OCR
Oxford Cambridge and RSA

GCSE

Biology A

Twenty First Century Science Suite

General Certificate of Secondary Education **J243**

OCR Report to Centres June 2016

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

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

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OCR REPORT TO CENTRES

A161/01 Biology A Modules B1, B2, B3 (Foundation Tier)

General Comments:

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

It was evident from the six-mark extended writing questions that candidates were trying to address all sections of the question set and many were clearly well prepared as to how to structure their responses.

On the whole, candidates limited their responses to the available spaces, which was pleasing to see.

The paper was challenging and discriminated well between candidates. There was no evidence that candidates ran out of time on this paper.

Comments on Individual Questions:

Question 1
1(a) In this question candidates were required to the select the correct word to complete three sentences to explain how genes function. The majority of students scored one mark for this question. The most common error being in the first sentence where many candidates thought that genes were **cells** that describe how to make proteins.

1(b) Candidates were asked to identify which cells in a human usually contain pairs of chromosomes. Many candidates selected the correct response. The most common error observed showed that candidates thought that all human cells contained pairs of chromosomes.

Question 2
2(a) This question required an understanding about clones. The majority of candidates scored at least one mark for this question, often for the correct identification that 'Clones A and B would have identical genes'; many candidates scored both marks. Unfortunately, some candidates did not tick two boxes and were therefore limited to one mark. Centres are asked to remind students to read the instructions carefully to avoid making such mistakes.

2(b) This question was on the whole answered poorly with few candidates gaining marks. Those that did score on this question correctly identified bulbs as a way in which plants could make clones. Many candidates incorrectly identified 'cuttings' and 'seeds' as a method of making clones, or simply repeated the stem of the question, indicating that the candidates had not fully understood what the question had asked or that the topic was not well understood. There were a number of candidates that did not attempt this question.

2(c) This was the first of the six-mark extended writing questions. It is pleasing to see that the candidates are now confident in tackling these questions and that many have developed good strategies to ensure that all parts of the question are answered. Candidates were asked to explain why identical twins look similar, but will not always look exactly the same. The majority of candidates scored between 1 and 4 marks on this question, with a large proportion scoring at Level 2. Candidates were able to correctly identify similarities and differences, though similarities were discussed less frequently. Candidates were able to express well that the differences were observed due to the environment and gave a good range of examples.

Candidates struggled to explain why the twins looked similar. Many referred to the twins having the same genes rather than the same alleles and unfortunately were therefore unable to score. Centres are asked to ensure that when discussing similarities that the distinction is made between genes and alleles. Some candidates were confused and thought that the twins would have different genes/alleles and discussed the inheritance of dominant and recessive alleles from the parents. Candidates did seem aware that something 'split' and frequently made reference to the egg splitting, fertilised egg or embryo splitting was rarely mentioned. Genetic variation was not well understood by most candidates.

Question 3

3(a)(i) This question on the whole was answered well with many candidates selecting 0.87. The most common incorrect answer was 1 in 87.

3(a)(ii) Many candidates failed to gain marks on this question. Many thought that Jane either had cancer or had a low chance of getting cancer; very few seemed to realise that it would in fact make it likely that she would get cancer. Few candidates were confident enough to say that she was certain to get cancer. Centres should be encouraged to develop candidates' understanding of probability.

3(b) This question asked candidates to consider whether Jane should have surgery to remove the breast tissue. Candidates found this question challenging. The majority of candidates scored 1 mark for this question; few candidates scored 3 marks. The responses indicated that the candidates did not understand that this was preventative surgery and not surgery to remove cancerous tissue. Many candidates seemed to think that Jane had cancer and that the surgery was to remove the cancerous tissue. As a result, many incorrectly identified that all the tissue may not be removed and that the cancer may return or discussed a cost element to the surgery. Those that did gain marks did so for correctly identifying that with surgery there are risks or that removing breast tissue could have implications for the future, such as being unable to breast feed or causing body image issues. Very few candidates appreciated that just because the chances of her developing cancer were high this does not mean that she will definitely develop cancer.

3(c) The vast majority of candidates did not answer this question well indicating that they had not understood the question or misinterpreted what the question was asking. Few candidates realised that there were other types of cancer or that lifestyle issues could be involved in causing cancer. Most referred to the 'faulty gene' and that she would be unable to remove this gene hence her risk of cancer would always be present.

3(d) Candidates found this question challenging. Most answers contained a discussion about who may or may not have had the faulty allele rather than identifying the line of inheritance from grandmother to mother. Candidates did correctly identify that the father did not have the faulty allele and was therefore not responsible; unfortunately, this did not score a mark. There was clear evidence that candidates could use a family tree, but they seemed to struggle to communicate their thoughts. It was rarely mentioned that the normal allele had only a 0.1% chance of becoming faulty despite the question stem pointing candidates to both the family tree and the information about the allele.

Question 4

4(a)(i) Many candidates did not realise that the figure required to calculate the number of bacteria came from the stem of the question. Common incorrect answers for this question included 100, 1200 and 6000, with the most common incorrect answer being 1600 indicating that some candidates did not complete the last doubling. Unfortunately, many candidates did not show their working so it was not possible to see how they arrived at their wrong answers. Centres should encourage candidates to show their workings as on many mathematical questions this can often score them a mark.

4(a)(ii) Answers for this question were variable and very much depended on the strategy used to calculate (a) (ii). Those that gained numbers in the thousands for (a) (ii) often went on to discuss the idea that to reach 20 000 bacteria would only take hours and not days. Some candidates went further than this and did include calculations to demonstrate how they had arrived at this decision which was good to see. Those that had struggled to double the numbers in (a) (ii) often failed to score on this question.

4(a)(iii) Very few candidates scored marks on this question. Many seemed to misinterpret what the question wanted and rather than stating two ways in which bacteria can cause symptoms of infection the candidates gave examples of symptoms of infections such as swelling, vomit, rash, fever etc. Those candidates that did recognise what that question was asking often went on to score both marks.

4(b)(i) Many candidates gained credit for placing the cross on the correct part of the graph. Centres are asked to encourage candidates to be as accurate as possible with such questions as some candidates narrowly missed out on the mark. Common errors included placing the cross on the line where it met the X axis. Some candidates did not attempt the question - this could be a result of candidates not realising that it was there and so candidates should be reminded to look for the marks at the side of the question paper to ensure they don't miss out a question by accident.

4(b)(ii) This question was answered well by many candidates. It was pleasing to see that candidates clearly had knowledge about the roles of the white blood cells in defending against disease. Many in-depth responses were seen. Weaker candidates lost marks for incorrect terminology such as eating/fighting or attacking bacteria and there was evidence of candidates being confused as to whether the white blood cells produced antibodies or antigens. Some candidates also incorrectly identified the antibodies as engulfing the white blood cells.

Question 5

5(a)(i) The majority of candidates calculated the value of 50 correctly, indicating that they are confident when calculating percentages. Unfortunately, a sizeable number of candidates quoted the value to no decimal places and therefore only scored 1 mark. Centres should reinforce to candidates the importance of reading the question carefully to check whether the number of decimal places required has been stated. Some candidates selected the correct values to use in this calculation, but unfortunately did not formulate them in the correct way.

5(a)(ii) This question proved challenging to many candidates. Candidates often secured a mark for the idea that the figure only applied to Mali, or that other countries were different. However, there was evidence that some candidates had interpreted the question in a number of different ways. Some candidates referred to the fact that the headline only gave percentages, not actual numbers. Others referred to the negative slant of the headline, suggesting there should be positive news about treatment and survival. The final three marking points were less commonly scored. Centres are encouraged to focus on analysing data sets to allow candidates to gain the skills required to answer such questions.

5a(iii) This question was poorly answered in many cases. Many candidates believed that by adding the country name to the headline already given was sufficient to gain the mark. Others rewrote the headline to make it more general to give less information than the original headline for example statements like "Many infected and some die".

The question was quite explicit in asking the students to better represent the data, however few candidates made the link from this statement to the idea that a mean or range would be appropriate approaches to represent the data. The purpose of mean and range in representing or summarising data could be reinforced by centres.

Where an attempt had been made to calculate a mean there were cases where the percentage calculated exceeded 100% indicating that whilst some candidates are able to calculate percentages they do not necessarily understand them.

5(b)(i) The most common error on this question arose from candidates only ticking one box instead of two, therefore those candidates were unable to gain the mark. Those candidates that did tick two boxes often correctly identified testing 'animals' as one of the first stages in testing new drugs. The most common incorrect answer was identifying that testing 'humans with the disease' was part of these initial testing stages.

5(b)(ii) This was the second of the six-mark extended writing questions. Candidates were asked to consider some information about plans to test a new drug in humans. This question discriminated well between candidates, with marks scored across the 0-6 range. A large proportion scored in Level 2 and it was pleasing to see candidates scoring in Level 3.

The most common correct answers arose from the identification of the use of groups A and B. Many candidates identified that giving healthy volunteers the drug would allow side effects to be identified. Many also identified that giving people with Ebola the drug would allow the scientists to see if the drug actually worked. Many candidates scored in Level 2 for those reasons. It was also common to see candidates discussing the ethical issues of using a placebo with Ebola patients with candidates identifying that the placebo would not help them and as a result they could die. Very few candidates correctly identified the reason for giving group C the placebo. Whilst a number of candidates understood that placebos were a "fake drug", very few grasped the reasons for using them in drug trials. Centres should ensure that when teaching about placebos and drug trials they highlight the fact that they provide a control group for the other results to be compared against.

Common errors made included giving ethical reasons for groups A and B receiving their corresponding treatments.

Question 6

6(a) It was clear from this question and the response observed that some candidates had a clear understanding of how to interpret data and as a result scored all three marks. Other candidates did not appear to understand how to analyse the information provided and as a result were unable to select the appropriate answers. A full range of marks was observed for this question, with the vast majority of candidates scoring one or more marks. Common errors included the selection of 'neither scientist' for the 'Who describes data' row of the table, which may be a result of students thinking that data had to be in the form of numbers. Centres should ensure candidates are aware that observational and numerical data both count as data. Concept cartoons provide a good method to analyse key features such as descriptions of data and explanations.

6(b) Most candidates scored at least one mark for this question with a high proportion scoring two marks. Statements C and E were often in the correct order, however statements B and D were commonly given in the incorrect order.

6(c) This question was answered well with many candidates correctly identifying the missing word as 'adapted; a small number used 'fit' or 'suited' which also gained credit. The most common incorrect words included evolved, used or known.

6(d) This proved a challenging question for many candidates and as a result few candidates scored more than one mark. The question appeared to test candidates' understanding of the interdependencies within food webs well. Some candidates seemed to struggle to interpret the food web and explain the implications of an increase in the deer population on the Neanderthal population, but for many candidates the main issue seemed to be in communicating their ideas.

A good number of candidates had many of the right ideas, but did not use the ideas to form a fully derived conclusion.

The most common correct mark was awarded for identifying that the Neanderthals would increase due to there being more deer for food. A common error made by many was a failure to include any statement about what would happen to the Neanderthal population following a correct discussion of an expected change to one of the other species' population.

Some candidates did correctly identify that an increase in deer would cause a decrease in the vegetable/herb or grass population, but very few candidates then made the link between the reduced vegetable/herbs and the decrease in Neanderthals or that there would be a decrease in bison which would in turn lead to fewer Neanderthals.

Some candidates seemed to misinterpret the question and subsequently went off on a tangent about how the deer population changes over an extended period of time.

Analysing and describing interdependencies is an area of the specification that centres should address.

6(e) This was the final of the six-mark extended writing questions and was the crossover question with the higher paper. This proved a challenging question in which to gain full marks and as a result fewer candidates were seen to score Level 3.

A significant number of candidates took this question as a follow on from 6d, and tried to use the same arguments to answer this question. Using a food web perspective alone limited their ability to gain marks. Those candidates that approached the question from a more general perspective did better.

The most common correct answers included the identification that Neanderthals had a lack of food or were unable to reproduce. For those candidates who did identify the causes of extinction, the most common answers included environmental change or natural disasters. Many candidates stated reasons such as competition or disease, but failed to identify that the competitor or disease was a new threat. Only a small number of candidates recalled that extinction is linked to an inability to adapt.

Many students wrote that Neanderthals became extinct as a result of modern humans and linked this to road building, loss of habitat, being hunted for their fur or to be used in medicine. This could have been partly avoided if candidates had read the information at the start of the question more carefully. Centres could address these issues through discussion of a wide range of species that have become extinct and the reasons without focusing on the human factors.

Question 7

7(a) Some candidates had clearly learnt the definition of a species and as such gained both marks for this question. Those candidates gaining only one mark often lost a mark for failing to identify that the offspring would be fertile. Many candidates resorted to intuitive notions of a species, such as 'a type of animal/plant', which have 'lots of similarities and are classified together'.

7(b) This question was answered well. The majority of candidates scored one mark for this question through the identification that 'all jellyfish were invertebrates' and that they are not a type of fish or that 'not all animals were vertebrates'. The most common error noted was that candidates thought that the newly discovered animal could be a mammal.

A161/02 Biology A Modules B1, B2, B3 (Higher Tier)

General Comments:

Candidates demonstrated that they had secure knowledge of many aspects of the specification such as appreciating the risks associated with diseases, identifying the sex chromosomes, recognising the cells involved in fertilisation to produce twins and being able to suggest causes and explain why the Neanderthals became extinct. In terms of mathematical skills, candidates were able to successfully calculate the probability of a patient developing breast cancer.

Candidates did not seem to have the knowledge or skills required to respond to questions about the role of the white blood cells in the immune response, interpreting genetic family tree diagrams, the role of ADH in water regulation in the body and explaining what interdependence is. Other areas of the specification that candidates did not perform well on include analysing and interpreting of graphical data and drawing conclusions from data.

Comments on Individual Questions:

Question 1
1(a) Many candidates were able to provide at least 2 correct responses for 1 mark.

1(b) The majority of candidates were able to produce the correct response.

Question 2
2(a)(i) This was a well answered question. Where candidates did not get the mark, they had not given the answer in the correct format.

2(a)(ii) Candidates who appreciated what a probability of 100 means scored the mark.

2(b) The majority of candidates achieved at least 1 mark for discussion of the risks due to having the operation. Only some candidates were able to discuss further consequences of her decision to have the operation or not.

2(c) This was a challenging question. Candidates had to be able to interpret the genetic family tree diagram correctly to access any marks.

Question 3
3(a) This question was well answered. The majority of candidates knew the process of fertilisation to produce identical twins.

3(b) This was a challenging question as candidates had to be able to describe the stages involved in artificial cloning.

3(c) This question was a good discriminator. Only some candidates were able to discuss how doctors' could investigate the impact of the environment on identical twins.

Question 4
4(a)(i) The majority of candidates were able to successfully manipulate the data to work out the number of deaths.

4(a)(ii) Candidates who were able to justify in detail why the headline was not a good summary of the data scored the highest marks.

4(b)(i) The majority of candidates were able to identify at least 3 statements concerning drug trials to score 1 mark.

4(b)(ii) Only some candidates could discuss the long term effectiveness of the drug as well as long term side effects to score full marks.

4(b)(iii) This question tested the full range of abilities. Many candidates produced detailed descriptions of how white blood cells work against a pathogen. Some candidates struggled with this idea in the context of the question, often discussing the concept of vaccinations, which did not gain credit.

Question 5

5(a) This was a challenging question. Candidates found it difficult to link increasing antigen concentration to the reproduction of microorganisms.

5(b) The majority of candidates could identify how long the infection lasted.

5(c) This question was difficult as students had to be able to interpret the graph to describe the relationship.

5(d) This was a challenging question which relied on candidates being able to interpret the 2 lines to identify the correct antibody concentration.

Question 6

6(a) Most candidates could identify that the pituitary glands secretes ADH.

6(b) The best responses could explain in detail the logical sequences of stages involved in the regulation of water.

Question 7

7(a) This question was difficult as candidates has to give 2 reasons why scientists developed different explanations from looking at the same evidence.

7(b) Candidates who could explain, within the context of the question, a meaning of the term interdependence and use the available food web to give examples scored the highest marks.

7(c) It was encouraging to see very detailed descriptions about the possible causes of extinction of the Neanderthals.

7(d) The majority of candidates could identify the correct responses to complete the evolution sentences.

7(e) This was a well answered question. Candidates displayed good data handling skills in working out the evolutionary relationships.

7(e)(ii) This was a challenging question, with very few candidates explaining the link between DNA similarity and time taken to evolve correctly.

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

General Comments:

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

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

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

Comments on Individual Questions:

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

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

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

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

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

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

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

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

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

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

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

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

Question 3

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

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

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

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

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

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

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

Question 4

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

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

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

Question 5

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

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

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

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

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

Question 6

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

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

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

Question 7

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

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

General Comments:

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

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

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

Comments on Individual Questions:

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

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

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

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

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

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

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

Question 2

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

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

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

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

Question 3

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

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

Question 4

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

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

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

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

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

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

Question 5

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

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

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

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

Question 6

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

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

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

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

A163/01 Biology A Module B7 (Foundation Tier)

General Comments:

There was a good spread of marks, candidates scores ranged from 0 to 44 out of a maximum of 60 marks with a score of approximately 26 marks. Very few candidates scored at the higher end, perhaps indicating that higher achieving candidates were correctly entered for the higher tier.

Many candidates appeared to have been well prepared for the examination, attempting the majority of questions. However many candidates had problems with Q3a, one of the six mark, extended writing questions (details in the next section). A number of these candidates did score well on the objective 'tick box' questions which perhaps indicates a lack of application rather than lack of ability with extended writing.

Most candidates used the spaces provided for their responses, very few extending their answers to other parts of the paper. An increasing number of candidates however did not seem able to limit their answers to the provided space and used additional examination sheets.

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:

Question 1
1(a) Most candidates were able to identify the statements relating to the function of the skeleton, however a number of candidates did not follow the instructions in the question and ticked two boxes.

1(b) Many candidates struggled to link the property of the joint part to the job, this then limited the marks gained as the marks were awarded for the complete link between Part – Job – Property.

1(c) Many candidates were able to gain at least one mark here, although a number gave weak responses such as 'break' for joint injuries.

1(d) There was a wide spread of responses in this question, showing that candidates had a good knowledge of the role of physiotherapists.

Question 2
2 This extended writing question was well answered by the majority of candidates. Many candidates were able to calculate the BMI and interpret the data and go on to formulate conclusions and suggest suitable actions.

Question 3
3(a) Unfortunately the success of the previous extended writing question did not continue with this question. Candidates found great difficulty interpreting the bar chart and connecting the data together. This resulted with poor scoring across the question.

3(b)(i) Knowledge of examples of biomedical engineering for the treatment of heart disease was quite well answered, many candidates giving correct responses, however many vague answers such as 'transplant' failed to gain marks.

3(b)(ii) Candidates tended to gain a mark for one of the acceptable answers, but again many weak responses, 'it may not work', failed to score.

3(b)(iii) Failure to respond well in the previous part had a negative impact here, very few candidates gaining credit.

Question 4
4(a)(i) Mathematical skills in the next two part questions were disappointing. Many candidates mistakenly interpreted <30 as 30 or less and also failed to add 'when stopped smoking'.

4(a)(ii) Very few candidates were able to correctly calculate the increase in percentage of fat, most mistakes were due to incorrect reading of the scale.

4(a)(iii) Most candidates were able to state one correct conclusion relating to non-smokers still having a risk of developing cancer.

4(a)(iv) Once again many candidates were able to recognise that number of years smoking was important in coming to a conclusion.

4(b) Most candidates exhibited good knowledge of the effects of unhealthy lifestyle choices.

Question 5
5(a) Most candidates gained one mark for recognising the reasons why sunlight was regarded as a sustainable source of energy.

5(b) As in previous series candidates still have great difficulties with open/closed loop systems. Many candidates gained one mark for explaining one effect but failed to recognise that the system would become open loop once the changes had occurred.

5(c) This question reflected the range of abilities within the candidates, marks gained were split with similar numbers gaining zero, one or two marks. Many incorrect responses reflected some candidates' inability to correctly read the question. Many responses referred to animals being affected, when the question specifically required a response about the effect on groups of people.

Question 6
6(a) Well answered question, many candidates gaining both marks.

6(b) Many candidates showed that they had a good knowledge of thermoregulation and gained both marks.

6(c) This good knowledge continued here again with most candidates achieving both marks.

Question 7
7(a)(i) Very few candidates were aware that enzymes were found in biological washing powders.

7(a)(ii) This question probably gained the least correct responses on the whole paper. Many incorrect answers referring to either the cheese not having meat in it or was not made from cow's milk. Only a minority knew that the enzyme (chymosin) was made from genetically modified yeast.

7(b) The final extended answer question produced a range of responses reflecting the ability of the candidates. Most were able to recognise the ability of bacteria to replicate very quickly but failed to consider the ideas behind genetic modification to produce a range of products.

A163/02 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, indeed some questions were answered exceptionally well.

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. Question 2 was answered exceptionally well by the vast majority of candidates and it was clear that they had learnt this section of the specification very well. Answers were a credit to centres.

The trend for candidates to write outside the allocated area was reduced this year by the introduction of an extra answer sheet at the end of the paper. However many candidates failed to clearly identify which question they were answering. Indeed, it was not uncommon for these additional answers to be incorrectly identified with candidates writing down the incorrect question number. Candidates should be advised that this jeopardises their chances of being correctly awarded the marks that they deserve.

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 1
1(a) This was answered well by most candidates. Examiners were looking for two lifestyle and two medical answers. Good answers included reference to alcohol or tobacco consumption and exercise for part (a)(i) and family history, medication or health problems for part (a)(ii).

1(b)(i) This was also answered well, with most candidates correctly performing both calculations to score the mark.

1(b)(ii) Many candidates failed to read and act upon the question. The most common error was for candidates to fail to explain each conclusion. Thus “more blood flow to the muscles” did not gain marks but “more blood flow to the muscles to provide oxygen” did gain marks. It is vital that candidates read questions carefully and act upon the instructions provided.

1(b)(iii) This was only answered well by the most able candidates who realised that all of the 5 litres per minute of blood must go to the lungs.

1(c) This was well answered with most candidates scoring both of the marks available.

Question 2
This question was a level of response question and overlapped with the foundation tier.

This question was answered exceptionally well by almost all candidates. Credit was given for candidates calculating the BMI, referring to data in the table, then drawing appropriate conclusions and finally indicating what action “Neil” should take. Most answers were a pleasure to mark with the majority of candidates scoring full marks. The only criticism was that some candidates did the BMI calculation in the white space next to the table, but did not refer to the calculation when they wrote their answer. Examiners were instructed to look at the white space before awarding the mark to ensure that candidates were given the mark that they deserved.

Question 3
This question discriminated well between candidates.

3(a)(i) Most candidates gave the correct answer of 4.5 cm. The most common incorrect response was 6.5 cm.

3(a)(ii) Examiners credited answers from three areas. For example, good responses included reference to the risks involved in the operation, the fact that patients in Group 1 were not operated upon, and finally that some patients simply decided not to have the operation.

3(b) This was well answered with the most common response being that the benefits outweighed the risks.

3(c) Many candidates struggled with this. Good answers included responses such as perceived risk is what the patients think the risk is and calculated risk includes data/statistics/numbers. Candidates should avoid tautology such as saying perceived risk is what the patient perceives and calculated risk is what the patient calculates.

Question 4
This question was overlap with the foundation tier.

This question also discriminated well between candidates.

4(a)(i) Most candidates scored both marks for saying "less than 30" and "when they give up smoking". However several candidates only gave one of the responses thus scoring only one of the marks. Only a few candidates stated that "<" meant more than.

4(a)(ii) Many candidates struggled with the percentage calculation. Credit was given for the correct answer without the calculations but candidates should be warned that this is a risky strategy. Some candidates were awarded one mark for correctly showing the calculation even though they completed the calculation incorrectly. Candidates would be well advised to show their calculations.

4(a)(iii) This was a good discriminator. Good answers included "the older you are when you stop, the higher the risk" or "even if you have never smoked there is a small risk". The most common error was to refer to the time that a person had been smoking. This was not credited as it was impossible from the data to determine the length of time that people had smoked. Indeed that was covered in the next question.

4 (a)(iv) This required candidates to demonstrate that they realised that this would allow the determination of time that people had smoked.

Very few went on to score the second mark by referring to the length of time spent smoking affected the risk of developing cancer.

4(b) This was another example of where some candidates did not read the question carefully. Simply identifying lifestyle choices did not gain marks unless the choice was explained. Thus "a sugary diet" did not score but "a diet rich in sugar could lead to type 2 diabetes" did score.

Question 5
This was the second level of response question.

Good answers included points from three different areas. Examiners were looking to credit answers that referred to the ecosystem and biodiversity, answers that referred to the world community such as climate change and production of oxygen, and answers that referred to the local community such as erosion and local jobs. Most candidates scored at least four marks on this question.

Question 6
This question was answered well by the majority of candidates.

6(a) This was very well answered with good responses including the idea of environmental impact, raw materials used, production or transport and finally disposal. Candidates should be applauded with how well they answered this question.

6(b) Most candidates scored at least one of the two marks. A common incorrect response was "How much will it cost to manufacture the plastic …"

6(c) This was answered well with credit being given for the increased cost to the shopper but the reduction of litter or the reuse of plastic bags. Credit was not given for ideas about fewer bags are used or more are recycled.

Question 7
7(a) Most candidates scored one or two marks in part (a) and some managed to score all three. Crossing out was common and this made the marking of some candidate's responses more difficult. Candidates should be encouraged to carefully decide their answers before putting the ticks into the boxes.

7(b) A wide range of responses were accepted for answers to part (b). Good responses included oxygen, the removal of carbon dioxide, food, tourism or medicines. Answers that included "clean air" or reference to agriculture were not credited.

7(c) Most candidates scored both marks in part (c), with the most common answers including reference to dead or decaying matter, animal waste or oxygen/carbon dioxide.

Question 8
8(a) This was the third of the six mark level of response questions and was targeted at A* candidates. Most candidates scored four of the six marks for correctly referring to how the gene is obtained and how it is inserted into the bacterium. Good answers referred to the gene being from a human, cutting the gene out with enzymes and using a vector for insertion into a bacterium. Many went on to write about replication of the bacteria to produce insulin. Only the most able candidates went on to score six marks by referring to the use of a gene probe to identify which bacteria had been modified.

8(b) This was an easy end to the paper with almost all candidates identifying "may cause disease" as the correct answer.

A164 Biology A Controlled Assessment

Overview

This was the fourth session for the assessment of the Twenty First Century Science suites Investigation controlled assessment. It was a real pleasure to see how most centres had responded to advice and guidance from previous years. There were fewer centres requiring adjustment than last year and in general these changes were smaller. The most common cause of significant changes to centres marks still relates to the hierarchical nature of the marking criteria, details of which are addressed below.

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

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

Administration

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

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

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

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

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

Annotation

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

Hierarchy

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

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

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

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

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

Interpretation of assessment criteria

Sa – formulating a hypothesis or prediction

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

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

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

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

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

Sb - Design of techniques and choice of equipment

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

Good scientific justifications of the method, equipment and techniques selected must be provided for candidates to be awarded marks in the 7-8 mark level. Some candidates carried out preliminary work prior to the experiment proper. Although not a requirement, if it is practicable to do so in the allotted time, this can help 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 '*correct 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 at the highest mark levels, range bars must be drawn accurately (in addition to there being minimal errors in the plotting of data). The scales chosen by candidates often made difficult accurate plotting of data, as did crosses drawn with unsharpened pencils, particularly where millimetre graph paper was used. Although it is not essential that graph scales should start at (0,0), where axes begin with a ‘zig-zag’ section it is important that candidates do not extend their line of best fit into this ‘undefined’ area. This bad practice was seen on a number of occasions.

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

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

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

Ea - Evaluation of apparatus and procedures

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

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

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

Eb - Evaluation of primary data

A major stumbling point here was the requirement for outliers to be considered at level 3-4 marks. A significant number of centres ignored this requirement. In addition there appeared to be some confusion over what an outlier is, both amongst candidates and teachers. The criteria state *'individual results which are beyond the range of experimental error (are outliers)'*. Not all anomalous results are outliers, in particular averages are not outliers and a set of data points for a single value cannot all be outliers.

In the new (2011/2012) specifications for Twenty First Century Science, statement 1.6 in the 'Ideas about Science' has clarified the definition and treatment of outliers (compared with the version in the legacy (2006) specifications) to state, *"If a measurement lies well outside the range within which the others in a set of repeats lie, or is off a graph line on which the others lie, this is a sign that it may be incorrect. If possible, it should be checked. If not, it should be used unless there is a specific reason to doubt its accuracy."*

Potential outliers in data collected during a controlled assessment should be handled in accordance with this statement. Candidates are permitted to draw a graph of their results during the (limited control) data collection stage of the controlled assessment task. This may help them to identify potential outliers. Ideally, any data points that look to be potential outliers should be re-measured, and this is easiest to achieve if they are identified during the data collection session i.e. strand **C**.

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

Ra - Collection and use of secondary data

This strand was poorly addressed by many candidates.

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

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

Secondary data can be of different types:

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

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

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

Rb - Reviewing confidence in the hypothesis

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

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

When giving an account of extra data to be collected this must go beyond 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
- 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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