GCSE

Additional Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J242**

OCR Report to Centres June 2015

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

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

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

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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. All questions were approached positively, with few examples of questions being left blank. Responses indicated that the instructions for each question were well understood. It did appear that, in the longer questions (3,4b and 6), better candidates had considered their answers before beginning to write. They made good use of the space available, without the need for additional answer sheets. Where candidates did not score well on the longer questions, it was generally a result of lack of precision in their answers.

Candidates were able to respond particularly well to the question on cells, chromosomes and cell division and were aware of issues concerning the prescribing of antidepressant drugs. Two questions concerned aspects of scientific method, and this appeared to be less well understood. The need for measurement and control of variables was not clearly expressed, and terms such as fair test and accuracy were often incorrectly used, and given as the reason why repeated results are required.

Comments on Individual Questions:

Question 1
1(a)(i) Candidates were asked to work out the number of chromosomes in gametes for the horse and donkey, given the body cell number. It was generally well answered – most candidates realised that the haploid number was required.

1(a)(ii) The correct chromosome number for the mule was obtained by adding the two haploid numbers to give 63. This proved rather more difficult. Common wrong answers were 64 (presumably a result of using the figure for the horse rather than the mule), and 126 (probably from adding the body cell numbers for the horse and donkey).

1(b) Only a minority of candidates were able to identify meiosis as the term for the type of cell division producing gametes, common wrong answers being mitosis and fertilisation.

1(c) Candidates were able to score well on this question – 4 marks were available for identifying whether processes were part of cell growth or cell division.

Question 2
2(a) Candidates were asked to complete a sentence describing the effect of salt on bacterial cells. Perhaps surprisingly, answers scoring full marks were rarely seen – few could state that the name of the process was osmosis.

2(b) Better candidates knew that anaerobic respiration takes place in the absence of oxygen.

2(c) Most could select the number of molecules of glucose needed to produce 36 molecules of ATP.

Question 3
This was a 6 mark, level of response question on the structure and the function of DNA. Most candidates gained some credit for aspects of structure – double helix, bases ATCG and the fact that they pair. The better answers referred to DNA as a store of information, genetic coding for proteins and being able to replicate.

Question 4
4(a)(i) In this question aspects of the role of symbiotic algae in coral were explored. In this part, the benefits to both organisms were required. Although most candidates scored, few gained all three marks available.

4(a)(ii) Most candidates were able to give at least one substance which the algae can make from glucose produced in photosynthesis. Starch was better known than cellulose, and calcium was a common incorrect answer.

4(b) This question asked for explanation of how changes in sea water temperature can lead to algae dying. Six marks were available for a full answer describing the effect on photosynthesis, the role of temperature and the effect on enzyme function. Weaker answers did not refer to photosynthesis, referred to temperature changes rather than being too hot or too cold, and reference to enzymes being killed, or being denatured above or below optimum temperature. Good answers covered points such as photosynthesis producing glucose and temperature being a limiting factor, at temperatures which are too high the enzymes will be denatured and correct references to active site and substrate. Few described the effect of temperature on particle collisions.

4(c) Only the best candidates gained full marks here. Candidates were asked to describe how scientists could show whether light or temperature is the cause of algae dying in their natural habitat. Many did not appreciate this and described a laboratory experiment, but credit was also available for answers along these lines. Few described a field investigation where temperature and UV were measured and related to the amount of living and dead coral in a number of areas, and references to sampling techniques were rarely seen. Where a laboratory experiment was suggested, ideas of control of variables were missing.

4(d) Most candidates seemed aware of key aspects of peer review and achieved at least one mark.

Question
5(a) This required an explanation of the benefits of taking a cutting rather than growing from seed. The word clone was often seen as was the fact that a faster result would be expected, but marks were lost by vague references to the plants being the same, rather than specifically stating that the flower colour would be.

5(b) This question required candidates to state whether specific plant structures are a tissue or an organ. Few candidates scored both marks but many gained one mark.

Question 6
There were two aspects to this question – how learning takes place and ways that could help revision for an exam. Most were able to suggest tips for learning, particularly repetition and examples of strong stimuli (use of colours etc.) but the process of learning was less well known. Credit was often given for use of ideas of short term and long term memory, unless they were used wrongly. (Some candidates obviously thought that short term is equivalent to a poor memory.) A disappointingly low number of candidates referred to neural pathways.

Question 7
7(a) Most candidates were able to recognise the reasons for prescribing one particular antidepressant in terms of side effects, and commonly scored at least 2 marks out of the 3 available.

7(b) Most candidates could identify explanations as to why patients are prepared to take the risk of side effects and scored well.

Question 8

8(a) This concerned an experiment on reaction timing by dropping a ruler. Calculation of a mean for distance was very capably completed.

8(b) Conclusions based on the data were required here, and the question was well answered, with most scoring both marks.

8(c) Less well answered, this called for candidates to suggest reasons why 3 trials were done. There were frequent references to increased accuracy and fair testing, rather than improved reliability, confidence in conclusion and recognition of possible outliers which were the required answers.

8(d) This question required candidates to suggest possible sources of error in the experiment. Some weak suggestions were seen, such as inaccuracies of timing where no timing was actually involved, and that different people took part, which was the point of the experiment. Most common answers which scored were issues with the dropping point/height, the possibility of anticipation of release and the need for a greater number of trials.

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

General Comments:

Candidates were well prepared for this paper and made a good attempt at answering all of the questions. There were very 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.

Candidates are still writing outside the allocated area. In the past, they have tended to write in any white space that they can find. It is common to see most of the lines allocated filled with a repeat of the question, before the candidate even begins to answer it. Now, they are writing on additional answer booklets. This should be discouraged especially when many questions have just a few words. These could be included in the proper place. It results in responses that drift away from the original question. Candidates need to be taught and encouraged to write concisely.

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) Candidates were asked to name two substances that algae convert glucose into. Many candidates seemed confused as to what the question was asking and the most common candidate response was to give at least one of products of respiration i.e. carbon dioxide and water.

The other most common correct answers were starch and cellulose but many failed to gain the second mark as they gave sugar/ethanol/lactic acid/energy or food as their second response.

1(a)(ii) Some candidates had obviously not read and/or understood the information at the beginning of the question. A significant proportion of candidates did manage to gain the CO_2 mark however very few candidates scored on the idea of a suitable habitat or protection as a large proportion suggested that the algae gained oxygen as their second response. Vague references to 'food' or 'nutrients' were also quite common.

1(b) Virtually all candidates were able to make relevant points about enzymes such as active sites/ lock and key/denaturing /enzyme-substrate complexes. However, a significant proportion were then not able to link this specifically to photosynthesis and/or temperature and were consequently limited to Level 1 despite some good science in their responses.
A significant proportion of candidates managed to achieve Level 2 on the basis of a single comment relating to temperature being too hot/cold in addition to multiple enzyme points. Again, many missed out due to references to temperature that were often too vague to credit e.g. just 'increased' or 'decreased' or were simply incorrect e.g. the optimum temperature causes enzymes to denature. There were also incorrect references to temperatures being too low causing enzymes to denature. Some better candidates did link temperature with reaction rates and particle collisions.

Only the better candidates realised that photosynthesis is needed to produce glucose for respiration and it was a lack of this that caused death. Good candidates also recognised temperature as a limiting factor for photosynthesis.

1(c) Most candidates failed to see that the question asked for an investigation in the natural habitat of algae. Some candidates obviously did not understand what UV light was – some seemed to assume it could only be created by some sort of special lamp. Many answers were muddled and failed to describe accurately what they were looking for - living/ dead algae and just said 'compare results'. Common errors included vague mentions of testing light or temperature but did not describe how this would be changed or measured using thermometers or light meters, only a minority could then relate this back to algae survival (or not). Better candidates did score marks by mentioning transects and sampling and many did give at least partial descriptions of lab based investigations.

There were also a few candidates who focused on how to make the test fair rather than what they would actually do. A few descriptions of global warming killing algae rather than any mention of an investigative approach and a few links to enzymes and photosynthesis (a carry-over from the previous section of the question) were also seen.

1(d) Most candidates scored both marks. There were very few rubric errors with the vast majority of candidates ticking two boxes.

Question 2

2(a) This question stretched the candidates, it was a difficult concept and many did very well to apply their biological knowledge to the process. A complete range of marks was observed for this question. Candidates felt comfortable with the concepts and it seemed to differentiate well. Many candidates explained this well and gained all 3 marks. There was some confusion about how particles moved. Diffusion and osmosis were routinely mixed up so the mark for diffusion was frequently missed.

Very few candidates made full reference to concentration gradient. Candidates frequently made reference to a high concentration in blood or fluid but few referenced the concentration being lower in the opposite fluid. A smaller number scored via the equilibrium route.

Many candidates referred to perceived health risks of build-up of Urea in blood. Common non scoring answers said that the body would be poisoned. Other incorrect ideas were, it would cause red blood cells to burst, it would lead to kidney failure, it would build up in machine and cause damage and it would contaminate the fluid for the next patient.

2(b) Candidates understanding of how many ml are in a Litre ensured that a significant number of candidates only achieved one mark. Candidates either divided by 100 or put down 72,000 as their answer. Some candidates forgot to multiply by 2.

2(c) Most candidates scored both marks. There was some misunderstanding of movement of water and its impact. Response 5 was the most common incorrect answer and response 2 was rarely chosen.

2(d)(i) Marks were lost here by not giving the answer to 2 decimal places. Most common error was 13.63. Other errors included 13.636 recurring. Time needs to be spent practicing this skill (rounding). Many divided 0.3 by 2.5 or, more commonly, divided 2.5 or 2.2 by 0.3.

2(d)(ii) The question asked candidates why it is better to calculate the percentage change rather than just the difference in mass. They made correct reference to comparison. Differences in starting masses not as frequently quoted. Candidates made reference to accuracy, reliability in question and referred to what each measurement showed. Many candidates seemed to understand what was required but couldn't express it, giving vague answers such as 'more accurate' to use percentage/then it is out of 100. Few got full marks.

2(d)(iii) This question tended to be answered well even by lower scoring candidates.

2(d)(iv) Candidates did not seem to use the data provided in the table to consider what the range could be, they focussed mainly on the range of concentrations used in the experiment. It was poorly answered by majority of candidates, many scoring 0 or 1 mark.

2(e) The most common correct answer was 'repeat', and 'use the same starting mass' was the next more commonly seen answer. Many candidates wanted to test more concentrations or do more intervals, but they were not specific. Very few made reference to controlling temperature as a variable. No candidates made reference to evaporation or prevention of evaporation. Many candidates made reference to a bigger variety of concentrations in order to make experiment accurate, peer reviewing or getting someone else doing the experiment

Question 3

3(a) The majority of candidates coped well with this item and correctly identified the number of chromosomes for each of the two sets of gametes as 32 for sperm from the horse and 31 for sperm from the donkey, showing understanding that the chromosome number was halved in each case. A common mistake was to double the number instead. Poorer responses seen were, XX and XY /31 and 32.

3(b) Again, the majority of candidates were successful with this item. Relatively few named the cell division as mitosis instead of the correct response of meiosis with many hybrid spellings. Weaker candidates guessed fertilisation, sexual reproduction and other terms associated with reproduction.

3(c) This proved to be one of the most challenging questions on the paper. Many candidates correctly noted that the product of fertilisation would result in 63 chromosomes for the mule. Some focussed on the haploid number of chromosomes for the horse and donkey but this was not credited because this does not correspond to the explanation. A significant number of candidates continued to obtain a second mark due to a correct reference to the incomplete formation of chromosome pairs or the feature of one chromosome remaining.

Candidates found it hard to express their ideas and often were confused by the question so that instead of explaining about the gametes of the mule not having the correct number of chromosomes to form pairs, they referred back to the horse having 32 pairs and the donkey having 31 pairs. Many referred to an odd number of chromosomes but did not explain how this would mean that the chromosomes could not form pairs.

Question 4

This question tended to be the lower scoring of three 6 mark questions. However, there were some excellent descriptions of protein synthesis, some responses included transcription and that although all cells have the same DNA only parts of it are read in specialised cells.

Unfortunately, some of candidates only got 2 marks as there was no correct mention of cell specialisation. A few candidates got 2 marks for a description of cell specialisation without mention of protein synthesis, but these were in the minority. Many candidates defined what specialised and unspecialised cells are e.g. cells may be specialised for a particular function, their structure will allow them to carry this function out, rather than stating whether genes are switched on or off.

The most common misconception was to discuss the cell, rather than the gene being switched on/off.

Question 5

5(a) Some well-written and excellent accounts to explain synaptic transmission and the effect of antidepressants were seen, but also poorer accounts were common. This level of response item did not overlap with the foundation paper and was therefore set at a higher level of demand. Better candidates referred to electrical impulses, not signals or messages and described clearly the diffusion across the synaptic gap to bind to receptors. Many candidates were able to progress onto level 2. Unfortunately, some candidates were not able to progress in this way since they did not include antidepressant operation within their response. This was a particular issue for some candidates who had a good knowledge and gave very detailed accounts of synaptic transmission without responding fully to the question. They correctly identified that re-uptake was on the first neurone. Poorer candidates often confused the receptors with the re-uptake channels, especially when trying to explain how an antidepressant works. Some candidates struggled with a satisfactory explanation of antidepressant operation because, although they appreciated that serotonin levels would increase in the presence of such drugs, they incorrectly assumed that this was either due to the blockage of the post-synaptic receptors (instead of the serotonin absorption re-uptake channels) or due to an increased secretion of serotonin. Some were confused thinking antidepressants contain serotonin. Also some were confused between serotonin and neurotransmitter, not realising the former is an example of the latter. But it did seem that most candidates realised that serotonin remained in the gap when a person takes antidepressant.

Many attempts at drawing a synapse were seen but most were of poor quality and did not explain what they had written. To gain credit diagrams must be clearly annotated.

5(b) The majority of candidates obtained one or two marks when answering this question. They simply looked at the information in the question and perhaps, unsurprisingly mentioned previous medical conditions and/or a reference to alcohol or wine drinking. Some candidates failed to obtain the marking point for alcohol consumption due to casual references to ‘drinking a lot’ etc. Few considered the effectiveness of the drug or the side effects. Very few scored any of the other mark points. Reference to the effects of drugs were mentioned but often without qualifying that the doctor would need to consider how severe they would be.

Question 6

6(a)(i) Most candidates correctly managed to name the cerebral cortex. There were some candidates however that did not attempt it at all and cerebellum was probably the most common incorrect response. A few candidates struggled to find the correct terminology and resorted to ‘speech centre’.

6(a)(ii) The most common misconceptions related to neural pathways dying or not being used, failing to link language skills to age, saying they were too old to learn but not linking it to language or vague statements along the lines of there being ‘no one around to teach them’. The lack of specific details cost many candidates marks as many were at least partway there with their responses. A few candidates used connections rather than neurone pathways.

6(b) Often students repeated the reverse of their primary statement, usually related to ‘damage the brain’ or ‘harmful’ and therefore only scored one mark. Some candidates failed to score because they simply referred to damage without specifying the brain. Surprisingly, not many candidates got the mark for electrical stimulation being invasive, and many did not know what a MRI scan actually was as they sometimes linked it to using radiation. There were also some comments about MRI being safe, more trusted and ethical arguments about consent.

Question 7

7(a) The majority of higher level candidates obtained one or two marks for this item. The item overlapped with an item on the foundation paper. Most correctly stated that the cuttings were clones or genetically identical copies of the parent/stock plant and referred to the colour of the flowers produced by the products i.e. purple. The speed of the process was generally not considered by many of the candidates. A common error appeared when candidates stated that the cuttings were clones but then repeated this feature by noting that the products generated by seeds were, effectively, not clones. This type of response could not obtain two marks for this feature. Some candidates erroneously introduced the idea of cost and said that taking cuttings is cheaper.

7(b) A surprising number of candidates did not know the term meristem. Stem cell was frequently given as an answer. Some candidates misread the question as needing to provide a **type** of cell **division** so answered **mitosis**. Cambium was another incorrect answer.

7(c) The majority of candidates were able to identify the organ, such as stem, flower, leave or root, but struggled to name a type of tissue. Those that did usually chose xylem or phloem. As a result, some candidates responded by writing the names of two different organs and incorrectly used the tissue line to include one of the organ names. Examples of a tissue was not answered well with many poorer candidates listing incorrectly leaf, chlorophyll, cytoplasm, stem as examples of tissues.

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.

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

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

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

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

Comments on Individual Questions:

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

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

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

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

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

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

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

Question 3

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

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

Question 4

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

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

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

Question 5

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

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

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

Question 6

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

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

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

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

Question 7

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

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

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

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

Question 8

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

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

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

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

Question 9

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

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

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

General Comments:

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

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

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

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

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

Comments on Individual Questions:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Question 6

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

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

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

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

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

Question 7

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

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

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

Question 8

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

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

General Comments:

This paper performed very similarly to its predecessors, with about half of the candidates earning at least half of the marks.

Candidates fared better with the six-mark questions that in previous years; centres have clearly been giving them practice at this type of question.

There were a variety of question formats included in the paper. There was some evidence that candidates were making up their own mind about how to fill in the table, draw the lines or tick the boxes, instead of reading the instructions carefully.

Many candidates were not using the mark and space allocation as guide for content of their answer, writing at length about one aspect, when they needed to write about more than one to earn full marks.

The use of specialist vocabulary in the context of radioactivity proved to be challenging for many candidates, both strong and weak. Their understanding of terms such as source, half-life, irradiation, contamination and waste was generally poor.

Comments on Individual Questions:

Question 1
1(a) Less than half of the candidates correctly identified the way to calculate gravitational potential energy for this part, many confusing mass with weight.

1(b)(i) The vast majority of candidates knew that gravity provided the downwards force on the cat for this part of the question.

1(b)(ii) Only half the candidates correctly stated kinetic energy as the answer, with gravitational potential energy being a very popular incorrect answer.

1(c) Only a minority of candidates realised that energy was conserved as the pot fell to the floor in this part.

1(d) Most candidates knew that the balls had different kinetic energy in part (d) because of their different masses, only a minority were able to satisfactorily explain why they had the same speed.

Question 2
Most candidates scored at least half of the marks in this question about a bike ride.

2(a) Most candidates ignored the instruction that they could put more than one tick in each row, this led to the majority of candidates earning only two marks.

2(b) The speed-time graph proved to be straightforward for strong candidates, although many did not draw a horizontal line for the central section where the speed was constant. Many weak candidates seemed to be drawing a distance-time graph instead.

2(c)(i) About half the candidates could correctly name the counter force on the bicycle and knew that it had to be exactly the same as the driving force for part **(c)(ii)**. As expected, weak candidates wanted the driving force to be slightly larger than the counter force for a constant speed.

Question 3
This question also appeared on the Higher Tier paper, so was expected to be accessible only to candidates operating at grades D and C. In practice, many candidates managed to earn half marks by discussing the different amounts of friction between the tyre and road in normal and icy conditions. Few were able to draw the correct force arrows on the diagram, let alone identify the interaction pair of forces responsible for the forward motion of the car.

Question 4
4(a)(i) Although few candidates earned both marks for part (a)(i), many earned one, usually for mentioning that copper is a conductor, the circuit was complete or it contained a battery. Too many candidates seemed to ignore the mark allocation and writing space provided, writing only a single statement which could only earn one mark.

4(a)(ii) Candidates fared much better with this part; most candidates correctly suggested adding another battery.

4(b) This was very poorly answered; few candidates mentioned the lack of free electrons or that plastic was an insulator, with many repeating the stem and saying that plastic is not a conductor.

Question 5
Most candidates were able to correctly identify all of the electrical circuit symbols in this question; some candidates confused the fixed and variable resistor.

Question 6
Many candidates struggled to earn marks in this question about electric motors.

6(a)(i) Strong candidates could correctly draw a force arrow for this part of the question but weaker candidates either got the direction upside down or from one pole to the other.

6(a)(ii) Almost no candidates scored any marks for this part, with most of them ignoring the current in the magnetic field and explaining that the forces were necessary for the motor to spin round.

6 (b) This question was extremely challenging for candidates with too many assuming that the motor was a generator.

Question 7
This six-mark question assessed about Ideas in Science, and was well answered by many candidates. Few candidates suggested the use of a thermometer to measure the temperature, and many assumed that being able to draw a graph of the existing pair of results was enough to confirm the correlation.

Question 8
This question about radioactivity proved to be quite hard, with only a minority of candidates earning at least half of the marks.

8(a) Many candidates confused “source of” with “type of” and named an ionising radiation rather than a source.

8(b) Strong candidates correctly identified both types of ionising radiation.

8(c)(i) Candidates were able to explain why the graph showed that the half-life was 5 minutes. Interestingly, many weak candidates assumed that since the graph stopped at 12 minutes, this was the lifetime of the sample, leading to a half-life of 6 minutes.

8(c)(i) Most candidates agreed that the source was safe after 10 minutes, showing that they had good skills at reading data off graphs.

8(d) Only a small minority of candidates were able to explain the meanings of the terms "irradiation" and "contamination" in the context of radioactive safety.

Question 9
The majority of candidates correctly identified all three particles in the atom of part **(a)** and the name of the process generating helium in the Sun for part **(b)**.

9(c) Only half of the candidates correctly linked each type of waste to its method of its disposal; most knew what to do with high level waste, but many confused the treatment for low and intermediate waste.

9(d) Few candidates were able to answer this question about the proposal to put radioactive waste in space, with many concerned that this would contaminate space and spoil it for us if we needed to be there some time in the future.

Question 10
This question about the risks and benefits of X-ray treatment was well answered by many candidates. A significant number of candidates didn't use the data provided at all, contenting themselves with a general account of the risks and benefit of X-ray imaging of people, restricting the number of marks that they could earn.

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

General Comments:

There were very few 'no response' answers indicating that candidates were able to complete the paper in the time allowed.

Candidates' answers showed that most had been entered by Centres for the appropriate tier paper and that they had been prepared for the style of questions included in the paper.

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, others wrote overly long answers, which included many irrelevant details, and 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.

Answers requiring explanation, candidates often displayed some idea of the physical principles involved but often made contradictory comments. The frequent use of the word 'it' in such answers made some answers unclear as it was difficult to know to what the candidate was referring. Candidates need to express their ideas more explicitly.

There was evidence that candidates coped 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 marks. 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 either wrote them wrongly or did not use them in their answer.

The electricity section (module 5) was generally poorly answered.

Comments on Individual Questions:

Question 1
This question required candidates to perform calculations involving energy, momentum and resultant force as well as commenting on statements about speed and kinetic energy of falling bodies. Most candidates achieved 4 or 5 marks, usually on parts (a), (b)(i) and (b)(ii). Answers to part (c) were often contradictory.

1(a) Most candidates chose the correct option.

1(b)(i) The vast majority of candidates calculated the momentum correctly.

1(b)(ii) The majority of candidates performed the correct calculation. The most common wrong answers involved a failure to realise that the answer to part (b)(i) should be used.

1(b)(iii) Not all candidates understood that 'explain' means more than just saying what happens to the resultant force and were not prompted by the beginning of the question where the time to stop was restated. The most common misconception was that the can bounced and hence the resultant force was smaller as it took longer to stop. A variety of answers were seen with various combinations of increased/decreased resultant force and shorter/longer time to stop. There was no evidence that candidates used the relationship between change of momentum and resultant force given at the front of the paper. Some candidates did not gain any credit because they used terms such as 'harder' to describe the change in the resultant force instead of 'increased'.

1(c) This question was poorly answered by most candidates. A significant number of candidates thought they had to choose between George and Kate, or that both were correct. Many contradictions were seen in answers. Common misconceptions were: that gravitational potential energy was the same for both balls at the start; that they reached terminal velocity; that heavier objects fall faster. Some candidates discussed momentum rather than kinetic energy and speed. The best answers were supported by referring to the relationships at the front of the paper. Some candidates quoted the relationship/s but made no reference to it/them in their answer; others misquoted the relationship/s.

Question 2
This question was generally answered well. It required candidates to interpret a displacement-time graph.

2(a) The majority of candidates completed all lines of the table correctly. The middle row was the one most commonly incorrect.

2(b) Most candidates did not choose the correct option. The most common choice was the top left graph.

2(c) The majority of candidates drew a correct sketch graph. Some candidates did not attain both marks due to careless drawing such as not starting the line at 0 velocity or not continuing the line to the dotted line.

Question 3
Many candidates met the criteria to be awarded a level 1 or 2, by correctly discussing the role of friction and the grip between the tyres and the road. Only a few candidates were able to give a clear account of the interactive pair of forces which make the car move. Where arrows were drawn on the diagram they were often in the wrong direction or on the wrong body and not equal in length. Many candidates included weight of the car, reaction of the road and the drag force in their answer and some thought the engine provided a thrust force like a jet engine. These answers usually became quite confused. Many answers were not well organised and candidates wrote as much as they could about forces, much of which was not relevant to the question.

Question 4
Candidates found this whole question challenging. The majority of candidates attained 2 marks usually from part (a) and one of part (b).

4(a) The majority of candidates were able to draw the symbol correctly for an ammeter and put it in series with the resistor. Although the voltmeter symbol was drawn correctly its positioning was often incorrect, usually in series with the ammeter and resistor. Some candidates failed to get any marks as their symbols were incorrectly drawn, some as boxes.

4(b) Very few candidates gave correct choices for all three parts of this question. Part (iii) was the one most candidates chose wrongly. Often parts (ii) and (iii) were interchanged.

4(c) The majority of candidates failed to achieve any marks for this part. The action of an LDR is not known by many candidates. The most common misconception was that an LDR acted like a solar cell and put voltage into the circuit. Those candidates who correctly stated that the resistance of the LDR decreased when light was shone on it usually went on to say that the current increased but were not able to reason why the voltage across the resistor increased.

Question 5
The majority of candidates achieved at least level 2 when responding to this question, as they commented on both statements and used the data to support one of their comments. Usually the data were used to say why Pat was wrong, but a few candidates confused correlation with proportionality. A much smaller number of candidates used the data to calculate at least two values of resistance to explain why Chris was wrong. Some candidates described a mechanism to support their comment on Chris's statement rather than, as instructed in the question, the data and consequently did not receive credit for this.

Question 6
This question was poorly answered. The function of the commutator was not known and many confused a motor with a generator. Most candidates achieved 2 or more marks.

6(a)(i) Most candidates drew a clear vertical arrow downwards. A small number drew it too far away from side CD.

6(a)(ii) Some answers confused the motor with a generator and others misunderstood what the question was asking as their answers gave the purpose of the forces to turn the coil. Magnets were quite often mentioned but not the magnetic field. Many answers lacked clarity and the use of the appropriate scientific terminology. Some candidates described the forces as an interactive pair.

6(b) Less than half the candidates achieved any marks on this part. There was confusion again with a generator. Vague references were made to something changing direction, though some thought it was the coil or the magnets. Very few candidates gave a clear and full description of the function of the commutator.

Question 7
Parts of this question were answered well and the majority of candidates achieved at least 4 marks.

7(a) The idea of contamination was better known and described than irradiation. Many answers were vague as the candidate did not distinguish between or confused the source and radiation. A common misconception was that contamination is radiation inside a body whereas irradiation only happens outside.

7(b)(i) Most answers were not given credit as the curve of best fit either had too many points on one side, or it was not a single line or it was not smooth. Candidates need to take more care when drawing lines on graphs. Very often the three points at the end were either ignored or the line was placed well below them.

7(b)(ii) Most answers fell within the tolerance given in the mark scheme. A few candidates wrote the time as seen on a stopwatch e.g. 5.30 meaning 5.5, others gave the activity e.g. 62 instead of the time.

7(c)(i) Some answers gave sources of background radiation rather than what it is.

7(c)(ii) About half the candidates obtained an answer within the values in the mark scheme. Some of those giving an incorrect answer were able to gain a compensatory mark by showing appropriate working.

Question 8
Only a minority of candidates achieved more than 2 marks. The action of the control rods was not known and most candidates could not complete the nuclear decay equations.

8(a)(i) Many candidates showed an understanding of the term 'chain reaction' but failed to achieve the mark as their answers were too general about the process repeating and they did not state that more neutrons are produced.

8(a)(ii) The action of the control rods was not well known. Some incorrect answers were about temperature control or changing the seed of the neutrons.

8(b) The representation of alpha and beta particles was not known by most candidates. Those who did know went on to correctly balance the equations. The nuclear representation of alpha was better known than beta.

8(c) Most candidates gave one reason, which was usually the consequence of a nuclear accident such as irradiation or causing illness such as cancer. Very few candidates gave more than one reason. Only a few candidates mentioned perceived risk or that Ali was not in control.

Question 9

This question was answered well by many candidates. The majority obtained at least level 2 and answered both parts of the question about risks and safety procedures. A few candidates limited the level they could achieve by not giving more than one risk or not mentioning any. The way in which long handled tongs reduce the risks was usually well explained. Gloves stopping radiation was not always linked to alpha. Quite a number of candidates thought the monitoring badge acted like a GM tube or that it was some sort of security pass or a warning to other people. A few candidates wrote about nuclear waste or went through the penetrative power of each type of radiation without linking these to the precautions in the question.

A154 - A184 21C Investigation Controlled Assessment

General Comments:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Secondly, major factors were not considered 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 lens available', based on safety issues, 'the upper end of the range was limited to 2M as any more concentrated would be too corrosive' or based on prior knowledge/preliminary work 'from PE I know students cannot do step ups steadily for more than 3 minutes' or 'my preliminary work showed a reasonable change in the dependent variable of this range'. Note both ends of the range should be mentioned.

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

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

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

C – Range and quality of primary data

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

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

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

A – Revealing patterns in data

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

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

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

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

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

Ea – Evaluation of apparatus and procedures

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

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

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

Eb – Evaluation of primary data

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

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

Ra – Collection and use of secondary data

This strand was poorly addressed by many candidates.

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

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

Secondary data can be of different types:

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

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

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

Rb – Reviewing confidence in the hypothesis

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

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

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

Sources of Support

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

- A 'Guide to Controlled Assessment' handbook for Unit A154 / A164 / A174 / A184 (Practical Investigation). The direct download link is http://www.ocr.org.uk/Images/77479-guide-to-controlled-assessment.pdf
- INSET training events for 2013-14 are available details may be found on the OCR website at http://www.cpdhub.ocr.org.uk
- We offer a Controlled Assessment Consultancy service, in which candidate work that you have marked will be reviewed by a senior moderator prior to moderation.
  To make use of this service, post photocopies of three marked pieces of work to the following address: *Michelle Hawley, Science Team, OCR, 1 Hills Road, Cambridge, CB1 2EU*.

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

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