OCR
Oxford Cambridge and RSA

GCSE

Additional Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J242**

OCR Report to Centres June 2016

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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

A162/01 Additional Science A Modules B4, B5, B6 (Foundation Tier)

General Comments:

In general, candidates across the ability range were able to access the questions. The highest mark was 54 out of a possible 60, and a great majority scored more than 20 marks. There was no evidence of shortage of time being an issue. There were few examples of specific questions being left blank.

Responses indicated that in general, candidates understood the instructions for each question. The longer questions (Q 3(b), 4(a) and 5(c)) were accessible, showing a good spread of marks across the levels.

Candidates were able to respond particularly well to the question on cells, chromosomes and cell division and the question involving graph plotting and interpretation. One question, concerning aspects of experimental technique rather than recalled knowledge, was less well answered.

Comments on Individual Questions:

Question 1(a)(i) Very few candidates were able to identify at which stage in the life cycle of a frog meiosis takes place. The most common wrong answer selected was at fertilisation.

1(a)(ii) The majority of candidates appreciated that the number of chromosomes in a leg cell of a frog would be the same as in a cell from the eye.

1(a)(iii) This question required candidates to label the nucleus on a diagram of a cell. This was very well answered.

1(a)(iv) Candidates were told that 4% of frog eggs develop into tadpoles and were asked to calculate how many of 2100 eggs would become tadpoles. The majority could calculate this successfully, and a very small number gained 1 mark for correct working only.

1(b) Almost all candidates knew that a zygote contains a set of chromosomes from each parent.

Question 2
2(a)(i) This question asked for the cell stage when cells in a human embryo stop being identical. It was not well known and only a minority scored.

2(a)(ii) Candidates were required to identify correct reasons why scientists think stem cells can be used to treat diseases. Most could select at least one correct reason.

2(b)(i) The question related to using stem cells to treat diabetes. It proved quite challenging. Some muddled and vague answers were seen, with candidates often using statements from q 2(a)(ii) in response, such as “stem cells are unspecialised”, “can become any type of cell” etc. Few clearly stated that the stem cells can replace or become pancreatic cells and produce insulin. Answers stating that blood sugar will be lowered, rather than controlled, were not credited.

2(b)(ii) Candidates were asked to suggest why scientists would decide to use stem cells from bone marrow rather than from embryos. Many answers referred to bone marrow cells being stronger or gave religious objections to using embryos, which were not credited. Again, candidates found this difficult, with only a minority scoring even 1 mark.

2(b)(iii) The question asked which body is responsible for regulating embryo research. Most candidates were unable to select the correct response, the Government.

2(c) Candidates were given the doubling time for mitosis in a human embryo and were required to calculate how many hours it would take to reach the 8-cell stage. Only a minority selected the correct response.

2(d) The question asked for the name of a group of specialised cells that perform a particular job. Only a small proportion of candidates recognised the word tissue.

Question 3

3(a)(i) Candidates were asked to plot a graph of data for the effect of carbon dioxide on the rate of photosynthesis; candidates performed well. Some lost a mark by not plotting the first point at 0,0.

3(a)(ii) Some very poor best fit lines were seen. In some cases, several lines were drawn, in others, the line was not smooth or was double in places. Random straight lines were common and also failed to score.

3(a)(iii) The great majority correctly read a figure from the graph for a value for carbon dioxide concentration not given.

3(a)(iv) Most gave the original correlation but few gave valid statements about the levelling off or the effect of another limiting factor to score 2 marks.

3(a)(v) The idea of an outlier was very well known, but fewer were able to state why it was not included, with reference to the pattern or trend of other results.

3(b) Candidates were asked to use graphs and their biological knowledge to describe what conditions should be provided to grow tomatoes. It was generally well answered, with many candidates scoring 4 marks for reference to the information provided. Few gained the full 6 marks, which required an understanding of optimum conditions for enzyme action or a clear explanation of limiting factors. Even weaker candidates gained 1 or 2 marks by referring to temperature and pH.

3(c) This was not well answered – few recognised the diffusion as the correct term for the process by which carbon dioxide enters the leaf. Respiration was the most common incorrect response.

Question 4

4(a) Candidates were given a description of an experiment on the effect of light on shoot growth and were asked to suggest problems and solutions in the experimental design. Many candidates did not realise the purpose of the experiment, so suggested measures to get the cress seedlings to grow upright. Others suggested problems which were not visible in the diagram, such as lack of water. Higher scoring candidates related the improvements to the problems identified.

4(b) Candidates who did not state that the phototropic response enables the plant to get *more* sunlight failed to score the first mark – the second was available for correct reference to photosynthesis or making food.

4(c) A sizeable minority of candidates recognised meristems as the regions in a plant where mitosis takes place.

Question 5

5(a) Although this was generally quite well answered, many candidates could not correctly give the two parts of the Central Nervous System. Spine was a common incorrect answer.

5(b)(i) Few candidates were able to identify whether three statements about receptors and effectors were True or False to score 2 marks, though many gained one mark for 2 correct responses.

5(b)(ii) Most candidates were able to recognise the fatty sheath on a diagram of a neuron.

5(b)(iii) This question required candidates to identify a correct consequence of damage to the fatty sheath on a motor neuron. A minority were able to state which of three people were stating the correct effect.

5(c) Marks were readily available for comparisons between nervous and hormonal systems but many candidates were not able to make explicit comparisons so failed to score the highest marks. Some features of the two systems were credited at the lower levels. Weaker candidates referred to reflexes or emotions.

Question 6

6(a) The terms long term and short term memory were quite well known.

6(b) The question asked for a technique to find areas of the brain which are damaged. MRI and CAT scans were quite well known. Brain scan and just "scan" did not score, nor did answers which involved brain surgery or questioning of the patient.

6(c) Candidates were required to give a way of remembering a telephone number. Answers which suggested writing it down were not credited. Repetition was the commonest correct response.

Question 7

7 Here, candidates were required to select words to complete sentences about respiration in yeast. The question was at least partly accessible to most and the full range of marks was seen.

A162/02 Additional Science A Modules B4, B5, B6 (Higher Tier)

General Comments:

Candidates appeared well prepared for this paper and made a good attempt at answering all of the questions. There were relatively few blank questions. The paper discriminated well between candidates. There was no evidence that any of the candidates ran out of time.
There was a good spread of marks; candidates scores ranged from 0 to 59 out of a maximum of 60 marks.

Centres are advised that candidates should try to write their answers within the allocated answer space. By focusing on what the question is asking, and writing concisely, candidates can give themselves a better chance to score.

The majority of candidates made a good attempt at answering the six mark questions and were well prepared as to how to present their responses.

Comments on Individual Questions:

Question 1
1(a)(i) A significant number of candidates failed to plot the origin point and therefore failed to score full marks. Candidates should be reminded to use an X when plotting points or a dot within a circle as, with scanned scripts, it is sometimes difficult to determine a dot by itself. Where these were not visible, candidates were given credit if the line of best fit passed through the correct points.

1(a)(ii) Many candidates struggled to draw a single, smooth and complete line of best fit. When candidates failed to achieve the mark it was generally due to them failing to include the point of origin, or they drew a straight line. A considerable number of candidates failed to realise that it was imperative that the line of best fit reflected the idea of 'no CO_2 = no photosynthesis', and as such, had to go through the origin. Candidates would also re-draw their line in a section which they considered to be incorrect, without erasing the original section of line. Extra lines, wobbles and feathery lines were common, and were penalised with no marks. Only a few joined the points dot-to-dot with a ruler.

1(a)(iii) Most candidates achieved a correct answer, or the ecf mark. Generally, even candidates who had not achieved the line of best fit mark still managed to score as they recognised the need for the value to fit within the pattern of the data presented. Of those who did not score, the majority seemed to mis-read the value on the graph, for example writing 0.41 as opposed to 41.

1(a)(iv) Most candidates recognised that increasing the concentration of carbon dioxide would result in an increased rate of photosynthesis. However only a minority were able to score a second mark for recognising that the rate then plateaued and the idea of limiting factors was very rarely seen.

1(a)(v) Most candidates used the key term outlier (or anomaly), but there was a general failure to relate the outlier to the pattern/trend with only around half scoring this marking point on the scripts seen. Simply stating that it wasn't 'close enough/similar to/didn’t match the other results was a common error, with some also referring to points on the graph in detail.

1(b) Most candidates scored the $6H_2O$ mark, and it was pleasing to see that a significant proportion, if still a slight minority, could also give the correct formula for glucose. Some candidates failed to score, despite giving the correct formula, as they put water and glucose on the wrong sides of the equation. Common errors here also included the inability to balance the equation i.e. simply giving H_2O, rather than $6H_2O$. There were also a significant number of candidates who did not score because they had failed to use appropriately sized subscript numbers, or because they failed to distinguish between capital letters and small letters. Very few candidates gave a word equation.

1(c) Almost all candidates were able to identify conditions needed for plant growth. The majority attempted to use the graphs, although occasionally their information was slightly inaccurate e.g. pH 4-8 or 25^{o}C. A sizeable minority were able to give excellent details about enzymes and active sites/denaturing at extremes of pH and high temperatures, but some omitted figures for correct pH and temperature from the graphs and so failed to gain full marks. A minority referred to the plant or cell denaturing. References to limiting factors were rarely seen.

Question 2

2(a)(i), (ii) and **(iii)**. About half of the candidates recognised that bacterial cells did not contain mitochondria with 'circular piece of DNA' generally being the most common misconception. Cell wall was probably the most common misconception seen for 2aii but most candidates recognised circular piece of DNA as the correct response for this question. There was no obvious pattern to the incorrect answers for 2aiii.

2(b)(i) Most candidates were able to identify two cell parts correctly but did not always achieve the second mark for the function. They often omitted aerobic or anaerobic from their answer when referring to respiration in the cytoplasm or mitochondria; several stated that enzymes were made in the mitochondria. There was fairly common use of vague terms like *substances* in relation to the cell membrane along with equally vague statements like *keeps the cell together*, not understanding that the question was asking about the role in respiration. Many candidates who gave nucleus as a cell part then struggled to score for the function as they did not refer to containing genetic code for making enzymes. A few candidates still gave cell wall as an animal cell part and a very small minority gave named plant organelles, or even referred to blood and lungs.

2(b)(ii) Many candidates failed to score here for lack of precision in their answers e.g. same shape was often seen. Common misconceptions included ideas such as ethanol breaks down methanol, that they both reacted with the enzyme at the same time, that ethanol itself was an enzyme, or that the products of ethanol breaking down would neutralise or remove the toxins produced by methanol. Few candidates appeared to understand that the ethanol would prevent the methanol from binding to the active site. The most common mark achieved was for the idea that ethanol would also fit into the active site of the enzyme. Most candidates did not appear to know what methanol poisoning was, which may have impaired their ability to answer this question successfully. A large proportion talked about lock and key model, but failed to mention the active site and so failed to score a mark.

2(b)(iii)_ Bread making appeared to be the most common correct response but a significant minority of those who did score gave biogas. There seemed to be a high level of candidates giving no response, and some rather obscure answers such as microbes under the skin. Making lactic acid, getting energy anaerobically and references to fermentation were common incorrect answers.

Question 3

3 Over one third of candidates scored zero on this question, suggesting a lack of knowledge of meiosis and mitosis, and/or a lack of knowledge of where they take place and what their purpose is within a living organism. Having to apply their knowledge to a non-human context may also have been problematic.

Of those who scored, responses were very variable with marks spread relatively evenly across the range. A large proportion of candidates identified B (rather than C) as a process of cell division, usually alongside A. Some candidates forgot to name the stages. Some candidates mixed meiosis with mitosis, e.g. stating that mitosis makes gametes, or showed other signs of confusion, e.g. sperm cells dividing before fertilisation. Explicit comparisons were quite rare, being recognised in about 25% of responses, although primarily focused on differences rather than similarities. Most candidates described aspects of each process without explicit comparison (usually talking about chromosome number, genetically identical/different, number of divisions, and number of cells produced), and in some cases they also forgot to name the types of cell division. Many candidates appeared not to understand the difference between fertilisation and meiosis, with many describing fertilisation as meiosis. A fairly common error was also to describe meiosis as happening in the gametes, rather than producing them. Candidates should try to ensure that they spell meiosis and mitosis sufficiently well that an Examiner can distinguish between them.

Question 4

4(a) Given it was a calculation, this was answered relatively poorly with the majority of candidates gaining no marks. Of those who scored, many gave 0.09 as the answer, but with no working or the incorrect working. Many candidates got the answer 0.09 but often by carrying out the calculation (37/40000) x 100, which limited them to one mark. It is important to note that showing working here was essential to gain the second mark, and candidates should always be encouraged to show their working. Some candidates gave the answer to more than two decimal places, or to two significant figures. Many candidates calculated 40000/37.

4(b) This question was answered poorly, with candidates not taking time to understand what was being asked. Many candidates focused on half of genes/23 chromosomes originating from each parent, without credit. Although some candidates had the correct idea that **most** genes come from the mother and father, they frequently forgot to say 'most', failing to understand what the question was actually asking. Some did say that characteristics are coded for by genes found in the nucleus. Very few made explicit the idea that few genes originated from the donor.

4(c) Most candidates did not score on this question, with a surprising number of no response answers. Of those who did score, enzymes was frequently given, with some candidates giving functional as a response and very rarely structural. Some did name specific enzymes or proteins, such as e.g. amylase/keratin and some candidates wrote ‘hair’, but these were not worthy of credit. Many also wrote 'amino acids', but again this was not worthy of credit. Given enzymes are a type of protein, the proportion of wrong answers was surprising.

4(d) Most marks were awarded for simple statements of ethical or religious reasons or problems associated with having three parents. Some candidates talked about the nucleus which could become a life being discarded, although some gave this in the context of an embryo, which gained no credit. ‘Playing God’ and unnatural were very frequent responses which gained no credit. Centres are advised that these responses do not gain credit, and candidates should be advised against them. Only a small number candidates considered costs, or considered consequences. The candidates that did identify consequences tended to be around the ideas of where it may lead. Very few considered the impact on the child themselves.

4(e) This question frequently scored 1 out of the 2 marks, with a significant number of candidates failing to use the information provided in the question. Many candidates gained credit for stating that the technique would improve quality of life, or save lives. Many candidates identified 1 in 6500 being a low number. Very few candidates discussed the idea of preventing faulty mitochondria being passed on. Some candidates did use both the 1 in 200 and the 1 in 6,500 figures thoughtfully in their answers to score 2 marks. Few candidates referred to it being cheaper to treat those affected than to develop the new technique.

4(f) Generally the idea that a different or wrong protein would be produced was scored by many candidates. The concept of amino acid *sequence* being changed seemed not to be so well understood, and rarely scored. There were quite a few references to amino acid *production*, which on its own did not gain credit. Quite a lot of candidates seized on the mutation idea and described how a mutation could affect an individual ranging from various disabilities to cancer, occasionally also talking about incorrect base pairing. The link between a protein being different and a protein not functioning was not often seen, so relatively few candidates scored the final marking point.

Question 5

5(a) Most candidates answered this question well. This question enabled candidates to demonstrate their knowledge of neuron structure and function, with many identifying the fatty/myelin sheath, although fewer understanding its role in insulation, with the impact on transmission awarded less frequently than the other areas. Many were able to identify the visible effect of multiple sclerosis on this structure. However, some struggled to explain the normal functioning of the neuron, often without the correct use of terminology such as *electrical/nervous* impulse, with many candidates mentioning signals, messages or just impulses, which did not allow them to gain credit. This was unfortunate since it prevented these candidates from obtaining marks for two out of the four areas upon which the mark scheme was based. Many candidates showed a good understanding of the overall impact of multiple sclerosis on the control of body movement, providing most candidates with the opportunity to gain marks.

5(b) Very few candidates scored both marks in this question. A number managed to subtract 100 000 from 64 000 000 but fewer explicitly showed the subsequent division, or stated the correct ratio: very few arrived at 1:639. Most of those who scored ended up with the answer 1:640, so gained some credit (others gained credit for the division 100000/64000000), although it was sometimes difficult to know *how* they arrived at these figures, with the working area suggesting many candidates were unclear about how to calculate a ratio.

5(c)(i) Very few candidates talked about ethical issues or animal rights. Of those candidates who scored marks, most picked up on the ideas of rejection, or the simple idea that mice stem cells would not work in humans. Some candidates did discuss differences between DNA/genes etc.

5(c)(ii) This question was not answered well at all; candidates may not have read the question carefully enough to appreciate what was being asked. Candidates seemed to find it difficult to articulate their understanding of the use of bone marrow vs umbilical cords. Some did, however, appreciate the ethical issues involved in the use of umbilical cords while others were aware of the difficulties in extracting cells from bone marrow. References to the capacity for cell differentiation were frequently made but this was not relevant for this item. A large number of candidates did not understand that the use of the umbilical cord blood was not harmful to the baby, so described this as an ethical issue against using umbilical cords. It also led to comments that bone marrow was less intrusive. Some candidates did comment on the fact that the umbilical cord was discarded after birth. Mention of matching donors was incredibly rare.

Question 6

6(a) Answers to this question were very varied, but most candidates scored, with marks frequently awarded for referring to learning, and for reference to a primary and/or secondary stimulus. Many candidates gained marking points by discussing Pavlov's dog, rather than describing the reflex more generically. Few candidates mentioned survival. There was some limited confusion between stimulus and response.

6(b) Most candidates responded well and identified 'neurons are in a fixed pathway' and 'reflexes do not involve conscious thought'. No clear pattern of alternative response could be identified.

6(c) Amy was the answer given by over half of candidates. If incorrect, Orla and Cillan were the most frequent incorrect responses. Simon's explanation was recognised by almost all candidates as being incorrect.

6(d) Many responses were acceptable for this item. The majority of candidates obtained the mark and concluded the paper with a positive outcome. A minority of candidates had not read the question carefully enough, and did not realise they were to give new-born responses.

A172/01 Additional Science 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 with the extended writing questions being most likely to be omitted.

Candidates did not always think about all that the question was asking and would lose marks by not going on to give the additional detail required.

Many candidates are trying to structure their answers to the six-mark extended-writing questions. The best answers used a brief plan to ensure that their response would include all the required points. Others 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.

Candidates' knowledge of experiments was often poor and they struggled to recognise observations or devise simple methods.

Comments on Individual Questions:

Question 1

1(a) Candidates struggled to identify properties of Group 1 elements. The most common incorrect answers discussed electron/atomic structure or said they were solids. 'Metals' was the most common correct answer.

1(b)(i) This was answered well by most candidates. Incorrect answers included writing the names of the elements or using proton number. Candidates who had identified the relative atomic masses in 1(b)(i) were usually able to identify the trend correctly for 1(b)(ii). Many said they were odd numbers or talked about reactivity. Many candidates clearly identified the positions of hydrogen, fluorine and chlorine in the modern Periodic Table for 1(b)(iii). Common errors included confusing groups with rows and placing hydrogen in Group 1. Most candidates identified the missing group as Group 0 for 1(b)(iv), with Group 5 being the most commonly chosen incorrect response. In 1(b)(v), the reason that elements were missing from the earlier table was because they had not yet been discovered was well known by candidates, although a significant number thought that it was because they did not have a relative atomic mass. Almost all candidates showed that they had used the Periodic Table to identify the elements for 1(b)(vi) and most chose the correct symbols of Be and B. Some gave names instead of the symbols requested and others used atomic numbers instead of relative atomic masses and so gave F and Na instead.

Many candidates did not know that the elements in the modern Periodic Table are listed in order of proton number for 1(c). Relative atomic mass and the type of bonding in the elements were both popular choices.

Question 2

Most candidates who attempted the extended writing question **2** were able to identify sodium and rubidium in minerals A and B although some concentrated only on reasons for not being able to identify the elements, frequently not referring to the flame colours at all. There were some good responses that went on to explain the problems with identifying the element in mineral C due to the absence of a green flame in the table although some thought that a green flame must mean chlorine or a mixture of two other flame colours.

Question 3

The colours and states of the halogens required for **3(a)** were not well known and few candidates got 3 marks. The identity of the missing particles in fluorine as neutrons for **3(b)(i)** was better known although a significant number chose electrons instead. Most candidates were able to gain at least 1 mark for the electron arrangement in **3(b)(ii)** by putting 2 electrons in the inner shell although a significant number lost the second mark by putting 8 electrons in the outer shell.

Question 4

Candidates struggled to relate their knowledge of the particles in solid and aqueous sodium chloride to the information given in the diagrams in 4(a). There were some good descriptions of the arrangements but links of these to relevant properties were less common so limiting the level possible. There were frequent references to atoms or molecules in spite of ions being clearly shown in the diagrams and some did not refer to particles at all.

Most candidates showed that they understood the correlation between the mass added and the freezing point in 4(b)(i), although there was some confusion about whether the freezing point was increasing or decreasing as it became more negative. Many went on to give the extra detail about the amounts. Few were unable to correctly predict the freezing point in 4(b)(ii) although some omitted the negative sign. There were some good answers in 4(c)(i), explaining why it is an outlier by either stating what the freezing point would be if the trend continued or stating the mass that had produced the given freezing point. Again there was some confusion as to whether the freezing point was higher or lower than expected as it was a less negative number. Some answers were too vague, such as ‘did not fit the pattern’. The need to repeat a test which has produced an outlier was well understood by candidates for 4(c)(ii) although some described drawing graphs and lines of best fit. Few candidates were able to describe any suitable experiments for 4(c)(iii). Some did have the idea of adding a further range of masses but most just added 50g in one go. Others did realise the need to keep the amount of water the same but hardly any described the need to measure the freezing point.

Question 5

In 5(a) many candidates did not discriminate between oxygen and KCl. A typical answer would be that they were both soluble. The fact that oxygen is a gas was rarely mentioned. In 5(b),the symbol for graphite was seldom seen and usually incorrect e.g. G/Gr and oxygen was often O. Potassium and chlorine were more commonly correct although there were quite a few references to chloride.

Question 6

There were some very good energy level diagrams drawn which clearly showed the relative size of the energy changes. Marks were often lost for lack of arrow heads or labelling. Some candidates struggled with the diagrams but were able to use the data given to compare energy or temperature changes.

Question 7

Answers to 7(a) showed that few candidates can have seen/used a pH meter as most referred to 'colour' and indicator. Some did realise that they would get numbers but did not know the relevant ranges for acids and alkalis. A few tried to link it with the bonding given in the table. In 7(b), more candidates were able to use the information in the table to explain that alkalis can be covalent or ionic although some did not use examples from the table as requested. In 7(c), most were able to link at least two substances with the correct state symbol with solid and gas most frequently linked successfully. Some seemed to think that (s) meant solution.

Question 8

Most candidates could write a correct word equation from the formula equation given in 8(a), although some omitted signs and arrows and others confused silver with sodium and got it the wrong way round. A significant number did not respond at all. Again, many omitted to answer 8(b) and few gave good descriptions of the experiment. Few knew the term 'funnel' and many thought that the solution which ended up in the beaker was to be put in the oven to get AgCl. In 8(c), many candidates correctly chose chlorine as the other element formed when light shines on silver chloride. The most popular incorrect choice was hydrogen.

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

General Comments:

Candidates used their time well. Some individual candidates left questions unanswered but in general candidates attempted all questions. However, the standard of responses to the questions was weaker than seen in previous years. This was particularly significant in questions which tested formal chemical knowledge and in the level of response questions. This suggests that some candidates are not well prepared for the examination and may be better served being entered for the foundation tier.

Although examiners try, where possible, to ensure that the quality of science determines the mark, rather than the quality of written English, it is important that candidates express their scientific ideas clearly, with all of the necessary logical links. The quality of expression in some answers was insufficient to be awarded marks because the necessary scientific reasoning was not expressed clearly. Examples of this included candidates not linking their ideas clearly in questions Q1 (c) (i), Q2, Q3 (c) and Q4a.

For the level of response questions, it is important that candidates read the question carefully and make sure that they address all of the task. To reach level three, there are often two or three aspects that need to be discussed (for example discussing both missing and unknown elements in question 2). In addition, these questions are often preceded by a stem which includes numerical data or other information. Marks are not generally awarded at higher levels for copying out selections from this information. It is important that candidates use the data as evidence to back up the points they make, or extend and explain the information rather than merely repeat the information in the question. As mentioned above, the quality of the responses did not always make the necessary logical connections or arguments that this type of question demands on a higher tier paper.

Comments on Individual Questions:

Question 1

1(a) Most candidates gained at least a mark. The two most common errors were to either discuss structure, rather than properties, for example by stating that elements had one electron in their outer shell, or to only give one property.

1(b)(i) Most candidates gained both marks. Candidates need to take care to read the question carefully. Symbols were asked for and names were not given credit.

1(b)(ii) Some candidates confused Newland's 'rows' with Periodic Table 'groups', hence incorrectly stating that carbon and silicon are in the same row of the Periodic Table. Some mistakenly thought titanium was in Group 2.

1(b)(iii) Although most were able to identify 'Group 0' or 'Group 8' as the missing group, some thought the halogens were missing. This suggests that they had failed to notice fluorine and chlorine in row 1.

1(c)(i) The main problem with answers to this question was that candidates did not structure their answers well. Many showed confusion between the reasons for reversing the elements and the reason for leaving gaps. For a higher tier question, it is important that candidates express themselves clearly and make the relevant links. In this case 'for undiscovered

elements' and 'because of properties' alone were answers which did not show that candidates understood the reasons for each decision that Mendeleev made. Better answers clearly linked each of Mendeleev's changes to its correct reason.

1(c)(ii) Most knew that elements are arranged in terms of proton number, but 'the relative atomic mass' was a common incorrect choice.

Question 2

2 This level of response question was not well answered. This was mainly because the question asked for conclusions and explanations. In most cases neither were given fully. The question asked for 'elements the mineral does and does not contain'. Many candidates did not discuss any evidence or conclusions for those elements which were absent. In addition, although most referred in vague terms to 'the spectra' for the elements, the discussion was often only in vague terms. The best answers discussed the relative position of lines in the spectrum. Many candidates did not complete the task; many omitted any discussion of why the spectra data cannot be used to identify all of the elements in the mineral.

Question 3

3(a) Many candidates gained no marks for this question. The states and colours of the halogens were not well known. Some thought that chlorine was orange. Many thought that iodine was a liquid.

3(b) Most gained at least one, and many gained both of these marks about the structure of Group 7 atoms and ions.

3(c) Most candidates did not know the meaning of the term 'diatomic', many gave properties of halogens such as reactivity or state. Those who had an idea of the meaning often showed only partial understanding which was not enough to gain credit such as 'they go round in pairs'. Many confused molecules, elements and atoms, stating that 'it contains two elements' or 'it contains two molecules'.

Question 4

4(a) This level of response question was poorly answered, with about a third of candidates gaining no marks. The candidates were provided with diagrams of the structure of sodium chloride both as a solid and in solution. It was expected that they describe the changes on the diagrams and link these to the properties of each. In common with other questions, the logical links between structure and properties were not usually well expressed. In addition, most candidates made fundamental chemical errors, for example discussing covalent bonds, molecules, moving electrons or intermolecular forces. Many candidates made no mention of ions in their answers.

Better answers discussed melting and/or boiling points and conductivity in terms of structure. About 10% of candidates gained a mark in the level 3 marking band.

4(b)(i) Most gained a single mark for describing a trend in the data. Some went further to quantify this trend by identifying that each 5.0g increase leads to a -3 ^{o}C decrease in freezing point. Some mistakenly said that the relationship is a 'positive correlation'.

4(b)(ii) Most answered this well and extrapolated the trend to work out the freezing point. Some omitted the unit or gave an incorrect unit such as cm^3.

4(c)(i) There were three marks available for this question. Many candidates gave a single response such as 'it goes up'. This was another situation where the logical connections were not well expressed. Best answers discussed how the trend was secure for 25.0 g of salt and then went on to work out a prediction for 35.0g and compare it to the experimental value.

4(c)(ii) This question asked for a description of some experiments. Most candidates did not gain any marks for this task. Most discussed carrying out repeats or 'testing 50g'. Few identified clearly that the volume of water would need to be controlled, a range of values for the salt would need to be chosen and the freezing point measured for each. Many candidates talked in vague terms about 'seeing how long it will take to freeze' or 'see what happens when it freezes'.

Question 5

5(a) Vague answers such as 'the melting point is low' or 'the melting point is high' or incorrect answers such as 'it is lower than bromine' were common. Few stated clearly that it would be lower or equal to the melting point of lead bromide (373 ^{o}C).

5(b) No marks were given for stating 'negative electrode' alone, the correct electrode needed to be linked to the correct reason. This proved very challenging for candidates. The fact that metals are always discharged at the cathode was not well known. Hence only about a third of candidates gained this mark.

5(c) This question demanded that candidates work out the charge on a lead ion and then use the symbol for the lead ion to construct a half equation. This is a higher demand task. Less than 10% of the candidates gained a mark for this question.

Question 6

6 Clear, unambiguous, correctly drawn diagrams could gain all six marks for this question. This meant that many candidates gained marks in the level 2 and level 3 mark bands. Candidates generally seemed to handle energy level diagrams better than they managed the longer reasoned answers which the other level of response questions demanded. Common basic diagram errors were to miss the 'product' labels off the diagrams; to omit the arrow heads on the enthalpy changes or to draw the arrow heads in the wrong place (upside down or not clearly meeting the product line). In terms of the chemistry involved, most realised that both the reactions for sodium chloride and potassium chloride were endothermic and showed this on the diagrams. Some recognised that the energy change for sodium chloride was smaller in value, and represented this correctly. Only the most able further recognised that the value of the potassium chloride energy change was smaller in value than that of lithium chloride.

Question 7

7(a) Most know which substances in the list were acidic.

7(b) The main issue that caused candidates difficulties was that many thought that calcium bromide was an alkali. This led them to incorrectly answer that alkalis have a pH of '7 and over'. However, many correctly stated that ammonia is a covalently bonded alkali, whereas the others are ionic.

7(c) The states of ethanoic and citric acid were not generally known. Few thought that either of them were solid.

Question 8

8(a)(i) Most stated that 'a solid is formed'. This was not awarded a mark because it does not 'use the equation to show'. Some candidates did discuss the state symbol (s) linked to precipitate, but most failed to gain a mark.

8(a)(ii) About half the candidates correctly wrote the word equation. Common incorrect answers included using incorrect names such as 'sodium chorine' or 'sodium nitrogen oxide'.

8(b) Most did not realise that silver chloride would produce chlorine when it breaks down to form silver. Oxygen and hydrogen were commonly seen.

8(c) The preparation of dry solids from aqueous solutions or precipitates was not well known. Many gained a single mark, usually for knowing that it was necessary to heat sodium chloride solution strongly.

A182/01 Additional Science A Modules P4, P5, P6 (Foundation Tier)

General Comments:

The paper was slightly more challenging this year, as there were more unfamiliar contexts than in recent papers. Candidates coped well in the main part with this.

Candidates fared better with the mathematical questions in this paper than in previous years and Centres should be congratulated on preparing candidates well, for this type of question.

There were a variety of question formats included as in previous papers. There is still evidence to suggest that candidates are not reading the instructions carefully and making up their own mind about how many lines to draw between answer boxes.

When answering the six-mark questions there is some evidence that candidates are not answering all aspects of the question. Again this could be improved by candidates taking time to read the questions carefully and ensuring that all of the aspects are covered in their answers.

Comments on Individual Questions:

Question 1
1(a) The vast majority of candidates knew the direction of movement of the electrons from the cloth to the rod.

1(b)(i) Many candidates ignored the instruction to use one line to complete this question and as a result did not gain any marks.

1(b)(ii) The candidates found this question tricky with many not realising that the rod was an insulator.

Question 2
2(a) Some candidates did not add the arrow to the diagram, and many others added arrows to show the flow of current.

2(b) This was answered well with many candidates either reversing the current or reversing the poles of the magnet.

2(c) The vast majority of candidates realised that the device that made use of this effect was the motor. The lamp was also a popular choice.

Question 3
3(a)(i) Many candidates found this difficult and could not use the power given in the table to work out that the spiral bulb used the most energy each second.

3(a)(ii) More candidates recognised that 230V was the mains supply in the UK and therefore the fluorescent bulb was the correct answer.

3(a)(iii) The majority of candidates worked out that two cells would power the filament lamp in this case.

3(b)(i) The vast majority of candidates were correct when circling the ammeter symbol in the circuit. A significant minority did not answer this question and candidates should be reminded to read the instructions carefully.

3(b)(ii) Candidates fared well on this mathematical question. It was pleasing to see the large numbers of candidates carrying out the correct calculations and then using these to describe the correlation.

3(b)(iii) Almost all the candidates could suggest that repeating the results was a way to improve the experiment.

Question 4
This question was common to the higher paper and as such should be a challenging question on this paper.

Many candidates gained 3 marks on this question by describing the correlation and then giving one improvement; a second improvement would have increased this to 4 marks. Many candidates used the term "negative correlation" which was pleasing to see.

Very few candidates on this paper attempted to explain why the resistance decreased as more wires were added. Some did use the "more paths" argument, which was enough to gain full marks.

Question 5
5(a) It was very pleasing to see the large number of candidates who understood the term half-life, could apply this to the data in the table, choose B as the correct answer, and justify their answer clearly using the data from the table.

5(b) Many candidates confused the use of the tracer in the question with the use of radiation to treat cancer. The idea that the risk of getting cancer from the tracer was small was understood by many candidates and gained a mark. Some of the better candidates were fully able to give good arguments that the benefits of using the tracer out-weighed the risks and that this could lead to diagnosis and then treatment of the problem.

Question 6
6(a) Not many candidates could choose the correct process in this question with all of the other answers being chosen frequently.

6(b)(i) The candidates who used the bullet points to address each method of disposal usually gained three marks on this question. There were very many vague answers about radiation being dangerous or harming the environment that were not credit worthy.

6(b)(ii) Most candidates could state that low level waste was less risky or less radioactive than high level waste and this type of comparative statement gained the mark.

6(c) Many candidates wrote about the small chances and low risk of an accident, with the more able giving some details about the safety features/control systems in the power station.

Question 7
Candidates who stated what they knew about the alpha and beta radiation scored well on this question. Reference to cancer was a common correct answer, although many candidates gave vague answers about radiation being dangerous. There was widespread misunderstanding of "ionisation" and many candidates saying that beta was more ionising than alpha, and that this was the reason for the need for shielding.

Question 8
This question was generally answered very well.

8(a) Most candidates used the correct number of lines and many of them correctly identified the motion of the lorry from the graph.

8(b)(i) This was answered very well by almost all candidates. A few gave 15.6 as an incorrect reading from the graph.

8(b)(ii) Again this question was answered very well and the vast majority of candidates scored the mark.

8(c)(i) Candidates universally used the correct number of lines in this question, and X was almost always correctly connected to the driving force. Y was often connected to the counter force as an incorrect answer.

8(c)(ii) Many candidates correctly explained that the forces or arrows were "the same" but fewer candidates could explain that they were in opposite directions.

Question 9
The candidates found this question difficult. Hardly any candidates discussed the increased time for momentum change leading to a smaller force and hence very few candidates gained 5 or 6 marks.

Many candidates did understand the concept of cushioning and there were frequent references to other examples of the same ideas e.g. crumple zones or crash helmets.

Candidates should be encouraged to apply their knowledge to more novel contexts to prepare them for this type of question.

Question 10
10(a)(i) Candidates found this more difficult than expected with many answering 20N by missing the weight of the box.

10(a)(ii) Many candidates did get the error carried forward from the previous part of this question. Hardly any candidates managed to give the correct unit of energy.

10(a)(iii) Hardly any candidates could state anything creditworthy about conservation of energy, and even fewer could apply this to Roy.

10(b) The vast majority of candidates scored this mark with the answer D.

A182/02 Additional Science A Modules P4, P5, P6 (Higher Tier)

General Comments:

There were very few scripts with 'no response' answers at the end, indicating that the vast majority of candidates were able to complete the paper in the time allowed. The responses and the number of 'no response' answers throughout the paper, including the multiple choice questions, from some candidates indicated that it would have been better for the candidate to have been entered for the foundation level paper. Most candidates showed that they had been prepared for answering the variety of styles of questions.

The six-mark extended writing questions were, generally, attempted by all candidates, with few 'no response' answers. Some candidates limited themselves to the level that they could obtain by only addressing one aspect of the question. Some responses were poorly organised and did not display good quality of communication. Well-planned and concise answers commenting on all parts of the question are more likely to achieve a higher level.

In descriptive answers, candidates often displayed some idea of the physical principles involved but they need to express these ideas more explicitly and to only use those appertaining to the question asked.

There was evidence that candidates could cope with the mathematical demands of the questions. Some candidates did not show their working and consequently where their answer was incorrect they could not be given any compensatory mark. Where data is given in a question they should be used in the answer. Some candidates did not refer to the relationships given at the front of the paper and some who did either wrote them wrongly or chose the wrong equation.

Comments on Individual Questions:

Question 1

1 This question required candidates to use forces and transfer of energy. The majority of candidates scored at least 2 marks, usually in parts (a)(i) and (a)(ii). Only a small minority of candidates scored any marks in parts (a)(iii) and (b).

1(a)(i) The most common wrong answer was 20, due to forgetting to add the weight of the box.

1(a)(ii) Error carried forward was applied from part (a)(i) but many candidates failed to see the relationship between the two parts. The unit was often wrong or omitted. Most common wrong unit was N, N/m or gpe.

1(a)(iii) The majority of candidates did not know the principle of conservation of energy. Many answers gave the meaning of conservation as retention or saving in reserve. Those candidates that did state the principle were often not able to relate it to Roy's situation. Heat was mentioned as wasted energy but not linked to the GPE of the tins and the total work done by Roy. A number of answers assumed the GPE of the tins became heat.

1(b) Most candidates did not see that the question was about transferring GPE to KE. Some calculated the GPE as 48 J but did not link it to KE. A few candidates gave well-explained answers showing their working. Some tried using the equations for average speed or momentum.

Question 2

2 Most candidates scored at least 3 marks for this question dealing with forces and motion. The three parts in part (a) produced better answers than those in part (b).

2(a)(i) A common wrong answer was 20.

2(a)(ii) Those candidates who chose the correct distance of 130 usually calculated the average speed correctly. The most common wrong answer was 7.5 obtained by candidates who read the distance as 150 m.

2(a)(iii) Less than half the candidates chose the correct answer.

2(b)(i) The correct term, reaction, was not known by the majority of candidates. Common wrong answers were upthrust, lift, gravity, air resistance and resultant.

2(b)(ii) There were just a very small number of candidates who gave answers showing an understanding of what an interaction pair of forces is, usually by saying that they act on different bodies. A significant number of candidates argued wrongly that an interactive pair are not equal otherwise the lorry would not move.

Question 3

3 There were many good answers showing an understanding of the action of seat belts and airbags in lengthening the time to stop the passenger in a collision and thus reduce the force, leading to a level 2 mark. There were also answers that succinctly used the equation of change in momentum to link the momentum, force and time and achieved level 3. Answers giving just a description of how injuries were produced were awarded a level 1. Few candidates failed to achieve a mark for this question.

Question 4

4 The working of a transformer was not known by the majority of candidates. Many seemed to be describing a generator with spinning magnets. Those who showed understanding usually mentioned the magnetic field in the core but omitted the alternating current in the primary coil or that the magnetic field is changing. A compensatory mark was awarded to those candidates who stated that the output/secondary voltage is lower than the input/primary voltage. However, they often left it as either an increase or decrease, without stating which.

Question 5

5 Most candidates scored 3 or more marks for this question, showing understanding of electromagnetic induction.

5(a)(i) The correct term is not known by most candidates.

5(a)(ii) Many answers indicated a change in direction or use of the south pole, but ambiguous terms such as rotate or spin the magnet were not accepted.

5(b)(i) About half the candidates gave acceptable answers such as more current, more voltage or more power. Those that chose more energy often did not get the mark as they failed to link it to time i.e. increased rate of energy transfer.

5(b)(ii) A majority of candidates chose the correct graph.

5(b)(iii) Iron was the most common correct answer, given by about half the candidates. Common wrong materials were copper, steel, (just) metal and magnet.

Question 6

6 Most candidates chose the correct names for parts (a)(i) and (a)(ii). The rules governing voltages and currents in series and parallel circuits are either not well known or candidates have difficulty applying them.

6(b)(i) Of the four parts in (b) and (c) candidates answered this part the best. Some candidates had difficulty dividing by 0.2.

6(b)(ii) Many candidates did not recognise the significance of both voltmeter readings in the question. Common wrong answers were 1.5 V and 1.0 V.

6(c)(i) Less than half the candidates were able to give the correct voltage. The most common wrong answer was 3.0 V.

6(c)(ii) Only a few candidates gave the correct answer. The most common wrong answer was 0.4 A.

Question 7

7 Most candidates were able to state the correlation and so access level 2, but did not attempt an explanation so could not access level 3. Many level 2 answers gave two improvements, such as repeating the experiment and using more or less wires, but some candidates could only be awarded the lower mark of 3 since they only gave one improvement. Vague statements such as 'get more results' were not credited. A few candidates gave an explanation in terms of more pathways for the current to be awarded a level 3. However, explanations in terms of collisions were not credited as they did not answer the question.

Question 8

8 Half the candidates scored at least one mark for this question. Many candidates did not show an understanding of how an injected tracer works and failed to read the information in the question carefully enough. Some ignored the statement that the source needed to have a half-life of one hour and instead looked for the one with least activity, to prevent causing cancer, or most activity, to get a good reading. Many thought that alpha is less damaging to humans than gamma and few appreciated that it needed to be gamma in order to exit the body. Many failed to get a mark for correct ideas about the meaning of half-life as they did not follow the instructions in the question to justify their answer using the data in the table. The terms half-life and activity were often interchanged such as in the incorrect statement 'the half-life of C is 500'.

Question 9

9 Most candidates were able to score at least 4 marks in this question.

9(a) Half the candidates wrote down the correct equation either in word form or by substituting the correct values. Some, however, forgot to square the speed of light.

9(b) Half the candidates gave at least one correct method of disposal. Some failed to gain marks as their answers were too vague, such as 'put it in a container' or 'bury it' The material from which the container is made and the qualifying word 'deep' were needed. Amongst the wrong methods were: burn it, release it into the atmosphere, dump it in the sea and put it in landfills.

9(c) Candidates often only gave one reason. They did not refer to the number of marks to direct their answer. Many answers failed to address the question as they tried to justify why he need not worry, such as descriptions of safety and control methods at power stations. Most common correct reasons were previous events publicised in the media and consequences of a disaster.

9(d)(i) Many answers just stated a property of alpha rather than applying it to the situation in the badge, examples such as 'alpha does not pass through paper', 'alpha only goes through a few cm of air' and 'alpha is the least penetrating'. In order to gain the mark candidates needed to say that alpha does not go through card, aluminium or lead, or to say it does not penetrate any of the windows.

9(d)(ii) The line for beta was correct more often than that for gamma. Some candidates ignored the instructions in the question and drew multiple lines from each of the types of radiation.

Question 10

10 Of the three extended writing questions in this examination paper, candidates found this the most difficult to answer. There were very few level 3 answers, which required a detailed explanation of the process using the idea of ionisation and the action of ions. Many candidates stated that the radiation killed bacteria which gave access to levels 1 and 2. Many reasons to explain why Donna's concerns were unfounded were confused and did not correctly differentiate between irradiation and contamination.

A154 – Additional Science Controlled Assessment

Overview

This was the fourth session for the assessment of the Twenty First Century Science suites Investigation controlled assessment. It was a real pleasure to see how most centres had responded to advice and guidance from previous years. There were fewer centres requiring adjustment than last year and in general these changes were smaller. 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 continues to be 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 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 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 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. 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 lenses 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, some very mundane statements were seen. 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 7-8marks. 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. 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 simple y 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
- 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 Spiller, 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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