OCR
Oxford Cambridge and RSA

GCSE

Biology A

Twenty First Century Science Suite

General Certificate of Secondary Education **J243**

OCR Report to Centres June 2015

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

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

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

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Biology A (Twenty First Century Science) (J243)

OCR REPORT TO CENTRES

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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, however Centres need to ensure that candidates know that unless they address all sections in detail they will not achieve a Level 3 mark on these questions.

On the whole candidates limited their responses to the available spaces and were therefore more precise in their answers, which was pleasing to see.

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

In general, candidates showed a good understanding of genetic inheritance. Candidates were not so confident in answering questions on the potential uses of stem cells and natural selection.

Comments on Individual Questions:

Question 1

1(a) This question tested candidates' ability to link the pair of alleles with the characteristic that would result from the combination. The majority of candidates correctly identified that two recessive alleles would result in the recessive characteristic and two dominant alleles would result in the dominant characteristic. However, relatively few candidates indicated that one dominant allele and one recessive allele would result in the dominant characteristic.

1(b) In this question candidates were asked to complete the table by ticking the correct symptoms for cystic fibrosis and Huntington's disease. This question was generally answered well. Many candidates correctly identified the symptoms for both cystic fibrosis and Huntington's disease and gained both marks. Some candidates did confuse the two genetic disorders and chose the correct pair of characteristics, but assigned them to the incorrect genetic disorder.

1(c)(i) This question asked candidates to consider whether any mistakes had been made when the Punnett square had been constructed. Many candidates chose to annotate the diagram, or redraw the Punnett square to indicate where they felt the mistakes had been made. This proved to be a very effective way of demonstrating their knowledge. Candidates did find it difficult to express the mistakes in a written form and often this is where marks were lost. An example which exemplifies this is when referring to the incorrect entry to box one of the Punnett square. Many candidates simply stated that 'the ff was wrong' and that 'it should be Ff', however, they did not specify which 'ff' they were referring to and therefore were unable to be awarded this mark. Over half of the candidates scored both marks for this question, with a further third scoring one mark.

1(c)(ii) Candidates were expected to use the correct version of the Punnett square in (c)(i) to predict the probability of Harold and Hilda's baby child having cystic fibrosis. Over half of the candidates were awarded this mark. Many successfully created a correct Punnett square to assist with their calculations. Candidates expressed this probability in a number of correct forms. Those who found this question a little more difficult often used the term 'likely' rather than a numerical answer to describe the probability of the baby having cystic fibrosis.

Question 2
This was the first of the six-mark extended-writing questions, and many candidates found this level of response question difficult. Candidates were required to give an explanation as to the reasons why a baby born to the same parents would be different to their sister, Poppy, and the child's parents. Many candidates failed to fully address the question and, whilst many candidates correctly identified the reason for these differences would be as a result of different genes, they often found it difficult to express and failed to attach this reason to Poppy or to the parents. This limited the candidates to a Level 1 answer.

Candidates were able to give other basic reasons as to why there were differences. These included reference to the role played by the environment and identifying that the baby could have been a different sex to Poppy. Some candidates referred to identical twins, highlighting that this would be the only occasion when the children would be identical. More able candidates introduced the idea of different allele combinations and random gamete fertilisation.

Occasionally candidates did not read the information correctly and talked about the new baby having a different mum or dad.

Question 3
3(a-d) This question presented candidates with statements about the possible future use of stem cells to treat intestinal problems in premature babies. Candidates as a whole found this question difficult. Parts a-c proved most difficult; candidates performed slightly better on part (d) with over half of candidates identifying the correct statement.

4(a)(i) In this question candidates were asked to describe the evidence from the diagram that a blood vessel was an artery. Many candidates performed well on this question, with over half gaining one or both marks. Candidates that did not score well lost marks due to the statements not being comparative. Some merely stated that Fred was correct as 'arteries have a thick outer wall' for example. Some candidates scored 0 for this question as they incorrectly claimed that Fred was incorrect and that Vessel A was a vein.

4(a)(ii) Candidates found this question very difficult. A small percentage of candidates identified valves as the feature. A common incorrect answer was blood.

4(b)(i) This question asked candidates to place the stages of a heart attack into the correct order. The vast majority of candidates gained at least one mark for this question. Most candidates were able to identify B, 'fatty deposits building up in the blood vessels supplying the heart', as the initial stage. Of those who did not correctly identify the first stage many did then proceed to place DAC in the correct order.

4(b)(ii) The second of the six-mark extended-writing questions was answered well by the majority of candidates with around three quarters of candidates being awarded a Level 3 mark. Candidates demonstrated a good knowledge of the risk factors for heart disease. The most commonly identified descriptions were lack of exercise, eating too many fatty foods and a diet high in salt. Candidates often referred to 'drinking', but failed to mention alcohol so did not gain credit; equally many referred to bad food or unhealthy food, but were not explicit with what they meant by bad. Some candidates were unable to move into Level 3 as they simply listed the factors rather than describing them. On occasion candidates did not answer the question in terms of lifestyle, but instead used the information from (b)(i) and referred to fats clogging up vessels.

4(c)(i) Candidates were asked to apply their knowledge of genetic testing to identify three benefits of genetically testing people before prescribing drugs. This question was answered well with most candidates gaining at least one mark and over half of all candidates correctly identifying all three benefits.

4(c)(ii) This question asked candidates to consider the ethical reasons why people might object to compulsory testing. Again this question was answered well with very few candidates failing to gain any marks on this question. Candidates scoring one mark on this question often did so for the response 'everyone should have the right to choose whether they are tested or not'.

Question 5

5(a) In this question candidates were provided with some data which showed the number of measles cases reported in South Wales over a period of nine months. Candidates were asked to describe the pattern shown by the data and use figures in their description. Approximately a third of candidates scored full marks for this question. Many candidates gave good descriptions of the data, identifying points of increase and decrease. Unfortunately some candidates did not back this up with figures and often when figures were included they were not attached to the correct month, therefore these candidates failed to gain full marks. On occasion candidates referred to seasons rather than the months as stated in the data.

Some candidates did struggle to comprehend the command word – describe and tried to explain the data giving reasons such as the warm weather contributing to spread or lack of vaccinations.

Some candidates found it difficult to write a description from the chart. Some went into minute detail describing every month whilst others glossed over the data set. Candidates should be encouraged to practise this skill in preparation for examinations.

5(b) This question presented candidates with some of the reasons why parents do not have their babies vaccinated.

5(b)(i) Candidates were asked to select which of the reasons showed the parent had properly considered their social responsibility. Around half of the candidates correctly identified the correct reason.

5(b)(ii) Candidates were asked to give a reason why the MMR vaccination should be made compulsory. Candidates found this difficult with only a third of candidates selecting the correct response.

5(b)(iii) Candidates were asked to select two people who had not properly considered the scientific evidence. This section was answered very well.

5(b)(iv) In this question candidates were asked to consider the risks and benefits associated with the MMR vaccination. Some candidates did not seem to understand the ideas behind vaccinations very well with over a third failing to score any marks on this question. Common errors which resulted in the loss of marks included referring to MMR as if it were one disease, the use of vague statements such as stating a risk as 'making them ill' or 'poorly' or as a benefit the idea of preventing 'diseases'. Candidates rarely used the term immunity.

Question 6

6(a)(i) This question asked candidates to correctly identify an outlier from the data set provided. Unfortunately around a quarter of candidates failed to gain this mark, which in part could be due to a nil response. It would be worth centres reminding candidates to look out for the marks awarded on the right hand side of the paper to ensure they do not miss out a question. That said, some candidates did seem to struggle with this question and could not correctly identify the outlier.

6(a)(ii) This question on the whole was not answered well with just over half of the candidates failing to gain any marks. Candidates did not seem well versed in how to calculate a mean. Many calculated the mode or median and many others included the outlier in the calculation showing that they had not read the question. Those that did perform the correct calculation often failed to round the number to the nearest whole number. The answer 10.25 was observed in a high proportion of the responses. On occasion this was rounded incorrectly to 11.

6(b) In this question candidates were asked to use the data to identify two statements that when taken together, could explain the data. A high proportion of candidates struggled to identify the correct conclusions with many candidates gaining no marks. Those candidates scoring one mark on this question for the correct identification of 'the water at site B is most polluted'.

6(c) This was the final of the six-mark extended-writing questions; it was the common question with the higher paper and discriminated well. In this question candidates were asked to explain the processes involved in three stages of the nitrogen cycle. A range of marks were awarded with those at Level 2 generally gaining credit for the correct identification of animals eating the plants, part B on the diagram, and the animals then dying and returning the nitrates to the soil , part C on the diagram.

Knowledge of process C was by far the best. Candidates frequently made reference to death, decomposition and faeces as methods of returning nitrates to the soil. The role of decomposers, however, was less frequently seen.

Knowledge of process A was more limited. Candidates were often vague in their descriptions and referred to the movement of nitrates into the plant as 'going in' they did not seem to understand that this was an active process. Very few candidates referred to the plants absorbing the nitrates through their roots.

Knowledge of process B rarely included more than a reference to plants being eaten. Very few candidates indicated that digestion was involved.

On occasion candidates did make reference to the nitrates being used to make proteins, but this was not seen often.

Few candidates scored 6 marks on this question.

Question 7

7(a) Just over two thirds of candidates correctly identified mutations as the correct name for a random change in a gene.

7(b)(i) In this question candidates were asked to use the information provided to complete the axis label on the graph and draw a line to show the relationship described. This question discriminated well; a full range of marks was observed. Candidates approached the graph in a variety of ways. The axis label sometimes had superfluous information in addition to the desired answer 'genetic changes'. Candidates should endeavour to be more concise in their axis labelling. Falling numbers of butterflies with mutations, as distance from the power station increase seemed difficult to translate into a downward sloping line. Those candidates gaining one mark predominately did so for the correct labelling of the axis.

7(b)(ii) This question asked candidates to consider why scientists could not be sure that the genetic changes were a result of the radiation. Candidates found this question difficult with many failing to attempt the question. Incorrect answers included suggestions about evolution or that the butterflies had come from elsewhere, rather than identifying that there were other factors that could be responsible for the mutations. Those candidates that did recognise that evidence was key to identifying radiation as a cause often failed to gain a mark as they stated that there was no evidence rather than a lack of evidence. Many candidates had misunderstood the correlation aspect of this question.

7(b)(iii) Again candidates found this question challenging. Candidates were unable to demonstrate an understanding of natural selection. Those that did gain marks for this question often gave an example of natural selection and seemed to find it easier to describe the process within a context that they had learned about. Some candidates incorrectly discussed selective breeding.

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 genetic testing, describing the formation of twins, how heart attacks are caused, the vaccination process and the stages in the nitrogen cycle. In terms of mathematical skills, candidates were able to manipulate formula successfully to calculate the cross-sectional area of a blood vessel. As well as being able to correctly predict the relationship between numbers of genetic mutations in a species to the distance away from a nuclear power station.

Candidates did not seem to have the knowledge or skills required to respond to questions about perception of risk, the relationship between genes, protein production and enzymes. Other areas of the specification that candidates did not perform well on include analysing data and drawing conclusions from it, explaining how an outlier result can impact upon results, defining the term sustainability and calculating a percentage increase.

Comments on Individual Questions:

Question 1
1(a)(i) Many candidates were able to provide the two correct genotypes. The distinction between the capital letter and the small letter had to be unambiguous to gain the mark.

1(a)(ii) The majority of candidates were able to identify the correct response.

1(b) Good responses demonstrated clear understanding of how cystic fibrosis is inherited and were able to prove why the statement was incorrect.

1(c) Candidates demonstrated secure knowledge in relation to concerns about genetic testing.

Question 2
Many excellent responses contained detailed descriptions on the origins of the identical twins A and B and the non-identical twin C. Others needed to discuss the differences between C and the identical twins in terms of alleles to gain the higher marks.

Question 3
3(a)(i) This was a well answered question. Where candidates did not get the marks, they had not given the answer to the required number of decimal places.

3(a)(ii) This was a challenging question. Candidates had to describe the relationship between the wall thickness of the blood vessel and pressure in the correct context to gain the marks.

3(b) Candidates who were able to produce a logical account of how the physical processes leading up to a heart attack, as well as discussing the risk factors, achieved the highest marks.

3(c)(i) The majority of candidates were able to identify the three correct responses in relation to the benefits of genetic testing.

3(c)(ii) Most candidates could identify the two best ethical reasons against genetic testing.

Q3(d) This question was difficult as it relied on candidates' knowledge of how genes code for proteins and then putting this into the context of how enzymes work on drugs in the body.

Question 4
4(a)(i) The correct response was 700%.

4(a)(ii) A good discriminator. Only some candidates were able to give three reasons why the data was of concern to doctors.

4(b) Most candidates could successfully link the shape of the graph to the two correct explanations.

4(c) This question tested the full range of abilities. Many candidates could explain how actual risk is different from perceived risk. Some candidates struggled with this idea in the context of the question.

Question 5
5(a) Candidates needed to identify the outlier and show how its omission or inclusion could lead to two different results in order to gain marks for this question.

5(b) This was a challenging question with the majority of candidates providing just observations and not conclusions about the data.

5(c) It was encouraging to see very detailed descriptions of the stages in the nitrogen cycle in the majority of student responses.

Question 6
6(a)(i) Most candidates could label the axis correctly and draw a line to describe the relationship between number of mutations and distance from the nuclear power station.

6(a)(ii) The majority of the candidates found it challenging to identify the causal mechanism and give an example of further evidence required.

6(b) The best responses recognised the Matt's idea was linked to mutated genes being passed on. Few candidates linked Claire's answer to background radiation.

Question 7
7(a) The best responses could define sustainability clearly and succinctly.

7(b) Most candidates could give the three best factors which need consideration when producing shopping bags sustainably.

7(c) Many Candidates were not secure in selecting the best explanation for why we should reduce the use of biodegradable bags.

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

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

Comments on Individual Questions:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Question 8

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

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

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

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

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

General Comments:

Candidates were well prepared for this paper and made a good attempt at answering all of the questions. There were very few blank questions. The paper discriminated well between candidates. There was no evidence that any of the candidates ran out of time.

There was a good spread of marks, candidates scores ranged from 0 to 59 out of a maximum of 60 marks.

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

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

Comments on Individual Questions:

Question 1
1(a)(i) Candidates were asked to name two substances that algae convert glucose into. Many candidates seemed confused as to what the question was asking and the most common candidate response was to give at least one of products of respiration i.e. carbon dioxide and water.

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

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

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

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

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

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

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

Question 2

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

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

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

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

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

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

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

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

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

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

Question 3

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

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

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

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

Question 4

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

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

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

Question 5

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

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

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

Question 6

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

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

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

Question 7

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

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

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

A163/01 Module B7 (Foundation Tier)

General Comments:

There was a good spread of marks, candidates scores ranged from 0 to 54 out of a maximum of 60 marks with a score of approximately 25 marks.

Many candidates appeared to have been well prepared for the examination, attempting the majority of questions. However, a number of candidates did not attempt Q5, one of the six-mark, extended-writing 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 with extended writing.

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

Candidates appeared to be better prepared for questions involving calculations. It was encouraging to observe that there were fewer scripts where candidates indicated that they did not have a calculator available.

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) Candidates were able to identify a number of questions that should be asked by fitness trainers prior to starting an exercise programme but found difficulties explaining their importance. This limited the majority of candidates to level one and two answers.

1(b)(i) This part was poorly answered with nearly half the candidates unable to interpret the data on the graph.

1(b)(ii) The second part of the graph data interpretation question was better answered, error carried forward enabled many of the candidates to access this mark.

1(b)(iii) There was some confusion amongst candidates in this part of the question with many wrongly thinking that an improved fitness level would produce a higher heart rate.

Question 2
2(a) Most candidates were aware of the function of white blood cells, however, this was not the case with platelets and plasma.

2(b) The simple cell structure of the nucleus was not recognised by many candidates, however the biconcave nature of red blood cells was better known, however over half the candidates failed to gain any marks in this part.

2(c)(i) The major blood vessels leading to and from the heart were not known, approximately 65% of candidates failing to recognise any of aorta, vena cava, pulmonary artery or vein.

2(c)(ii) The function of valves was better understood, over half the candidates scoring here.

2(c)(iii) Most candidates struggled to explain what was meant by a double circulation.

2(c)(iv) Even more able candidates could not explain the differences in the diagrams between a human and frog heart.

2(c)(v) Data interpretation is an area which many candidates at this level find difficult. This was very apparent here.

2(c)(vi) This part was better accessed by the candidates, the majority were awarded both marks.

Question 3
This extended writing question was well answered by many candidates with approximately 70% being awarded a level 2 or 3 mark.

Question 4
4(a) Many candidates found it difficult to make suitable suggestions for the very large differences in the number of eggs produced by humans and fish, however, more were far more successful in suggesting a suitable answer in parts **(b)** & **(c).**

Question 5
5(a) As in previous years closed loop systems appeared to cause problems for the majority of candidates at this level. Only 25% of candidates achieved more than a level 1 mark.

5(b) This problem was continued in this part and is clearly an area of the specification that is poorly understood by the majority of the candidates.

Question 6
This whole question was better answered; candidates were clearly more knowledgeable concerning the areas of biodiversity and sustainability.

Question 7
The calculation caused problems for many candidates, however, the parts concerning genetic modification were much answered more successfully.

Question 8
8(a) Surprisingly the question on ordering the sizes of various structures was poorly answered, many candidates were under the impression that the cell was the smallest structure.

8(b) & **(c)** These objective 'tick box' question parts were well answered.

A163/02 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. 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. In the past, candidates have tended to 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. Now, the trend is to write on additional answer booklets. This practice should be discouraged. All too often this results in rambling responses that drift away from the original question. Candidates need to be taught and encouraged to write concisely and only use the space provided for their answer.

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 the first of three, six mark questions and was intended to assess candidates at levels grade D to grade A.

The first part of the question required candidates to complete and label a diagram showing an artificial replacement to a knee joint. Most candidates completed this task successfully, but common errors included incorrect labels or not completing the drawing. Unless it was clear where the labels were pointing, they did not score.

The second part of the question required candidates to both describe the properties of various parts of the joint and then provide an explanation of these properties. An example of a good answer included “tendons are non-stretchy and connect muscles to bones so that the muscle can move the joint.”

In order to score six marks, candidates were required to adequately answer both parts of the question.

1(b) Good answers to this question included reference to dislocation or torn ligaments or tendons. Answers that referred to sprains, strains or fractures, did not score.

1(c) Most candidates managed to score both marks on this question by quoting either rest, ice, compress or elevate. Candidates that only quoted two or three of these methods scored just one mark. Simply stating ‘RICE’ did not score.

1(d) This question was answered well by most candidates. Examiners were looking for an understanding that the role of the physiotherapist was to rehabilitate and return the injury to normal. However, answers that referred to exercise or strengthen the joint were also credited.

Question 2

2(a) Although this question was answered well by most candidates, a significant number failed to score all three marks. Credit was not given for simply naming the parts. Good answers stated that white blood cells fought infection, platelets clot blood and plasma transported nutrients around the body. Answers that referred to red blood cells did not score.

2(b) This question was surprisingly well answered and most candidates were not put off by the context. Many candidates scored both marks for realising that a lack of a nucleus provided extra space for haemoglobin and the shape gave a large surface area for the absorption of oxygen.

2(c)(i) Many candidates provided three correct labels and thus scored the full three marks. The most common error was the label the chambers of the heart, rather than the blood vessels. Surprisingly several candidates thought there was a left and right aorta. These responses did not score.

2(c)(ii) This proved to be more challenging than the normal "what is the job of a valve" type of question. The context of being a valve inside of the heart prevented many candidates from simply stating that it prevented the backflow of blood and thus scoring the mark. Good candidates also included atria and ventricles in their answer.

2(c)(iii) This question was not answered well. Most candidates had a vague idea of what was meant by a double circulation but were unable to put their idea into words. Good answers made it clear that blood was pumped to the lungs and the body on each circuit and that it went through the heart twice on each circuit. Answers such as 'the heart pumps oxygenated blood and deoxygenated blood' did not score.

2(c)(iv) Most candidates managed to score one mark for this question, but very few managed to score both marks. The first mark was awarded for a correct observation, such as the frog's heart only has three chambers. The second mark was for realising that this would make the transport of oxygen less efficient, or that oxygenated and deoxygenated blood would mix.

2(c)(v) Once again, most candidates only scored one of the two marks available. The first mark was for realising that mechanical valves had a better survival rate. Credit was not given for stating that the older the valve, the lower the number of survivors as this would happen anyway because as time passes people die and not necessarily from a faulty heart valve. Very few candidates realised that data did not exist after 15 years and assumed that there were no survivors at 20 years.

2(c)(vi) Good responses to this question included how many patients were involved with each study, or an example of how patients in each group were matched. These examples included age, medical history, lifestyle questions and BMI.

Question 3

This was the second six mark question and was targeted up to grade A. Although the context was unusual, examiners were looking for an understanding of how temperature control worked. Weaker answers referred to cooling down in icy water and warming up by lying in the sunshine. More able candidates referred to the hypothalamus action as a control centre to regulate vasoconstriction and vasodilation and giving an account of how these two processes work. Credit was also given for heat loss by evaporation of water from wet skin.

Question 4

4(a) Better responses to this question referred specifically to the diagram and gave arguments both for and against it being a closed loop system. Good answers referred to carbon being recycled by being released from the burning fossil fuels and then reabsorbed by plants through photosynthesis. Arguments against it being a closed loop system included fossil fuels taking a very long time to be produced and subsequently burnt and that carbon dioxide was being released faster than plants could reabsorb it.

4(b) Simply stating that outputs or losses equalled inputs or gains, was sufficient to score this mark.

Question 5
5(a) This was the third of the six mark questions and was targeted up to grade A*.

Good answers included a very good account of eutrophication and then went on to relate this information to the data in the table and finally concluding that pond A was eutrophic. The most common error was to fail to use the data in the table and just give an account of eutrophication. Less able candidates often thought that fertiliser was toxic that lead to the direct death of all pond life. These candidates often failed to score on this question.

5(b)(i) Candidates needed to convey the idea of harm to humans who ate the contaminated crops. However, correct references to harm to the environment or bioaccumulation was also credit. References to eutrophication did not score.

5(b)(ii) This question was only answered well by the most able candidates. Candidates who stated how serious the risk was, and the chances of it happening, scored both marks.

5(b)(iii) In order to score both marks for this question required candidates to give an advantage of using the pesticide, such as improved crop yield, and also state that the risk was quite small. Answers that referred to having confidence in scientists or farmers scored one mark, Answers that stated the benefits outweighed the risks, scored both marks.

5(c)(i) Candidates scored surprisingly well on this question. A wide variety of responses were accepted by examiners, to include 3 in 1000, 3/1000, 0.003 or 0.3%. Evidence of correct working or 1 in 1000 scored one mark and the correct answer always scored both marks. Candidates should always be encouraged to show their working as this can often salvage a mark even when the incorrect answer has been given.

5(c)(ii) This question was not well answered. What should have been two straightforward marks were often not awarded because the candidate had failed to read the question carefully. Candidates were explicitly told to use their answer from part (5ci) in their answer. Candidates failed to do this and gave a generic answer about perceived and calculated risk that did not score. Good answers used the data calculated in the previous question and this was credited as an error carried forward even when they gave an incorrect response to the previous question. This was a similar error seen in the eutrophication question when candidates failed to refer to the data in the table. Good answers stated that a perceived risk of 50% increased seemed high but the actual risk of 0.3% was in fact very low.

Question 6
6(a)(i) Most candidates performed well on this question, stating that stem cells were unspecialised but could become specialise to develop into any type of cell.

6(a)(ii) This question proved to be more difficult with most scoring only one or two of the three marks available. Many stated that stem cells could be made to specialise into nerve cells. Fewer went on to state that these nerve cells could then produce dopamine. The most common error was in thinking that specialised nerve cells could be transplanted into the brain with very few candidates understanding that the stem cells had to be placed into the brain before they began to specialise.

6(b) Most candidates scored one mark for this question with the most common correct answer being that the battery would run out or need to be replaced. Other good answers included the idea of rejection or that the pacemaker would not change the heart beat rate to match the demands made by the body. Although credit was not given for the idea of pacemaker failure, credit was given for the idea of electromagnetic interference disrupting the pacemaker.

A164 21C Investigation Controlled Assessment

General Comments:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

C – Range and quality of primary data

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

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

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

A – Revealing patterns in data

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

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

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

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

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

Ea – Evaluation of apparatus and procedures

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

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

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

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

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

Ra – Collection and use of secondary data
This strand was poorly addressed by many candidates.

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

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

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

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

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

Rb – Reviewing confidence in the hypothesis

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

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

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

Sources of Support

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

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

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

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