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GCSE

Further Additional Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J246**

OCR Report to Centres June 2014

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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

A163/01 Twenty First Century Biology A Module B7 Foundation Tier

General Comments:

This was the second time that candidates were able to access this new specification paper. There was a good spread of marks, candidates scores ranged from 0 to 46 out of a maximum of 60 marks.

Many candidates appeared to have been well prepared for the examination, attempting the majority of questions. However several candidates did not attempt the six mark, extended writing questions, that required the candidates to answer with a written response of several sentences, as well as some of the other questions. A number of these candidates did score well on the objective 'tick box' and quantitative skill questions however, which perhaps indicates a lack of application rather than lack of ability.

Most candidates used the spaces provided for their responses with very few extending their answers to other parts of the paper. Candidates should be reminded that additional examination sheets should be used if their responses are likely to extend beyond the available space.

Candidates should be encouraged to have access to a calculator. It was disappointing to observe a number of scripts where candidates indicated that they did not have one available, however there were fewer cases of this than in last year's examination.

There were a number of specification areas that appeared to be causing some problems for the candidates. These will be highlighted in the next section.

Comments on Individual Questions:

Q1 (a) (i) Candidates answered this part well, the majority being able to accurately interpret the scale on the graph

(a) (ii) The majority of the candidates correctly interpreted the second chart, however some candidates used the diastolic value.

(b) The wide range of acceptable days ensured that most candidates could access this mark.

(c) There were a wide range of acceptable answers here, however a number of candidates failed to gain the mark by going down the diet route.

(d) (i) There was a disappointingly high number of candidates who were unable to calculate a mean.

(d) (ii) The idea that the mean is the best estimate of the true value was known by very few candidates.

(d) (iii) This section was answered well, most candidates able to interpret the data in order to obtain the range.

(d) (iv) This section proved to be quite difficult for a number of candidates as the data on three pages needed to be accessed in order to obtain the evidence.

Q2 (a) The extended writing question differentiated well with many candidates able to discuss the functions of the skeleton, however fewer able to discuss how joints work.

(b) (i) A number of candidates did not know the meaning of the word ‘symptom’, however were able to gain the marks for the treatment of a sprain injury.

(b) (ii) Several candidates were under the misapprehension that joints could ‘break’ and failed to give correct injuries.

Q3 (a) The idea that red blood cells do not have a nucleus to allow for more haemoglobin or to allow more oxygen to be carried was very poorly understood.

(b) Likewise the problems associated with carbon monoxide was very poorly understood, very few candidates gaining many marks here.

Q4 Once again this extended writing question differentiated well. Many candidates understood that insulin had a role in control of blood sugar, however they were unsure whether it raised or lowered the level.

Q5 (a) Many candidates failed to understand the concept in this question and merely answered that there would be more plants grown rather than the idea that reproduction has many failures.

(b) (i) Many candidates failed to do what they were asked in the question, ie to compare. Many answers only wrote about one condition, or failed to use numbers.

(b) (ii) This question was answered well, with many candidates able to interpret the data.

(b) (iii) However, many candidates failed to extend this interpretation of data in this section and confused range and mean in the answers.

(b) (iv) This was a well answered section, with many candidates' knowledge of how science works enabling them to score well.

Q6 Once again this extended writing question had a wide spread of marks. Many candidates were able to take the information from both areas and produce a response that answered the question, namely 'prediction and explanation'.

Q7 (a) This was well answered, indicating that many candidates knowledge of genetic modification was good.

(b) There was a large problem in this question with candidates not knowing what a herbicide does. A number knew that it killed something but many were under the misapprehension that it killed insects.

Q8 (a) – (d) This area of the specification was poorly answered last year and although slightly better answered this year it still indicates that candidates are unsure about open and closed loop ecosystems. The question was worth seven marks in total and it was only part (c) about ecosystem services that gained many marks.

A163/02 Twenty First Century Biology A Module B7 Higher Tier

General Comments:

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

The paper included three, six mark questions. Centres that scrutinise the mark scheme for this paper will notice that the marking of these questions is more structured and the mark scheme allows credit for what the candidates know and can do. The majority of candidates made an excellent attempt at answering these questions and were well prepared as to how to structure their responses.

The trend for candidates to write outside the allocated area continues. Too often candidates write in any white space that they can find. This is nearly always caused as a result of the candidate failing to think the answer through before commencing to write. 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. This is a very dangerous practice. Due to the fact that these scripts are marked electronically, examiners do not see the whole page by default and unless there is some indication that the candidate has written outside the allocated window; it is possible that the examiner will fail to spot additional text and the candidate could lose marks. It cannot be stressed too strongly that candidates should attempt to contain their answer in the space provided.

The paper was suitably challenging and discriminated well between candidates. Very few sections were unanswered suggesting that the paper was accessible to most candidates. There was no evidence that any of the candidates ran out of time.

Comments on Individual Questions:

Question No. 1

This question proved to be an accessible start to the paper, giving encouragement to less able candidates.

(a) (i) Most candidates correctly identified both the diastolic and systolic pressure readings from the graph. Both readings were required to score the mark.

(ii) This question was also well answered, with most candidates determining from the chart that the blood pressure readings were in the high category.

(b) Once again, candidates scored well on this question. As it was hard to be specific concerning the exact date that the medicine was administered, a range of answers from day 27 to day 35 was accepted.

(c) This was also answered well by most candidates. A wide range of responses were accepted, but vague answers that just referred to diet were not. Better answers referred to exercise, varying activities, smoking, or stress.

(d) (i) Most candidates scored two marks for this question. Some candidates however answered incorrectly and wasted the opportunity of scoring at least one of the marks, by not showing their calculations. Students should always be encouraged to show their calculations as this can often salvage at least some of the marks.

(ii) This proved to be a more challenging question. Vague answers that just referred to producing a more accurate result were not credited. Better answers referred to being closer to the true value or being able to compare with other sets of data. Candidates who performed better on this question were those that had been taught the definitions from the specification. It is time well spent for centres to ensure that candidates are familiar with all the statements that deal with definitions in the specification.

(iii) Candidates performed well on this question, correctly identifying the extremes of the range from the data in the table.

(iv) This question was not answered well. Many candidates failed to make it clear that their answer referred to data both before and after the medicine was taken. This lack of comparison resulted in some candidates failing to score. Another error was that most candidates only used data from the systolic readings on the graph and failed to refer to the diastolic data. Examiners used an ‘error carried forward’ to determine the date the medicine was taken in order to compare before and after data.

Question No. 2

(a) This was a six mark, level of response question that was targeted up to A* standard. Examiners were looking for answers that referred to monitoring and control of both high and low body temperatures. Most candidates performed well on this question, with reference to receptors and the hypothalamus monitoring changes in temperatures and then describing how effectors were responsible for maintaining a constant body temperature. An area of concern is the number of candidates who refer to blood vessels in the skin moving closer or further away from the surface. This is such a basic error that, when this occurred, examiners were unable to give full marks for what otherwise may have been an excellent answer.

(b) This question elicited a wide range of responses from thermostats to open loop systems. Good answers gave either negative feedback or antagonistic and then explained that greenhouse two was better as the temperature could be lowered. Vague answers, that just referred to heat rather than temperature control, were not credited.

Question No. 3

(a) Most candidates scored at least one of the marks for this question by inferring that substances passed through the capillary wall. Fewer candidates went on to refer to pressure or that plasma was involved in the formation of tissue fluid.

(b) Candidates found this question more accessible than part (a). Good answers included reference to diffusion and the transfer of oxygen and glucose to cells and the removal of carbon dioxide and urea from cells.

Question No. 4

This was the second level of response, six mark question. It was targeted up to grade A standard. Lower level answers simply referred to the effect of insecticide on the targeted insects and how their removal would influence the food chain. Better answers stated how the insecticide would be passed on through the food chain. The best answers referred to the build-up of insecticide to lethal levels due to top carnivores eating a larger number of organisms lower down the food chain.

Question No. 5

(a) Most candidates managed to score the mark for this question. Examiners allowed a wide range of 84 to 90 minutes for person A, in order to ensure that any reasonable answer was credited.

(b) This question proved to be more challenging. Candidates were asked to state how the level differed between the two people. A common failing was simply to state what was happening to one of the individuals rather than compare the two.

(c) Some candidates failed to realise that this was a three mark question and consequently needed three conclusions. Good answers included the idea that A was a diabetic, produced too little insulin and that B was healthy.

(d) Good answers referred to increasing confidence in the prediction, but not necessarily proving that the prediction was correct. However this question was not answered well by most candidates. Rather like question 1 (d) (ii) it required candidates to know the correct definition from a statement in the specification. Answers that stated that it proved the prediction was correct did not score.

Question No. 6

This was the third of the level of response questions and overlapped with the foundation tier. It was targeted up to grade C standard. As expected for higher tier candidates, this question was answered well by most candidates. Examiners were looking for three specific areas in candidates answers. Credit was given for predicting what would happen to Helene as she rose to the surface, what problems this would cause her and finally how these problems could be prevented.

Question No. 7

(a) This proved to be the most challenging question on the paper and was only answered well by the most able candidates. Credit was given for correctly identifying which of the three statements were correct and then giving a credible reason why, for each statement. Centres would be well advised to spend more time on this area of the specification.

(b) This question proved to be harder than was anticipated. Candidates could either state that it was open or closed loop. Although they were not credited for this, they were then credited for justifying their decision. Some candidates gave the opposite reasons for their decision and were not credited. Others only gave a partial explanation and thus only received one of the two marks. Good answers for open loop gave examples of things that were both added and taken away. Good answers for closed loop gave examples of things that were retained within the greenhouse or were recycled.

Question No. 8

(a) This was answered well with most candidates scoring all four marks.

(b) Examiners were looking here for some physical evidence that the DNA was in fact carrying the allele. Good answers referred to glowing under UV light, or even that the black colour in the diagram indicated the presence of the allele.

Question No. 9

(a) This was a straightforward multiple choice question that required three correct responses for three marks. It was answered well by most candidates.

(b) This multiple choice question required three correct responses for two marks and was also well answered by candidates.

A173/01 Twenty First Century Chemistry A Module C7 Foundation Tier

General Comments:

The performance of candidates overall in this paper was comparable to other series. Candidates were willing to attempt many of the questions, including the Level of Response 6 mark questions. Many candidates were conversant with scientific language, including scientific vocabulary in their extended responses, and identifying the correct words to use in different situations, such as “exothermic” as being a reaction that gives out energy.

Candidates demonstrated an awareness of sustainability and the importance of reducing waste in industrial reactions. Many were able to explain that processes were more “green” if waste was reduced. Despite this being a foundation paper, candidates’ knowledge of challenging ideas, such as the way catalysts work was extensive. In addition, many were able to use the idea of atom economy in the correct contexts.

Candidates were less secure in their ideas about molecules; masses were frequently calculated incorrectly. Furthermore, candidates found the questions on chromatography challenging, with many accumulating only a few marks on Q.7.

Comments on Individual Questions:

Q.1 (a) Generally answered well by the majority of candidates. Where mistakes were made, it was usually because extra products had been added into the equation.

Q.1 (b) (i) Answered correctly by many candidates; the principle of conservation of mass had been taught well in centres, and candidates recognised how to arrive at the correct response of 44 tonnes.

Q.1 (b) (ii) Many candidates achieved at least one mark here – usually for recognising that a lot of waste was produced by the reaction, and many were able to state that carbon dioxide is a greenhouse gas. Some candidates did not achieve full marks because they stated that the reaction makes carbon dioxide (already given in the stem).

Q.1 (c) This question posed challenges for the majority of candidates. Two marks were rarely achieved. Despite the question stating that *both* processes produced carbon dioxide, candidates still used this as a response. This question required candidates to discuss both the intake and production of carbon dioxide; trees absorb carbon dioxide was sometimes given as a response, but candidates also needed to explain that this offsets the carbon dioxide produced in combustion.

Q.2 This question was answered extremely well by many candidates. Marks were achieved by almost all students attempting the question. Centres had taught the principles of the Haber Process in many instances, successfully, to a higher level. Responses given were well structured and clearly explained. Candidates had been careful to try and address all three aspects of the question. Their responses were detailed and included many key scientific terms. The term “catalyst” was explained well; often discussing the lowering of activation energy, or the provision of an alternative route for the reaction. The reasons for recycling of gases was often clearly depicted including reducing waste, and having a high atom economy. Furthermore, the details given about the process were exact; temperatures and pressures were stated, and it was common for candidates to have remembered that the catalyst was iron. The difference between four marks and six marks was usually because candidates had not mentioned a reduction in waste, or that some gases are re-used because they did not react in the first pass through the converter.

Q.3 (a) Many candidates correctly identified the different chemicals in the production of the ester.

Q.3 (b) Few candidates understood the term “equilibrium” in this context. Many selected Steve as being correct. This question required candidates to understand that there would not be 100% conversion, and that there would still be reactants and products present because the reaction is reversible.

Q.3 (c) Candidates were often able to state carbon dioxide as a product of burning but rarely gave water as the second response.

Q.4 (a) Candidates were aware of the uses of ethanol, with many achieving at least one mark. However, marks were needlessly lost because a use of ethanol was frequently stated as “alcohol” rather than “as an alcoholic *drink*.”

Q.4 (b) Few candidates achieved any marks in this question. The required response was for recognition that yeast is used and this stops working at higher ethanol concentrations.

Q.4 (c) Candidates lacked understanding of this process. Where marks were achieved, it was usually for simple operational points such as heating the solution and using a thermometer to monitor temperature. Some candidates were able to explain that there was evaporation and condensation. However, marks were sometimes lost because candidates were confused about which liquid was evaporated, when in fact *both* will evaporate, but the vapour is richer in ethanol. For six marks to be achieved, the question required candidates to describe the process simply, explain what happens to the liquids, and refer to the different boiling points of the liquids.

Q.4 (d) This question was rarely answered well. Many candidates misunderstood the rubric and assumed that the table referred to the amount of poison produced from each alcohol upon heating.

To achieve full marks, the candidates were expected to realise that there is a difference between the amounts that can be consumed; to quote ethanol as the alcohol that will be produced at 79^{o}C, and to state that more of the ethanol can be consumed as its toxicity level is highest.

Q.4 (e) Many candidates were able to calculate the correct number of atoms, and to select three as the number of elements in the formula. Where mistakes were made, it was usually on the total number of atoms; candidates had assumed that if there was not a subscript number next to the element then it need not be counted.

Q.5 (a) Candidates were aware of neutralisation processes, and recognised this as a neutralisation reaction. However, many found it difficult to correctly sequence their ideas; indicator was frequently added at the end of the reaction and therefore the neutralisation would not work. In many instances, the alkali was described as being placed in a burette, rather than acid. The rubric clearly asked for consideration of a number of titrations, and few candidates discussed repetition of their experiments, or the reasons for repetition. Six marks could not be achieved without this as a factor in each candidate's response. Although a correct sequence may have been described, without explaining that it was necessary to observe the volume of acid added. The best responses, were those where it was evident that the candidate had experienced the practical assignment themselves; clearly sequenced descriptions were explained; indicator was used (and a colour change made explicit); the volume of acid was noted, and finally, the experiment was described as having a "rough" titration initially, followed by several more attempts. In some cases, there was a description of the calculation of a mean.

Q.5 (b) There were a number of very good responses here which included an explanation of James excluding an outlier, and how he calculated the mean. Incorrect responses were common; candidates described the value as the "median" value without considering the nature of the first result in the table.

Q.5 (c) for full marks in this question, candidates needed to consider both parts to the question (the second was either ignored, or it wasn't clear from the response as to which part of the question was being discussed). The best responses were those where candidates had explained the importance of checking for purity *over time*, and had then clearly explained that it was important that titration of collected samples should be immediate so that the sample didn't deteriorate. Many candidates appreciated that the samples may need checking due to safety and to protect consumers.

Q.6 (a) The majority of candidates were able to select the correct definition for a reaction that gave off energy.

Q.6 (b) There was a great deal of confusion in the answering of this question. Selected responses often seemed random; one mark was often achieved, but three marks were seldom achieved. The most commonly selected correct response was the energy needed to start the reaction being the activation energy.

Q.6 (c) (i) Many candidates were able to correctly identify the number of molecules in a reaction.

Q.6 (c) (ii) Candidates demonstrated a lack of understanding of the calculation of masses of numbers of molecules.

Q.7 (a) (i) & (ii) Almost all candidates were able to interpret the diagram and understood that there were three colours in the original sample, but they were less secure about the most soluble colour. Good responses came from candidates who had experienced the experiment and they clearly explained that the most soluble sample moved highest up the paper. The most common misconception was for candidates to think that C was the most soluble because it was darkest, or that B was most soluble because it was lightest.

Q.7 (a) (iii) There were a number of candidates who successfully achieved full marks in this question. However, frequently, candidates had used randomly selected numbers to try and calculate the Rf value (values that were not given in the diagram). In some cases, the candidates had correctly used the correct numbers, but had incorrectly substituted them into the formula given in the rubric.

Q.7 (b) (i) The best responses to this question were those where the candidates had used scientific vocabulary such as “insoluble”, “solvent” and “solute.” It was a common misconception that Alex didn’t use enough pen, or that the spots had moved, just not much even though the diagram does not support this.

Q.7 (b) (ii) Misconceptions meant that few candidates were able to explain that a different solvent was required. Candidates had completed experiments on chromatography, but many described that spots would have been observed had the paper been sprayed with a special dye, and therefore not appreciating that pen wouldn’t be very useful if it was invisible.

A173/02 Twenty First Century Chemistry A Module C7 Higher Tier

Most candidates were entered appropriately for this tier and had enough time to answer all the questions. However, the candidates who scored zero, one or two marks on the whole paper would clearly have been better placed if they had sat the foundation tier.

Examiners noted that more candidates are prepared to show their working when answering numerical questions. As a consequence, this year several candidates who gave incorrect answers were able to gain partial credit through the working shown.

Examiners commented that, for extended-writing questions, those candidates who had had some practice in organising their thoughts into a coherent sequence tended to contradict themselves much less frequently, and to score more highly. Candidates are reminded that written communication is not limited to continuous writing. Answers which used bullet points or annotated diagrams often resulted in clear communication of all the salient points, and so were able to gain the maximum mark.

1 (a) (i) The calculation of atom economy was well attempted. A very common mistake was to mis-read 'the mass of all reactants as 'the mass of one of each reactant plus each product'. It was very pleasing to see that although a large minority of candidates may have got the wrong answer, they showed enough working to still gain some credit.

1 (a) (ii) Most candidates realised that a low value for atom economy meant a large amount of waste. There was some confusion between atom economy and percentage yield.

1 (b) Most could suggest that trees are a renewable resource, and many realised that methane is a finite resource.

2 (a) Most candidates were aware that an equilibrium would be achieved in the flask, and went on to discuss how the forward reaction was favoured in the Haber process. The role of temperature was not quite as well understood, and there were some muddled statements as candidates tried to sort out their ideas.

Beside the confusion over the role of temperature, the three most common misunderstandings were:

- that pressure is increased in order to speed up the reaction
- at equilibrium the *amount* of reactants equals the *amount* of products
- that the Haber process uses an enzyme catalyst. This was usually preceded by the use of the term 'optimum conditions', so presumably that term is too strongly linked to enzymes in the minds of some candidates.

2 (b) This question explored candidates' ability to relate concepts of risk and benefit [IaS 6.1] to an actual example. Most candidates realised that the use of ammonia for fertilisers made a justifiable reason for its continued production and some discussed the concept of benefit versus risk. Some candidates found it very difficult to make a considered value judgement, and responses such as "ammonia isn't only used for explosives, it is a valuable resource used to make hair dye" did not gain credit.

3 (a) Whilst any suitable formula for ethanol was acceptable, almost all candidates realised the significance of the OH group. C_2H_6 and C_2H_6OH were the most common wrong answers, and some candidates gave a word equation instead of a formula.

3 (b) Candidates gave good explanations of alcohol distillation and discussed the difference in boiling point between alcohol and water. However, there was often confusion between the use of a condenser in this context and its use for refluxing. Other candidates recalled their notes indiscriminately and described fractionating columns. Weaker candidates had great difficulty in describing what happens in a condenser.

3 (c) The table of lethal amounts for different alcohols was designed to apply information in an unfamiliar context, and proved difficult for candidates. Some candidates did not realise that the amount need to poison a person is inversely related to the relative safety of the alcohol, so suggested that ethanol was the least safe to drink of the alcohols in the table.

3 (d) The balancing of the butanol equation was very well attempted, the weakest candidates gaining credit for writing the correct chemical species, the more able going on to balance the equation itself. Many candidates were able to put the correct numbers into the right hand side of the equation, the left hand side was, unsurprisingly, more difficult. Candidates who doubled the quantities for the equation were not penalised.

3 (e) (i) Most candidates knew that hydrogen is the gas produced when sodium reacts with both water or butanol. A huge number of weaker candidates suggested that the gas was sodium hydroxide.

3 (e) (ii) The number of candidates who suggested that sodium sinks in butanol clearly shows that they were remembering the experience of seeing something in class.

4 (a) Candidates found it slightly easier to choose the correct reactants than products for the esterification reaction. Some candidates did not read the question and drew more than one line.

4 (b) This question proved to be surprisingly difficult for candidates to answer. It revisited the nature of reversible reactions and equilibria, but required candidates to think for themselves rather than depend on recall. Candidates often copied out material from the two statements in the question rather than apply their knowledge to the situation they were faced with. The command word ‘explain’ needs the candidate to use scientific ideas to say why the person is right or wrong.

4 (c) Most candidates appreciated that the sulphuric acid is used as a catalyst and that it speeds up the reaction or lowers the activation energy. Weaker candidates tended to think that it increased the yield.

5 (a) Most candidates were clearly familiar with the procedure for carrying out a titration, but there was also a significant minority who appeared to have little or no practical experience. There was a surprising number of descriptions of a burette as a “titration stick” or “titration tube”

5 (b) Able candidates had no difficulty calculating the mass of sodium hydroxide in the solution, though others found it more taxing. Few candidates showed their working, so were not even able to gain that mark. This part was not attempted by a minority of candidates.

5 (c) Most candidates realised that the first result was an outlier and that the best value was the mean of the other three results. Some candidates showed confusion between mean and median. Also common was “after discarding the first reading, 25.4 is in the middle of the other three”.

5 (d) While calculating the relative formula mass was within the reach of most candidates, using the equation to decide what mass of acid reacts with 40g of sodium hydroxide was a lot more difficult and was not attempted by a significant minority.

6 (a) Most candidates realised that the reaction is exothermic and that energy is given out to the surroundings. Contradictions were often seen, and there was the usual confusion over whether energy is released or taken in to make bonds.

6 (b) Candidates were much more confident in describing the need for energy to break bonds in part 6b.

6 (c) The number of bonds to be broken in the reaction was well understood, as was the calculation of the overall energy change. Many candidates even included the negative sign.

6 (d) Most candidates understood that water was produced in both reactions, and usually also knew that carbon dioxide was produced only when hydrocarbons burn.

A183/01 Twenty First Century Physics A Module P7 Foundation Tier

General Comments:

The paper examined knowledge and understanding of Physics module P7.

The paper was generally well attempted and produced a good spread of marks across most of the paper, with typical scores ranging from single figures up to the low fifties. The performance of a very small number of candidates indicated that they should perhaps have been entered for the Higher Tier but for the vast majority, the Foundation Tier was appropriate.

Candidates demonstrated a range of skills in their responses. Most candidates were able to show a good understanding of Ideas about Science, although less able candidates clearly have difficulty when for example they are required to compare data to assess levels of confidence or whether ideas are supported or undermined. This is a skill that needs to be addressed in future teaching.

Candidates were able to interpret and evaluate data, in a variety of formats, appropriately in calculations and comparisons. The most able candidates were also able to recall correct scientific terminology, apply abstract ideas about Cepheid Variables and provide scientific justifications for improvements in telescope technology

Most candidates are showing greater confidence with the six-mark extended writing questions with evidence of significant amounts of extended writing across the mark range. They are adhering more closely to the rubric information and addressing different aspects in their responses. The most able candidates link their ideas using comparative words in their answers. Further down the mark range, candidates still have a tendency to repeat much of the information provided before introducing an idea of their own. These questions differentiate well. Candidates who achieved well on these questions generally performed well on the paper as a whole.

Comments on Individual Questions:

1. This question was about how our knowledge of stars comes from the light we receive from them. It was generally well answered. Candidates were expected to recall and draw how white light is dispersed by a prism. Many drew 3D prisms and consequently found it harder to represent a continuous ray through the prism, which changed direction at a boundary to gain all three marks. Most candidates were able to select 'refraction' as the correct term for the change of direction. The common error was 'parallax'. Most candidates did not know 'diffraction grating' as another method of creating a spectrum. A common incorrect response was 'star'. Most candidates were able to select words correctly to complete sentences about absorption spectra and interpret line spectra to determine similar elements in a star. Most were able to name hydrogen and helium as the most common elements in a young star. The common errors here were nitrogen, carbon and carbon dioxide.

2. This question was about interpreting the Hertzsprung-Russell diagram. This was also very well answered by many candidates. Most were able to correctly identify regions of brightness and temperature, types of stars and also locate the Sun on the diagram. Many candidates could not recall 273 for converting Celsius to Kelvin. In the explanation for why the Earth could not be plotted on the diagram, candidates often answered simplistically 'it is a planet' and so did not gain credit.

3. This six-mark extended writing question, targeted at grades up to E was about describing the life cycle of a star like the Sun. Some candidates recalled the names of the stages, others described them, the best candidates did both and used some good Physics terminology in their responses. However many stages the candidates were able to recall, at Level 2 and 3, most candidates gave the correct sequence of stages.

4. This six-mark extended writing question, targeted at grades up to E was about evaluating data to explain and justify the choice of a site for a new astronomical observatory. A misunderstanding of the term 'cloudless' led a number of candidates to choose inappropriate locations. Most candidates did understand the terminology correctly and made justified choices, although explanations were often limited to 'highest' or 'furthest from'. The most able candidates used additional scientific knowledge to explain the factors involved in the choice of location.

5. This question was about the evidence for planets around nearby stars and the likelihood of life existing elsewhere in the Universe. Many candidates knew that planets have been discovered, with many references to exo-planets and 'Goldilocks zones'. However few candidates were able to express clearly why many discoveries increased the probability of finding life. Candidates were awarded a compensation mark for correct scientific ideas about the necessary conditions for life although this is not a requirement of the specification. Most candidates also knew that no extra-terrestrial life forms have been discovered.

6. This question was about drawing and labelling a diagram of a lunar eclipse. Many drew solar eclipses and were compensated with two marks. The weakest part of many diagrams was the representation of light rays. These were often no more than indicative – which was sufficient for the level of this question for showing the Earth's shadow.

7. This question was about applying a formula and interpreting data. Most of the question was in common with the Higher tier paper. A common error in the first part of the question was to suggest, simplistically, that the reason why planets further than Saturn were not included in the data was that they were too far away. Many candidates realised correctly that they had not yet been discovered. Most candidates were able to apply the formula correctly, but very few candidates compared their calculation with a given number in order

to judge whether a 'law' was supported. Only the highest ability candidates judged that the numbers were very similar. Most candidates assessed the number with respect to the calculations for Mars and Jupiter and so 'yes, because it fits the gap' was not sufficient to gain credit. In part b(iii) most able candidates gained marks for the idea of that it was necessary to confirm or verify the observation but very few gained further marks for the idea that this improved reliability or gave greater confidence in the observation. Some realised that the original astronomer may have been wrong or lying. Less able candidates clearly struggled with this 'Ideas about Science' question and their responses indicated that observations by other astronomers were necessary to determine if Ceres was e.g. suitable for life, or a threat to Earth. In part c candidates were presented with further data and asked to discuss the data in relation to 'confidence in the Titius-Bode Law'. Able candidates compared calculated with actual values and judged that the differences were increasing. Many less able candidates did not understand the question.

8. This six-mark extended writing question targeted at grades up to C was a common question with the Higher tier paper. Candidates were required to explain the improvements in observations afforded by space telescopes and explain how these lead to improved observations of Cepheid variable stars. Many candidates were able to recall that space telescopes removed light and atmospheric pollution from observations, but only the most able could also link improvements to the removal of absorption and refraction effects of the atmosphere. A large number of candidates recalled that Cepheid variables have a period, or pulse, but very few were able to recall the link with luminosity.

9. This Ideas about Science question was about the use of peer reviewed secondary data to make a speed of recession calculation. There is a wide misconception that 'peer' in this context is a friend e.g.at school, or a colleague at work. This difference between the common use of the term and the scientific use needs to be addressed in teaching. Most candidates gained marks for the idea that the work needed to be checked, however. A third mark point was available for the idea that the review is carried out before publishing the research, but was very rarely seen. Many candidates were able to calculate the speed of recession correctly. In the final part of the question candidates were asked to state the problem with the method used to 'reproduce the results'. A few able candidates provided the expected answer that Ian did not measure the distance or that he looked up the data in a book. Many candidates misinterpreted 'reproduce' as a lack of repeats.

A183/02 Twenty First Century Science Physics A (P7) Higher Tier

General Comments:

The candidates covered quite a wide range of abilities, with the increase in candidates at the lower end of the ability range noted last year continuing. Candidates who are entered inappropriately to the higher tier are often unable to access questions and have very limited opportunities to demonstrate what they know. There was no evidence of candidates running out of time. Very little evidence was seen of candidates 'killing time' in the exam by scribbling or 'doodling' on the paper, so it appeared that they were kept occupied for a large part of the time.

There was a noticeable increase in the number of candidates writing on continuation sheets. This should only be necessary in rare cases. The space provided for answers are an indication of the depth of answer required. Most candidates using extra sheets were simply repeating information from the stem of the question, or from their own answers. Conciseness is desirable in answers, particularly in the 6 mark questions, which also assess the quality of written communication. Candidates did not always note the command word in the questions, for example 'describe' requires a different type of answer to 'explain'. This issue was seen very clearly in question 3(b).

Many candidates lost marks due to not reading through their script at the end of the examination.

Comments on Individual Questions:

Question 1

(a) This was answered well by most candidates. 'They were too far away to measure' was the most common error.

(b) Part (i) was calculated correctly by nearly all candidates. In Part (ii) the most common errors were to consider the difference between 2.77 and 2.8 as too great to support the law. A similar error was to reverse the calculation and say that 23.7 was not a whole number so did not support the law. Weaker candidates often did not make any connection with the answer to part (i), just saying it fitted between Mars and Jupiter. Part (iii) was essentially asking 'what is the value of reproducing measurements/observations?' Many candidates were keen to use terminology such as 'peer review' without thinking more carefully about what the question was asking. Other vague responses included the idea about wanting to know more about the planet, to see if there was life on it.

(c) The best responses normally covered a comparison of agreement for all three planets. A significant number of candidates focused on differences in distances between planets, rather than the differences between the predicted values and the actual distances.

(d) Only a minority of candidates were able to identify the need for a plausible mechanism/scientific explanation. By far the most common incorrect response was to focus on gathering more data.

Question 2.

The best responses were succinct and direct in their comments about each aspect of the question. Weak responses merely repeated the information given in the stem of the question. Many candidates were able to identify the absence of atmosphere/air pollution, and some candidates were able to amplify this by including the absence of absorption and/or refraction of light in space. Light pollution and atmosphere were the most commonly stated improvements, with a good number able to explain why being outside the atmosphere was a benefit. A common non-creditworthy response was that telescopes in space have larger mirrors. Weak responses merely repeated the information given in the stem of the question, or referred to lenses/mirrors/apertures/ being closer to stars, or computer controlled. Very few candidates were able to identify the increased baseline provided by the space telescopes, and how this gave rise to an increased and more accurate measurement of parallax angle. Detail of Cepheid variables rarely extended beyond variation in brightness/pulse. The connection between distance, brightness and luminosity was rarely stated.

Question 3.

(a) The calculation was done well by the majority of candidates. The most common errors were due to the incorrect rounding in significant figures, and incorrect units.

(b) The relationship was well understood by most candidates, but few provided any explanation of the relationship.

(c) Many candidates merely provided an answer relating to red shift measurements, which did not address the question. Only a minority of candidates were able to state that a large amount of data had been collected in order to provide more confidence in the relationship.

Question 4.

(a) The common error was to think that the horizontal axis was distance and the unit km. Of those who knew it was temperature, most also got the unit correct. Luminosity for the vertical axis was not well known.

(b) (i) Many incorrectly thought they colours should be on the vertical axis and the order of colours was often wrong, commonly with blue and red reversed. (ii) Many candidates were able to correctly relate temperature to colour. The best responses, however, also included the relationship between frequency and colour. The most common error was to link red with hot/high frequency and blue with cold.

(c) In part (i) most correctly ringed stars on the main sequence, the most common error was to ring a red giant at the top left of the H-R diagram. (ii) Many candidates scored well here. The common error from weaker candidates was the “fact” that hydrogen is needed to fuel the star or to make helium – the link to ‘fusion is happening so must have hydrogen in’ was often seen.

(d) Many got this right but there were a few who thought black holes weren't stars or that they ‘happen too quickly’.

Question 5

(a) Many candidates were able to state the correct stages for either high or low mass stars. Some candidates failed to relate the level of mass to the sequence they provided. The detailed physical differences between high and low mass stars appeared to be less well understood, and only a minority of candidates were able to provide details of temperature, pressure and density differences between high and low mass stars. The formation of more

massive nuclei in high mass stars was observed in some of the better responses. The best responses were ones where the stages of low mass and high mass stars were considered in turn, including appropriate physical differences in the narrative. Many gave detailed discussions of post main stage burning and collapse of stars. The weakest responses were muddled with incorrect stages named or stages/masses jumbled and references to the formation of protostars. Some answers took up large amounts of space and writing time and scored little credit in most cases, for long descriptions of protostar formation from nebulae .The detailed physical differences between high and low mass stars appeared to be less well understood, and only a minority of candidates were able to provide details of temperature, pressure and density differences between high and low mass stars. The formation of more massive nuclei in high mass stars was observed in some of the better responses. A very common misunderstanding was that large mass stars had more fuel and hence had longer lives.

(b) Overall many candidates demonstrated a very limited understanding of standard form. In (i), the most common errors were where candidates tried to take away the 10^{-5}, some divided by 10^{-5} and got a larger number. (ii) Many candidates show a correct numerical solution relationship, but failed to give the relationship ($E=mc^2$) that they were using. A common error was forgetting to square the speed of light. (iii) showed very few correct responses. In many cases there seemed to be no awareness of what a suitable answer would be, e.g. 15 seconds is not very long and 10^{49} seconds is longer than the age of the universe.

Question 6

(a) Many candidates had little understanding of ray diagrams. Detailed ray diagrams, resulting in the correct image formation in the focal plane, were rarely seen. Candidates need to know the way in which rays are refracted as they enter the lens. Candidates often continued top ray without refraction and bent central ray along principal axis. In the high scoring responses, a poorly labelled or shrunken image were the most common reasons for only scoring 3 marks. In the weakest responses it was common to see rays bending in mid-air.

(b) The need for greater magnification was well understood, however a common misunderstanding was that the eyepiece lens did the magnifying. Very few candidates were able to state the relationship between magnification and the focal lengths.

(c) This was generally well answered with many good candidates considering the refraction of different colours and absorption, weaker candidates tended to focus on size and ease of manufacture.

Question 7

Many candidates didn't fit their answers into the available space and many went onto additional sheets, most such answers were poorly structured and repetitive. The best responses showed evidence of candidates having thought about their answer before writing it down and so wrote to justify their planned conclusion. The weakest responses were characterised by restating data from the table in a random manner, without adding any comparisons or justifications. Mid-range responses often had a scattergun approach, stating the best aspect of some sites with or without justification, or gave reasons for their chosen site without looking at all of the aspects. Many candidates reached the top band but wrote 3 or 4 times the amount necessary and often reached level 3 within the first 6 lines of their response! Candidates should be encouraged to realise that if their answer requires more than the space provided they have possibly missed the point of the question.

A194/02 Further Additional Science A Controlled Assessment

Overview

This was the second 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 last year. There were far fewer centres requiring scaling than last year and in general these changes were smaller. However a significant proportion of centres still had their marks altered this session, with large scalings. 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. Cases of significant 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 for 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 criteria should be annotated where it is met. Beginning with the lowest level and working up to the level where a criterion is not met. This will determine the level of marks awarded. If the candidate meets all the criteria a given level then the higher of the two marks is awarded. Where the candidate meets some of the criteria in a level the lower of the two marks must be awarded.

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

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

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

Interpretation of assessment criteria

Sa – formulating a hypothesis or prediction

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

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

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

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

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

Sb - Design of techniques and choice of equipment

In this session, this strand was often generously marked. It was often not possible to justify the centre marks because students limited themselves to a maximum of 5 marks by failing to explain their chosen range of data. It was disappointing to find that the range (of the independent variable) was rarely explained. Centres seemed to believe that just ‘stating’ the range was sufficient. This explanation can be pragmatic, e.g. 'there were only 5 different strength lens available', based on safety issues, or '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 ie. 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 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.

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