraction of numerical data and subsequent manipulation using simple mathematics was beyond a significant number of candidates.

Whilst the six-mark extended-writing questions did give good discrimination, weaker candidates found this style of question particularly difficult. Many candidates gave long, rambling answers that had little relevance to the question, whilst others wrote only one or two lines that were clearly an inadequate response. These six-marks extended-writing questions were often poorly planned, with ideas jumping form one context to another. Coherent, logically ordered answers were rarely seen. Spelling, punctuation and grammar were often poor.

The overall spread of questions gave all candidates of appropriate ability for this paper the opportunity to demonstrate their expertise. Most questions discriminated well, giving a good spread of marks across the ability range. Only a small number of questions were not attempted.

Comments on individual questions:

Q1 Though graph point plotting was generally good, few candidates could draw a good best-fit curve. Most candidates could make some valid interpretation of the data.

(a) Stronger candidates suggested a valid reason for the value for this sample being different to the others in the range to gain one mark and some suggested that the value may not be an outlier to gain a second mark. Very few candidates suggested that the scientists had no reason to discard the result. Many weaker candidates framed answers based on fair testing or repeating of results, which gained no credit. Some candidates became confused and attempted to give reasons for discarding the sample.

(b) Most candidates correctly plotted the points and drew in the range bars to gain both marks in (i). In (ii) only the stronger candidates could draw a smooth best-fit curve. Many candidates drew multiple lines or lines that were distant from one or more points. Some weaker candidates drew straight lines. A large majority of candidates correctly described the change in sulfur dioxide concentration to gain a mark in (iii). A few of the stronger candidates also pointed out that the rate of decrease of concentration declines as the distance increases to gain a second mark. Few candidates realised that the small ranges indicated a high level of confidence, with most gaining no marks in (iv).

(c) Only the weakest candidates gained no mark but few of the stronger candidates gained both marks. There was no discernible pattern to the incorrect choices.

Q2 Few candidates made a good attempt at the six-mark extended-writing question (part aii).

(a) Though many candidates correctly drew a carbon dioxide molecule on the right to gain one mark in (i), very few also drew an oxygen molecule on the left to gain a second mark. Most of the weaker candidates clearly had little idea of what to draw. In (ii) most candidates gave answers based on only one harmful product of incomplete combustion and gave minimum details of why this product is harmful to health. Many attempts at the question were confused and rambling. Only the stronger candidates gave clear, concise and detailed answers.

(b) Most candidates gained at least one mark, usually for mention of photosynthesis. Fewer described the dissolving of carbon dioxide in the sea.

Q3 Many candidates found interpretation of the data challenging.

(a) Only the weakest candidates could not give at least one valid factor to be kept constant in (i). Common incorrect suggestions were the size of the rubber sample and the number of rotations. Some weaker candidates suggested that the time should be kept constant. In (ii) only the stronger candidates correctly chose the fourth statement. The major distracter was the second statement.

(b) Most candidates wrote about large differences between the ranges and means without gaining any credit in (i). A few of the most able realised that the ranges did not overlap and even fewer correctly pointed out the mean of the original rubber was outside the range of the vulcanised rubber. In (ii) most candidates identified one correct statement but not the other. There was no pattern to the incorrect choices. A majority of candidates gained at least one mark in (iii). Common incorrect suggestions were heating, polymerisation and vulcanisation.

Q4 The negative values in the table confused many candidates.

(a) A large majority of candidates correctly identified pentane. Incorrect suggestions included all of the other hydrocarbons.

(b) Stronger candidates could correctly describe the trend in boiling points in (i). A common error was to link melting points to boiling points. In (ii) only a few of the stronger candidates realised that butane would be a liquid and even fewer suggested that it could only be used as a fuel when a gas. Common errors included the idea that the butane would be too cold to heat anything and that the butane would begin to boil.

Q5 Few candidates framed a logical and coherent answer to the six-mark extended-writing question (part b).

(a) A large majority of candidates chose the correct statement.

(b) Most candidates gained one or two marks, but only the stronger candidates scored better. Many became confused when they tried to interpret the data. A common error was to think that the bag stretched more down than across. Others interpreted the data correctly but then thought that the polymer chains would stretch less in the direction of alignment. Some candidates based their decisions on the false idea that the diagram showed the polymer chain arrangement know to be correct rather than Ann's suggestion. Many weaker candidates tried to support their decisions with ideas that showed little or no understanding of either the data or polymer chemistry. Very few candidates mentioned forces and of these only a tiny number used the term correctly.

Q6 Attempts at interpretation of and calculation from the data were generally poor.

(a) Very few candidates could interpret the negative and positive energy values correctly. Some gained a mark for the idea that making and using the shirts uses energy. Many incorrectly thought that the negative values meant that less energy was being used.

(b) Only the stronger candidates could work out the energy and water totals for each material.

energy totals
polyester 97+33+340-33 = 437 MJ
cotton 60+40+340-7 = 433 MJ

water use totals
polyester 17+1260+4900 = 6207 dm3
cotton 22200+3900+4900 = 31000 dm3)

Stronger candidates often added the negative energy values instead of subtracting them or wrote down their calculations with no indication of which figures applied to which material. Many weaker candidates wrote a meaningless jumble of figures. Few candidates mentioned sustainability in their answer, and many of those who did could not support their conclusion from the data. Stronger students generally gained a mark but few scored better.

Q7 The performance for this six-mark extended-writing question (part a) was better than for the other two.

(a) Most candidates made at least two of the three choices correctly and made some attempt to justify their decisions. Often the justification was poorly expressed. The best answers made clear that both Mary and Joe were each partially correct and partially incorrect and gave clear explanations for these conclusions. Many candidates incorrectly thought that Sally was correct.

(b) A large majority of candidates gained at least one mark, with the more able gaining both. Common correct answers referred to liking the flavour of salted food and not being aware of which foods contain high levels of salt.

(c) Almost all candidates scored a mark and most scored both. Ideas of flavour and preservation were expressed in a variety of acceptable wording.

Q8 The majority of candidates scored one or two marks whilst the stronger candidates fared better. Tectonic was the most common correct answer and solution the least.

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

Section 1 – General comments:

The overall performance of candidates was slightly better than in previous sessions. In particular, candidates had clearly been guided in the way that they tackled six-mark extended-writing questions; fewer left these as blank spaces and the quality of extended writing had improved. In addition, there were fewer incidences where candidates had wasted space in re-writing the rubric. Centres have clearly given their candidates practice and guidance in the way that these questions are answered.
There are still occasions when candidates are ticking too many boxes for objective questions, and also in some cases not enough boxes where there are two marks or more awarded.
Candidates were able to select and use information given in questions well. They were able to identify masses and perform simple calculations successfully.
One of the weakest areas was in the knowledge and understanding of energy changes; many candidates were unclear as to the differences between exothermic and endothermic reactions.

Section 2 – Comments on individual questions:

Q1(a) An overwhelming majority of candidates were able to achieve full marks on this question. However, there were a small number who only drew 1 or 2 lines.

Q1(b) This was generally answered well. Common mistakes were; hydrochlorine/ hydrochloride, hydrochloric acid and incorrect formulae (although the question did not require formulae in the responses).

Q1(c) Most candidates answered this question well; there were few incorrect responses.

Q1(d)(i) Many correct responses were given, although there were a significant number who stated that the elements became more reactive down the group.

Q1(d)(ii) About half the candidates selected the correct response, and half an incorrect response (choices seemed to be random).

Q2(a) This question differentiated well between candidates of different abilities. Sodium hydroxide was given as a response more often than hydrogen, and sodium chloride proved a popular distractor.

Q2(b) This proved a challenge for many candidates; a majority did not achieve any marks for this. Many were unable to name a suitable indicator, or give the correct pH for an alkaline solution. Common incorrect responses included "indicator" without specifying a name or the resultant colour change.

Q2(c) was also poorly answered; very few candidates achieved the mark (both responses were required for a mark).

Q2(d) Most candidates were able to select the box for "sodium and potassium are difficult to handle."

Q3(a) Very few candidates were able to achieve both marks for this question; most got a mark for the idea of comparing results, or checking results, but most did not appreciate the idea of more data.

Q3(b) This six-mark extended-writing question was well answered by many candidates, and even those who struggled with extended writing were prepared to attempt the question; often achieving over three marks. The best responses were those where candidates had clearly stated the evidence supporting or not supporting Alex, and also the name of those students who had found the evidence for their claims. Some only achieved level 1 marks because their evidence only supported or disagreed with Alex without balance to the discussion.

Q4(a) Few candidates gained all three marks, but most were able to select the correct result of a test for calcium ions. Most candidates failed to explain that pure water would show no change.

Q4(b)(i) This was generally answered well, with many candidates offering a number of good responses such as type of soap and size of drops. Number of drops of soap was the most common incorrect response.

Q4(b)(ii) This six-mark extended-writing question was well-answered by many who achieved at least four marks demonstrating the ability to draw conclusions. The best responses were those that linked the concentration of calcium ions to the number of drops of soap. Weaker responses linked purity to geographical location – purer the further south you go or the nearer the sea/ or related to the dirt and pollution of big cities. A few candidates lost marks because they discussed time taken to lather as opposed to number of soap drops.

Q5(a) A minority of candidates scored full marks on this question, but most scored at least one mark. The most common incorrect response selected was about the covalent bonds.

Q5(b) was answered really well; most selected the correct response here.

Q5(c) There were many good diagrams of molecules and candidates were able to show the correct numbers of atoms in molecules. Some marks were lost needlessly because diagrams had atoms that were not linked together and looked like individual atoms.

Q6(a) There were no problems with this question overall, although occasional marks were lost where candidates had correctly added up percentages but subtracted 88% from 100% to give 22% instead of 12%.

Q6(b) This question wasn't well-answered and very few candidates achieved 2 marks. Many candidates concluded that both tables have similar percentages (which they haven't overall) with no reference to the elements. Many stated low copper, but one site had no copper at all; this is not therefore a similarity.

Q6(c) 1 mark was most commonly achieved. Site B was suggested but then no reason was given in the weakest responses. The best responses were those where candidates clearly suggested "a greater percentage of (stated) metal <u>and</u> has copper."

Q7(a) This proved a challenging question for many; it was not very well answered on the whole. Often the correct copper compounds were selected and placed in the wrong boxes.

Q7(b) Candidates performed really well on this question; the vast majority achieved both marks for matching the correct salt with its acid.

Q7(b) Candidates also performed really well on this question; the vast majority achieved both marks for selecting the correct state symbols.

Q8(a) Very few candidates achieved both marks, and less than half achieved on mark. Marks were lost as candidates often discussed reactivity instead of formula or atomic mass.

Q8(b)(i) & (ii) were answered really well; correct numbers were selected and then used to calculate formula mass.

Q9(a) This was the least well-answered of the six-mark extended-writing questions. There were a few good responses, but equally there was a higher omission rate. The best responses were those that gave simple definitions for exothermic and endothermic reactions, followed by the slide selection and a reason. Many candidates were unable to explain the difference between the two reactions, and common misconceptions included the idea that one had a bigger energy change than the other.

Q9(b) The majority of candidates achieved only one of the two marks. Many failed to select the option that containers may be damaged by high temperatures.

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

General comments

In general, candidates were appropriately entered for the higher tier paper and had been well prepared for the examination. Most candidates completed all questions although some left a significant number of questions unattempted. Some candidates wrote lengthy answers on additional sheets of paper. Candidates should use the mark allocations for the questions and the number of lines given as a guide to the nature of the answer they should make. It should not be necessary to write long additions to answers in this way.

In the objective questions, very few candidates left any gaps, showing good examination technique by eliminating distracters for more difficult answers. Where two choices were needed, candidates generally made two choices, showing that they followed instructions effectively. Occasionally, candidates ticked too many boxes in the single choice questions.

In general, candidates answered the longer answer questions well. In the two and three mark questions, candidates showed a skilled approach and generally made enough points to access the number of marks available. Examiners commented that the six-marks extended-writing questions were addressed more fully, leading to higher scoring, than in previous sessions. All three six-marks extended-writing questions provided candidates with information to use in their answers. In general, candidates made very good use of the information provided. However, candidates should re-check the question to make sure that they have addressed all aspects of the task before moving on. A common reason for a low score was that some candidates only discussed part of the task.

Comments on Individual Questions:

1(a) Candidates found writing this equation very challenging. Most did not know the formulae for hydrogen and fluorine. The most common error was to represent fluorine as 2F. As the balancing was dependent on the correct formulae, this led to most candidates failing to score.

1(b)(i) Again, this was question proved difficult. Most did not use the information to deduce the correct state symbols for the gas and aqueous ions. Some gave full words rather than symbols.

1(b)(ii) Just under half of the candidates recognised that hydrogen ions being made was responsible for the acidity.

1(c) About a third of candidates did not score any marks for deducing the name and formula of hydrogen iodide. Some who did score wrote the correct formula but gave an incorrect name, such as ‘iodine hydroxide’ or ‘hydrogen iodine’.

1(d)i This question was well answered with most candidates correctly interpreting the trend in the table.

1(d)(ii) Candidates need to take care when answering this type of question that they address the task fully. Rather than discuss the trend in reactivity linked to the position of bromine in the group, some merely re-quoted the observations in the table.

2(a) About a third of candidates correctly completed the word equation for the reaction of sodium with water. Common errors were to incorrectly name either the alkali or the gas. Common incorrect answers included sodium oxide, carbon dioxide, oxygen or water being formed.

2(b) About a fifth of candidates did not correctly describe how to test pH. Most knew that 'an indicator' is needed, but at this level of demand it is expected that they name an indicator fully, such as 'Universal Indicator'. The use of a pH meter was less commonly stated.

2(c) This question demanded two correct answers for a single mark. A common incorrect choice was that 'the reaction of sodium takes less time than the reaction of potassium'. Just under half of the candidates selected the two correct responses.

3(a) This six-marks extended-writing question also appeared on the foundation tier paper. Higher tier candidates attempted this question well with the majority of candidates gaining a Level 2 mark or above. Most classified the views of the students correctly as 'support' or 'do not support' statements. However, the question asked candidates to 'Explain….'. The most common reason for a lower score was that some candidates listed the statements by the student's name only, rather than explain how the evidence supported Alex's views.

3(b) Candidates were very confused about the peer review process. Many implied collegiate work such as people 'doing the same experiment' or 'working together to check findings'. Few candidates clearly expressed the idea that peer review is a formal process carried out by scientists on research that has been made public, for example by publication.

4(a) This question demanded that candidates link data in two separate tables. Most candidates did this well, with over half gaining three or more marks. Weaker answers did not make enough points to score the four available marks. Some incorrectly tried to justify the reasons for the differences, for example by discussing the size, geographical position or industrialisation of the towns, rather than focusing on the data.

4(b)(i) Almost all candidates knew at least one reason for the use of a desiccator. Over half selected both correct answers.

4(b)(ii) About half of the candidates gained both marks for calculating the mass of solid. The most common errors were involved in the conversion of the volume. Many candidates were not sure whether to multiply or divide by 1000.

4(b)(iii) This question was a developed quantitative task, in which the answer to 4bii was needed to calculate the answer to 4biii. About half of the candidates gained the available mark. Where the answer to the first part was incorrect, 'error carried forward' was allowed to ensure that there was no barrier to scoring in the second part.

4(b)(iv) Most candidates correctly concluded that there must be other ions in the water.

5(a) This six-mark extended-writing question provided candidates with data about the properties of carbon dioxide and silicon dioxide. The task demanded that the candidates compare the similarities and differences between the compounds. A relatively common barrier to scoring was that some candidates discussed either the similarities or the differences between the compounds, but did not address both. It is important that candidates check that they have accessed all parts of the task before moving on. The question information did not give any information about structure. A correct discussion of structural similarities and differences was demanded at Level 2 or above. Most candidates made correct comments about structure, sometimes, but not always, clearly linked to the properties, but often the exposition was confused with incorrect points expressed alongside correct explanations. Common misconceptions included that the bonding in silicon dioxide is ionic and that the bonds between atoms in carbon dioxide are weak.

5(b) Almost all candidates knew where carbon dioxide and silicon dioxide are found on Earth.

6(a) Most candidates correctly identified the positively charged metal ions on the diagram.

6(b) Candidates found this equation very challenging. Over half of the candidates did not score. The most common route to a one mark answer was to correctly balance the oxygen atoms. Few knew the symbol for an aluminium ion and very few could balance the ionic equation by inserting electrons.

6(c) Again, this part question was very difficult for candidates with only about a third gaining any marks. Some knew that electrical conductivity in metals is linked to the electrons, but few linked conduction in aluminium oxide to moving electrons.

7(a) Most candidates correctly identified both compounds in the correct places in the equations. However, some reversed the order of their chosen compounds and all distracters were seen, revealing that not all candidates have a secure knowledge of the reactions of acids with oxides and carbonates.

7(b) This was another question that involved the use of formulae. About one in five candidates gained both marks. Most of the others gained a single mark, usually for the correct formula of copper chloride or a hydroxide ion.

7(c) Candidates found this mathematical question difficult. A few gained a single mark for a correct calculation of the relative formula mass of magnesium sulfate, but over half of candidates scored no marks here.

8(a) This last six-mark extended-writing answer was the most difficult of the three six-mark questions. About half of the candidates did not score any marks. Many were not able to relate the shapes of the graphs to energy changes. Some gave the wrong energy change (for example saying that the dissolving of lithium chloride is an endothermic reaction). Of those who correctly linked the energy changes to the diagram, few went on to then predict the correct direction of the temperature changes. In common with question 5a, this may have been caused by poor examination technique. It is important that candidates fully re-check the question to ensure they have addressed every part of the task. About a fifth of the candidates scored marks at the highest level, Level 3.

8(b) About half of the candidates correctly identified the input and output variable. A common error was to attempt to join all of the boxes on the right to the boxes on the left. Questions with ‘extra boxes’ are relatively common and candidates should be aware that it is not always appropriate to try to connect every box.

8(c) Most candidates gained at least one mark, usually for identifying that energy changes affect the rate. Fewer knew that containers need to be cooled. Common incorrect choices included thinking that reactions that give out energy use fuel or that reactions that take in energy must be cooled.

A173/01 Chemistry A Module C7 (Foundation Tier)

General comments:

The paper produced no evidence that candidates struggled to complete it on time. Candidates are becoming more confident in tackling the six-mark extended-writing questions and are structuring their answers better although some do not tackle all the aspects required in the question and so limit the level they can achieve. In order to access the higher marks they need to include more details and scientific points in their responses. Many candidates are hampered by lack of knowledge of, for example, practical techniques and so choose to describe completely inappropriate experiments.

Comments on individual questions:

Q1(a) Most candidates were able to use the ruler given to measure the distances moved by the spot and by the solvent and then to calculate the R_f value by substituting into the formula. A few were confused by the scale, thinking that each graduation was 0.1cm instead of 0.2cm and others did not realise that the solvent front showed the distance travelled by the solvent.

Q1(b) Stronger candidates were able to identify both soft drinks that contained the banned food colouring and most could identify at least one correctly, showing that they understood that both spots must be present in the drink for it to contain the banned colour. A small number quoted spots or values instead of identifying the drinks.

Q1(c) The relationship between R_f value and distance moved by the dye was much less well understood although there were some good responses that explained that the lower R_f value of the first spot in alcohol compared to water meant that it had travelled less far. A significant number thought that the dyes had moved further in alcohol because the difference between the two spots in alcohol was greater than between the two spots in water.

Q2 Candidates struggled to correctly identify the formulae of the appropriate organic compound from the list given. Many understood the meaning of hydrocarbon but gave the alkene as saturated in (a) and the alkane as unsaturated in (b) but a significant number thought that the carboxylic acid was a saturated hydrocarbon and the alcohol was an unsaturated one. In (c), most candidates could identify at least one of the compounds which would combine to form an ester and many correctly identified both the alcohol and the carboxylic acid. Few could identify the weak acid for (d) with most seeming to choose the compound not used in the previous parts, making the bromoalkane a popular choice.

Q3(a) This was the first of the six-mark extended-writing questions. There were some good descriptions of the effect of the various conditions on the amount of ammonia produced from the Haber process, with the effect on rate by catalysts and temperature appearing frequently. Stronger candidates were able to give reasons for the increases in rate by mentioning activation energy or collision rate. Some candidates failed to score by just restating the question or by describing the flow chart without reference to the effect of the conditions given.

Q3 (b) There were some good descriptions of the environmental damage caused by large scale use of fertilisers but many candidates did not know what a fertiliser was leading to references to herbicides, air pollution, animals dying and damage to soil. There were also some good responses that used the bar chart to link the increase in ammonia production to an increase in use of fertilisers and hence greater environmental problems although many answers just discussed the need for more fertilisers to grow more food.

Q4(a) Most candidates understood that the reactants should be on the left of the energy level diagram and the products on the right. A few gave incomplete lists, others just wrote ‘reactants’ and ‘products’ and a small number put them the wrong way round.

Q4(b) Most candidates were able to recognise that energy had been gained from the surroundings during the reaction and many were able to identify either that the reactants had less energy than the products or that the reaction was endothermic. Good candidates were able to select all three responses correctly. Errors were almost all to give the reverse of the expected answers e.g. more than instead of less than etc., with randomly selected guesses from the list being rare.

Q4(c) Candidates were expected to recognise that there would be bubbles due to the formation of carbon dioxide and that the tube would get cold as the reaction is taking heat from the surroundings. However, few candidates were able to explain the expected observations from the information given. Many stated that there would be no reaction, in spite of having been given the reaction in the stem of the question, while others gave no explanation e.g. just saying that it will bubble without explaining why.

Q5(a)(i) This was the second of the six-mark extended-writing questions. Few candidates had any idea about how to carry out a titration or even, in many cases, what a titration is and so a significant number made no response. The most commonly remembered actions were the use of a burette, although the name was not always known, and the idea of seeing a colour change from an indicator. A few thought ‘acid-base’ was a single substance and so did not have the idea of adding one to the other. Descriptions of the method to produce a standard solution were also seen, often with no use then made of the solution produced. There were some good accounts that gave extra detail such as swirling the mixture, adding drop by drop or use of a white tile

Q5(a)(ii) Hardly any candidates understood that the uncertainty in a set of results is determined by how close the measured values are. Looking for outliers and taking averages both appeared frequently as did the idea of more repetition of the results.

Q5(b)(i) Only the better candidates could complete the word equation correctly with many not able to give the water that was given in the question. ‘Salt and water’ was seen frequently as were hydrogen, other chlorides (e.g. calcium chloride) or other magnesium salts.

Q5(b)(ii) Stronger candidates could successfully calculate the relative formula mass of magnesium hydroxide as 58. Some did not double the hydroxide masses to achieve a mass of 41, some doubled everything to get 82 and some doubled only the hydrogen to get 42. A few multiplied relative atomic masses together to produce large values.

Q5(b)(iii) Again, stronger candidates could substitute the correct values into the formula to work out the mass of hydrogen chloride in the acid solution although some did not give the answer to the nearest 0.1g as they were asked to do and some were unable to correctly evaluate the expression. A significant number of candidates used 1 for the mass of hydrogen chloride rather than the 73 given in the question and a few were confused by the units and cubed values e.g. 15.1^3

Q5(b)(iv) More candidates were able to use their values calculated in (ii) and (iii) to find the mass of magnesium hydroxide in the tablet. Some used the volume of acid used (15.1) instead of the mass of hydrogen chloride they had calculated.

Q5(c) The idea that all tablets within a batch must meet the standard of 1.0 g +/- 0.1 was not well understood by candidates with many basing their argument on the average of the results rather than the masses in the individual tablets within the batch. Some candidates discussed the values for each batch without saying whether or not it met the standard and others were not specific enough e.g. not saying whether results were too high or too low. A few thought that batches C and D met the standard because being too high did not matter.

Q6(a)(i) Most candidates could draw a correct structural formula for methanol. Errors included C-H-O instead of C-O-H, incorrect number of carbons and presence of C=O.

Q6(a)(ii) The fact that methanol is an alcohol was also well known although a significant number thought it was an alkane.

Q6(b) Few candidates could work out the number of each molecule in the equation and a wide range of apparently random numbers appeared. Some candidates had worked out the number of atoms in each compound and some the number of different types of atom in each compound.

Q6 (c) Uses for methanol were not well known. Many gave 'used in alcohol', 'to make alcohol' or 'used in drinks' and others used the equation given to suggest it was used to make carbon dioxide and water.

Q7(a) The was the third of the six-mark extended-writing questions. There were some good comparisons of the sustainability of the 2 methods for making ethanol based on the renewability of the raw materials although some ignored the ethane and described steam as more renewable than the sugar. Few candidates went on to discuss other factors although some better candidates understood the need for extra energy to produce the higher temperature for method 1 and others referred to environmental problems caused by carbon dioxide produced in method 2.

Q7(b)(i) The fact that alcohol cannot be produced in high concentrations by fermentation because the yeast is killed when concentrations are high was quite well known although a significant number of candidates thought that it was because the yeast stops working when it runs out of sugar.

Q7(b)(ii) The majority of students knew that distillation is used to make a more concentrated solution of ethanol, with filtration being the most common incorrect response.

Q7(c) There were some good descriptions of the denaturing of enzymes if fermentation is carried out at high temperature and of the need for a high temperature to increase rate/produce steam for the ethene reaction but too may answers were too vague e.g. 'the ethene reaction needs a higher temperature than fermentation',

A173/02 Chemistry A Module C7 (Higher Tier)

General comments:

The introduction of six-mark extended writing questions has provided an increased challenge for candidates. In this type of question designed to assess at the level of higher grades most candidates did not include sufficient detail to merit level 3 marks. Performance in this type of question designed to assess at standard grade was markedly better. In all three of the six-mark extended writing questions some candidates wrote at too great a length with little coherence. Many candidates could interpret simple information provided in graphs, tables and diagrams correctly, but only the stronger candidates could cope with more complex data. A number of candidates successfully demonstrated sound knowledge and understanding of the extension material and the ability to use their skills in a variety of situations. For many, however, knowledge and understanding was patchy. This component is intended to assess candidates across the middle and upper levels of ability. Whilst many candidates could perform adequately in the more modest areas of this range, very few could consistently answer questions set nearer to the top end. It is expected that some questions will be answered well by only the stronger candidates, for example those involving concepts such as dynamic equilibrium. There was, however, poor performance by many candidates in many of the basic areas. Only a minority of candidates could perform anything but the most simple of calculations correctly. However, few candidates left many questions blank. There was no evidence that candidates had insufficient time to complete the paper.

Comments on individual questions:

Q1 Many candidates evidenced no knowledge of the technique of reflux.

(a) Most candidates knew that the acid acted as a catalyst or that it speeded up the reaction to gain the mark. Some incorrectly thought it neutralised the solution or reversed the reaction.

(b) In (i) only the stronger candidates could name this apparatus as a condenser. Common incorrect answers were bung, stopper and lid. Again in (ii) only the stronger candidates could name the process as reflux or refluxing. The most common incorrect answer was distillation, though a wide range of incorrect responses was seen.

(c) Stronger candidates wrote a correctly balanced symbol reaction in (i). Many candidates omitted water from the right side of the equation. In (ii) most candidates made a sensible suggestion based on taste eg flavouring of sweets or smell e.g. perfume. The response from some candidates was not specific enough to gain the mark e.g. food additive.

Q2 Few candidates could apply ideas about dynamic equilibrium to paper chromatography.

(a) This was a six-mark extended-writing question. Stronger candidates candidates related distance moved by the dye chemicals to affinity for or solubility in the mobile phase and stationary phase. Only the strongest candidates used ideas of dynamic equilibrium to explain the different distributions of the dye chemicals between the two phases. Very few candidates referred to differences in the speed of travel of the dye chemicals. Many weaker candidates based their answers on incorrect parameters of the dye chemicals such as difference in mass. For a number of candidates the only credit-worthy part of their answer was the naming of the two phases. Some named these as stages rather than phases, applying a chronological basis to their answer.

(b) In (i) stronger candidates read off the correct values from the chromatogram and used them to calculate the Rf of the third spot.
Rf = 4.2/5.6 = 0.75
Many candidates read off incorrect values from the chromatogram. A common error was to divide the distance travelled by the solvent front by the distance travelled by the spot.
In (ii) stronger candidates realised that Peter should compare Rf values of the dye chemicals in his chromatogram with those of the banned dye chemicals to see if they match. Few could suggest how Peter would obtain the Rf values of the dye chemicals. A common error was to suggest comparing distances run by the dye chemicals, even though they were not run on the same chromatogram.

Q3 Again ideas of equilibrium were seldom applied. Only the stronger candidates could cope well with the calculations.

(a) In (i), a six-mark extended-writing question, most candidates made some reference to the compromise for temperature and pressure. The stronger candidates gave explanations for the effect of these parameters on yield. Only the strongest candidates used ideas about dynamic equilibrium in their explanations. Many candidates mentioned use of a catalyst but few realised that this did not affect the yield. In (ii) most candidates chose the correct statements to gain both marks.

(b) All but the weakest candidates could correctly calculate the relative formula mass of ammonia to gain the mark in (i).
(1 x 14) + (3 x 1) = 17
Some weaker candidate multiplied atomic masses rather than adding them.
In (ii) only the strongest candidates could complete the calculation correctly.
1.0 x (2x17)/28 = 1.2 tonne
Many candidates with incorrect answers included working with a jumble of figures that contained little or no logic.
Stronger candidates gained the mark in (iii) even if they did not have the correct answer for (ii), since they correctly calculated 95% of the answer that they gave in (ii). Most candidates could not successfully calculate 95% of their answer in (ii).

(c) Most candidates could describe the polluting effect of fertilisers washed into rivers. Many did this at great length, but only one mark was available for this part of the answer. Fewer stated that the production of ammonia or the use of fertilisers had increased, and only the strongest candidates linked these two ideas to explain why the pollution had increased. A number of candidates incorrectly thought that the pollution was caused by release of ammonia into the environment, or to gases released during the production of ammonia.

Q4 Most candidates carried out some of the calculation correctly.

(a) Stronger candidates corrected calculated the energy to break bonds in ethanol.
(5 x 411) + 348 + 358 + 459 = 3220 kJ/mol
A common error was omission of the energy needed to break the C-C bond (348 kJ/mol).

(b) Most candidates corrected calculated the energy released when the water is made.
6 x 459 = 2754 kJ/mol

(c) Most candidates correctly added and transferred data from (a) and (b) into the table and subtracted correctly to gain two marks. A common error was to make a mistake in one of the two additions.

(d) Most candidates described one of the trends shown in the table. Stronger candidates described two trends.

Q5 Most candidates could carry out simple calculations.

(a) Most candidates chose both correct statements to gain both marks in (i). Add acid 1 cm^3 at a time was a commonly chosen incorrect statement. In (ii) the majority of candidates knew that the indicator shows when the solution is neutral but only the strongest candidates realised the significance of this in determining the quantity of acid to react completely with the magnesium hydroxide.

(b) The calculation in (i) was performed correctly by most candidates.
24 + ([16 + 1] x 2) = 58
A common incorrect answer was 56.
In (ii) only the stronger candidates calculated the mass of hydrogen chloride correctly.
0.0151 x 73.0 = 1.1 g
It was clear from the jumble of figures many candidates wrote that they had little idea of how to approach this calculation.
Only a few of the strongest candidates performed the calculation in (iii) correctly, even allowing for the carrying forward of errors from the previous two parts.
58 x 1.1/73 = 0.87 g
Most candidates had little idea of where to begin.

(c) This question differentiated well across the ability range. Many candidates realised that batch A meets the standard and could explain why. For batches B, C and D a lack of detail in the explanation of why these did not meet the standard cost marks for many candidates. A large number of candidates calculated the average mass for each batch and used this as a basis for deciding each batch met the standard. They did not appreciate the idea that every tablet in a batch had to meet the standard, despite this having been pointed out in the stem.

Q6 The lower demand of the six-marks extended-writing question in part (a) allowed many candidates to score well.

(a) Details of the sustainability of feedstock for the two methods of ethanol production were used as a basis for answers presented by most candidates. Many gave good Level 2 answers. Stronger candidates gave details of other factors that affect the sustainability of these processes. A significant number gained full marks. Weaker candidates often wrote at length but omitted to compare factors for the two methods.

(b) This question presented a challenging test of candidates' knowledge. It differentiated well across the stronger candidates section of the cohort.

A174 Chemistry A Controlled Assessment

Overview

This was the first session for the assessment of the Twenty First Century Science suites Investigation controlled assessment. There were significant changes to the structure and assessment criteria for the investigation from the previous specification. Many centres managed the transition from the old specification very successfully, demonstrated a good grasp of these changes and criteria. However a disappointingly large proportion of centres had their marks altered this session, many with large scalings. The most common cause of significant changes to centres marks related to the hierarchical nature of the marking criteria, details of which are addressed below.

Administration

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 controlled assessment 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. 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. Candidates should not be allowed unreasonable amounts of time and It should be impressed upon candidates that producing reports is an exercise in conciseness.

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 must be met before marks can be awarded at a higher level. So for example all the criteria at level 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 at a given level then the higher of the two marks is awarded. Where the candidate meets some of the criteria at 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 Twenty First Century 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 before 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.

At the highest levels (7-8 marks) it is important that candidates consider all relevant factors. 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 candidates 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 candidates 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 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, some very mundane statements were seen. At this 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.

Please note that experiments that 'pool' data from a class are <u>not</u> 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 candidates 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 marks. 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

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 strand **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 7-8marks. 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. Candidates 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 strand **Sa**, as strand **Sa** is carried out under conditions of low control whereas strand **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 strand **Ea**. Different techniques or experiments that will provide additional data to assess the hypothesis are required for this strand.

Sources of Support

In addition to this Principal Moderator's Report, OCR also 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.
- OCR also offers 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: *Carolyn Brawn, Science Team, OCR, 1 Hills Road, Cambridge, CB1 2EU*.
  - Typically, Centres are encouraged 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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