GCSE

Biology A

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OCR RECOGNISING ACHIEVEMENT

Biology A

Twenty First Century Science Suite

General Certificate of Secondary Education **J633**

Report on the Units

June 2010

J633/R/10

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GCSE Twenty First Century Science - Biology A (J633)

REPORT ON THE UNITS

Chief Examiner's Report

Overall, the candidates taking the Biology papers in this session performed extremely well. The papers were constructed to allow candidates to feel that they had every opportunity to demonstrate their knowledge and understanding while at the same time discriminating between candidates of differing abilities. It was intended that candidates should feel that they had a positive experience in taking the examinations.

Most centres entered their candidates for the correct tier of examination. Weaker candidates that are entered for higher tier papers do not have a pleasant experience and find many of the questions impenetrable. Schools are well advised to enter weaker candidates for the foundation tier where they are more able to demonstrate their knowledge and understanding.

Most candidates found the papers accessible and demonstrated sound knowledge and understanding of the course content. Candidates had generally been well prepared by their centres and, due to the fact that questions towards the end of the papers were answered equally as well as questions at the beginning of the paper, there was no evidence that candidates ran out of time. Nor was there any evidence that any group had been disadvantaged by the language or by any cultural issues.

As always, there are lessons to be learned and specific points relating to each paper are picked up in the individual reports from each Principal Examiner and the Principal Moderator Some issues, however, occurred across the suite of papers and these are detailed below.

Candidates are well advised to read questions carefully. Each year a number of candidates lose marks unnecessarily because, in their haste to complete the paper, they fail to read the question carefully. It cannot be stressed too strongly that reading and re-reading the question is time well spent. Candidates would also be advised to pay similar attention to their answers. Answers should always be re-read to ensure that they do indeed answer the question on the examination paper.

When answering questions that include numerical calculations, candidates are always asked to show their working. It is vital that they do this. Candidates are very good at answering calculation questions intuitively or performing simple metal arithmetic and then writing down the answer. Providing the answer is correct, this is not a problem as they will gain full marks. However it is a very risky strategy. A simple mistake in their mental calculations will lose them all of the marks. If they had written down their working, the chances are that they would have salvaged at least one of the marks available for the question.

Candidates, particularly at foundation tier, had a tendency to leave some questions that they had difficulty answering, blank. This was particularly noticeable in questions that required longer answers. This type of question was introduced in January and candidates are still coming to terms with writing more extended answers. Leaving questions blank will guarantee that they get no marks for the question. At least attempting the questions opens up the opportunity of them scoring some of the available marks. Candidates should be encouraged to at least make an attempt with every question.

Centres and candidates will now be aware that these papers are scanned and marked online. Candidates would be well advised to ensure that, as far as possible, they use the appropriate answer lines and spaces in which to write their responses. Some candidates crossed out initial incorrect responses, and then crammed the answer into a much smaller space. This is another good reason why candidates should think carefully before beginning to answer the question. Centres will be well aware that many of the questions in these papers are based on variations of 'Put ticks (✓) in the boxes next to the correct answers'. In order to ramp up the degree of difficulty of higher tier questions, candidates are not always told how many correct responses are required. Some candidates may well look to see how many marks the question is worth and

then assume that the number of marks available for the question must match the number of correct responses required. This is not necessarily the case. These questions require candidates to consider each choice independently so the number of marks available will be more closely related to the number of choices that candidates have to make, rather than the number of ticks required. For example, in such a question with five choices, candidates are having to evaluate five choices irrespective of the number of ticks expected. Therefore, candidates must be advised to answer each of these questions on their merit and place ticks next to those answers that they think are correct.

Centres should also realise that Module B7 is not just another module comparable with B1 to B6. It is, in fact, three times larger than the other units and centres are well advised to regard it notionally as B7, B8 and B9, rather than just B7. This does, of course, mean that it requires three times the amount of teaching time given to each of the other six units.

The Skills assessment component of each of the above specifications is weighted at 33% and it is still evident that some centres are not developing the underlying skills, knowledge and understanding of Ideas about Science in their candidates before an assessment takes place. Those Centres that responded to the early introductory letter to establish an email contact between the Centre and their moderator improved the efficiency and effectiveness of the moderation process and this was much appreciated by moderators. However, there are still too many Centres who do not send the paperwork and coursework samples promptly by the OCR deadline. The best Centres follow the advice on the checklist included with the introductory letter and provide all the relevant information, in particular, details of how each of the tasks used for assessment has been introduced and presented to candidates. Those Centres that do not provide this information may make it difficult for moderators to support the marks awarded by the Centre.

The following reports provide more detail on how candidates performed on specific papers and skills assessment, highlighting areas of concern as well as improvements from previous years. Please ensure that your staff are encouraged to read these reports. They are available on line at www.ocr.org.uk

A221/01 – Twenty First Century Science Biology A (B1, B2, B3) Foundation Tier

General comments

This foundation level paper did not appear to present significant access issues for the majority of candidates. Most were able to complete all items in the time allocated and most were capable of following the rubric of the paper without any difficulty. The overall marks ranged from 1 minimum to 39 maximum out of a total of 42 marks available. The achievement may have been affected by the format of the question-style. Candidates coped very well with the set of objective-style items, however, the free-response items presented a challenge for some. Candidates are currently much more familiar with the objective style.

With regards to the free-response items, many candidates struggled to express themselves clearly when completing the sentences/statements required, although the maximum marks assigned to such items was three. There was a tendency for candidates to use lengthy statements to describe a structure or process, possibly because they could not recall the correct biological term involved. Some candidates continue to present responses out of the dotted-lines. This does not correspond to the rubric of the paper and, on many occasions, did not necessarily achieve a higher mark.

Comments on individual questions

1(a)   The majority of candidates responded correctly to this item. They are confident about the location of genes in a cell.

1(b)   Candidates are also aware of the role of genes and were, overall, able to obtain a mark for this item.

1(c)   This item did not present a problem to most candidates, although the responses were not as unanimous as for the earlier items in question 1. No clear pattern emerged in relation to other options.

2(a)   Candidates showed a good understanding of chromosome number linked to sex cells in humans.

2(b)   Most responses indicated that cystic fibrosis is inherited by alleles from both parents. Some candidates incorrectly selected the other options but, again, no clear pattern was observed.

2(c)   The inheritance of two recessive alleles was equally understood by many. The correct responses to this item were likely to be related to the previous item.

3   Many candidates were able to express one clear statement made by Amrit and one from Raj but relatively few considered the privacy issue or the right to know the results.

4(a)   The function of white blood cells was understood in relation to engulfing and digesting but making antibodies was not appreciated by all candidates. Some candidates were quite challenged by this item.

4(b)   This item appeared to be accessible to many candidates but not all were fully aware of the need for both wet and warm conditions, in addition to food.

4(c)   This item was challenging for a number of candidates. Relatively few chose to identify the skin as the natural barrier but this was already provided in the stem of the question. Although some identified saliva, sweat and/or tears, they did not explain how they work. The acid in the stomach was a popular and correct response.

5(a)   The health education message regarding smoking cigarettes and taking exercise enabled many to give correct responses. However, not all recognised the reduction of stress levels as a positive factor.

5(b) Some candidates obtained full marks but not all. No clear pattern emerged in relation to the choice of the alternative words in each sentence.

5(c) There was a tendency for candidates to select D as a high risk. They did not appreciate that having six hours sleep most nights is a relatively low risk for developing heart disease. The other options were, generally, understood by a number of candidates.

6 This question proved to be difficult for many candidates. There was an apparent confusion with regards to the scientific principles held within the various quotes. Although some candidates obtained full marks for parts (a) to (c), they failed to identify Jane and Ranjit for part (d). Jane was often correctly chosen but without Ranjit. Peter was frequently selected as an alternative to Ranjit.

7 Although a number of candidates obtained full marks, many added extra lines, thereby preventing them from achieving the 2 marks for this question. Many candidates struggled with the selection of the correct links, as demonstrated by their crossing out of various lines initially selected. No clear pattern emerged in the context of other options chosen.

8 (a) Many candidates were able to respond correctly to the evidence of evolution. The options did not present a pattern for those who struggled with this item.

8(b) This item was straightforward for many candidates. Most are aware of natural selection and the ability of the early molecules to copy themselves.

8(c) The responses indicated that a number of candidates did not appreciate the link between climate change and evolution. Although some appreciated that survival was a key factor they did not understand that only some species would be affected. Many failed to understand that new adaptations become favourable.

9(a) The shading of the correct region of the evolutionary chart did not present a problem for some candidates but many shaded the entire row or selected incorrect areas of the chart. Few chose areas below 2 million years ago, but many chose the top row of less than 30,000 years ago.

9(b)(i) Many correctly chose the common ancestor option. No clear pattern was observed for other responses.

9(b)(ii) The concept of divergent evolution was not fully understood by many candidates. The terminology used may have been challenging. Some chose central evolution, perhaps based on the shape of the evolutionary chart.

9(b)(iii) Many correctly chose Homo sapiens, but many other options were also chosen by candidates. Again, no clear pattern emerged but a number selected the other species within the genus, Homo.

9(c) Having a bigger brain and being smarter, were often selected by candidates, thereby obtaining full marks. However, life style changes often confused the responses for some candidates.

9(d) This item was challenging for many. It appeared that the concept of scientists lacking evidence or having conflicting evidence was not understood. Some responses were unclear.

A221/02 – Twenty First Century Science Biology A (B1, B2, B3) Higher Tier

General Comments

This paper continued the changes introduced in January, such that marks were allocated to questions that required extended answers. This provided the paper with more stretch and challenge, enabling more able candidates to show the full extent of their capabilities.

Candidates performed well on this paper and were well prepared for the examination. There was no evidence that any of the candidates ran out of time.

Candidates should be aware that this is mainly a multiple choice style of question paper and that any questions that they cannot answer, they should at least try to eliminate incorrect responses and then take a guess at the correct answer.

The paper is now marked by electronic marking after first being scanned and then fed electronically to examiners. It is now more important than ever that candidates use legible writing and restrict their responses to the boxes, spaces and lines that have been provided rather than writing in margins and other areas that may not be visible to examiners in the electronic copy.

Candidates should also be aware that some multiple choice responses require more than one response and the number of responses required does not always match the number of marks available. The paper included several questions that required candidates to write down individual letters or a sequence of letters. All too often candidates changed their responses by scribbling their corrections over the top of their original response. This often resulted in lost marks as examiners were unable to determine which letter the candidate intended to use. Candidates should be instructed to completely cross out incorrect responses and write the new response after their initial crossed out response and not write over the top of it.

Comments about individual questions

1   Part (a) was an easy start to the paper and most candidates correctly identified the Y chromosome as the correct response. Any indication of a correct response was credited, such a ringing just the Y or the whole chromosome.
     Part (b) was not so well answered. Many candidates simply explained the implication of XX being female and XY being male. This did not score. Credit was given to correct reference to TDF, production of testosterone or an androgen hormone, or the development of testes.
     Part (c) was also well answered, but common errors included ringing either cystic fibrosis or Huntington's disorder. Presumably this was because candidates interpreted "several genes" as two alleles working together.

2   Most candidates scored the mark for part (a). However all too often candidates just referred to only one of the parents or "either or parent". Credit was only given when it was clear that both parents contributed.
     In part (bi) most candidates scored the mark. When errors where made it was usually because the answer "dominant" was incorrectly given.
     Once again, in part (bii), most candidates gave "A" as the correct answer. When errors were made they were randomly distributed across the remaining choices.

Most candidates scored the mark for part (biii), however some candidates failed to notice that three responses were asked for or gave "A" or "F" as an incorrect response for one of the three required answers.

Part (biv) was not well answered. Only the most able scored more than one mark on this question. Candidates should have realised that E must be a carrier and therefore a 50:50 chance existed for the faulty gene to be passed on. Credit was also given for realising that it was not possible to know the genotype of the mother and whether or not she could pass the faulty allele to the daughter.

3   In part (a) most candidates scored one of the two marks available. Credit was given for "he may not want to know" or that it might affect his employment prospects, result in more expensive life insurance or even provide false positive or false negative results.

Only the most able candidates scored two marks in part (b). Many obtained the easy mark for giving an implication for his staffing of having someone with a genetic disease, but few went on to extend this argument in how it would affect his cost or profits, such as paying for sick leave. Candidates who simply stated that Raj wanted to know, without giving an implication, did not score.

4   Part (a) produced a variety of responses. Many candidates incorrectly gave the nucleus from an egg cell as the answer. More able candidates correctly identified the nucleus from a body cell as the correct response.

Part (b) was intended to be a challenging question. It required three correct responses for two marks and only the most able candidates had the confidence to give three correct responses. Those candidates who were unsure gave two correct responses and scored one of the two marks.

The correct response for part (c) was "environmental factors only". However all too often weaker candidates gave either genetic, or a mixture of environmental and genetic as their incorrect response.

Part (d) was another question that did not specify the number of correct responses required. However this time, as there were only two correct responses, worth one mark each, most candidates were able to score both of the marks. A common incorrect response was that they are specialised cells that can develop into any type of cell.

5   Part (a) proved to be a very challenging question. Candidates first had to decide which responses to use and put them in the correct order. Many candidates failed to identify C as a correct response with the majority of candidates only scoring two of the three marks available. The correct response of DECA was only given by the most able candidates. Many candidates changed their original responses and attempted to write the correct response over the top of their original one. This was very foolish as all too often, examiners were left unable to decide which response was intended by the candidate. Incorrect responses should be completely crossed out and a correct response written next to the incorrect one; not over the top of it.

Most candidates scored the mark for part (b). The penultimate answer was the most common incorrect answer given.

6   In part (a) most candidates gave Peter as the correct response. The most common error was Ranjit.

In part (b) most candidates gave Ranjit as the correct response. The most common error was Peter.

Part (c) was very well answered with Stella as the correct response.

In part (d) most candidates gave Jane and Ranjit as the correct response. The most common error was Jane and Peter.

7   Very few candidates failed to score the mark in part (a) for giving Ben and Louise as their response. Both responses were required to score the mark.

Only the most able candidates scored all three marks in part (b). Most candidates gave the first correct response by saying the drug was a fake or not real and many then went on to score one of the other two marks for say that it was used as a control to test new drugs, and that patients whose lives were at stake should not be given a placebo if an effective treatment was available. Not many candidates however gave both of these correct responses.

8   Part (a) should have been an easy question. However many candidates failed to score the mark. All too often whole rectangles were shaded in, more than one area, or incorrect areas. It is clear that some candidates found it quite hard to interpret the data provided in this question.
Part (bi) was generally well answered with most candidates ticking the first box as the correct response.
Part (bii) was more challenging. Most candidates thought it was an example of central evolution, with fewer giving divergent evolution as the correct response.
Part (biii) was well done with most candidates correctly identifying Homo sapiens as the correct response. When errors did occur, the most common incorrect response was Australopithecus.
Many candidates scored both marks for part (c). Specific answers were required, such as the brain had got larger, and this gave a better chance of survival, by enabling the use of tools or speech. Credit was not given for vague answers such as live longer, learning or communication, as these are factors found in many other animals.
In part (d) many candidates made life difficult for themselves by specifically relating their answer to Darwin or natural selection. The question specifically asked about scientists. Good answers included not enough evidence or that the evidence may be conflicting.

9   It was thought that this would be a very challenging end to the paper, but candidates performed very well by most giving the two correct responses. This indicates that candidates are being taught the ideas about science and have a very good understanding of them. The most common incorrect response was that this proves the theory of evolution is correct.

A222/01 – Twenty First Century Science Biology A (B4, B5, B6) Foundation Tier

General comments

This summer's exam paper was in general answered well by most candidates. This indicates that they were well prepared for the examination. There was no evidence that any of the candidates ran out of time.

Candidates need to be aware that this paper mainly consists of multiple choice style questions or choosing the correct word or words from a given list. Candidates would be advised that for any questions they cannot answer or that they are unsure of they should at least try to eliminate incorrect responses and then choose the response that they consider to be the most likely correct response.

This paper is marked by electronic marking. It is important that candidates use legible writing and restrict their responses to the spaces provided. This is particularly important in the free response sections where their response needs to be confined to the spaces and lines that have been provided and not continued in margins and other areas which may not be visible to markers in the electronic copy.

Candidates would also be well advised to make sure that they know how many responses are required for each section and to respond with the correct number of answers.

Comments on specific questions

1 (a) This section of the question proved difficult for most candidates. Some candidates knew that enzymes were made of protein and were responsible for speeding up reactions.

 (b) A well answered section many knowing the lock and key model.

 (c) Many candidates knew that temperature was the correct response.

 (d) Many candidates knew that the rate of reaction would increase.

2 (a) Most candidates scored at least one mark on this question, the correct response for sugar being the most popular correct response.

 (b) This free response question enabled a significant proportion of the candidates to score at least one mark. Many candidates knew that alcohol reduced the water level of the body. Fewer knew that the concentration of the urine was more dilute.

3 (ai) This question was not well answered, many candidates referred to homeostasis as maintaining body temperature.

 (aii) Again this was not answered by the majority of the candidates and they had failed to realise that energy gain had to be the same as energy loss.

 (b) Most candidates scored at least 1 mark on this question.

 (c) This was answered correctly by half the candidates, breathing being the most popular incorrect distractor.

4   (a)   This section was well done with most candidates scoring both of the single marks.

     (b)   Again most candidates scored this mark.

5   (a)   Less than half the candidates knew that only some of the genes in a cell remain active.

     (b)   This question was not particularly well answered. Many of the candidates thought that fertilisers were needed to grow new roots.

     (c)   This section was answered correctly by over half of the candidates.

6   (a)   A well answered section, many candidates were able to match the description to the correct label.

     (b)   Most candidates scored at least one mark on this question. A significant proportion scoring more than one mark.

7   (a)   A well answered section, most candidates knew that the brain was responsible for memory.

     (b)   Another well answered section with candidates knowing that memory is the storage and retrieval of information.

     (c)   This section was answered correctly by over half the candidates, the most common distractor being short-term memory only.

     (d)   In this section two correct responses were needed for one mark. Many of the candidates knew that the brain was needed for learning and that as a consequence of this humans can adapt to new situations.

8   (a)   In this free response section many of the candidates knew that pulling the tentacles in was to protect itself. Most candidates who responded incorrectly thought that the anemone was a plant and was responding to a lack of light for photosynthesis.

     (b)   Many candidates were talking in terms of reflexes in babies in general rather than reflexes in newborn babies. As a consequence of this only half scored one or two marks. Candidates who did respond correctly mainly used the examples of grasping and sucking reflexes.

     (c)   Over half the candidates scored at least one mark on this section.

9   (a)   This section required two correct responses for one mark. Over half the candidates correctly identified both.

     (b)   This section required candidates to identify which of the 2 actions was involuntary and which was voluntary. Many candidates were able to write a general statement explaining the difference between the two.

     (ci)   This question was not generally well answered. The incorrect responses were divided between the other responses.

     (cii) This section was only answered correctly by a minority of candidates.

A222/02 – Twenty First Century Science Biology A (B4, B5, B6) Higher Tier

General comments

This higher level paper did not appear to present significant access issues for the majority of candidates. Most were able to complete all items in the time allocated and many were capable of following the rubric of the paper without any difficulty. The overall marks ranged from 7 minimum to 40 maximum out of a total of 42 marks available. The achievement varied according to the format of the question-style. Candidates coped very well with the set of objective items, obtaining from 8 to 29 out of the 29 marks allocated. However, the free-response items presented a challenge for some, with a range from 0 to 10 out of the 13 marks allocated. Candidates are much more familiar with the objective style questions.

With regards to the free-response items, many candidates struggled to express themselves clearly when completing the sentences/statements required. There was a tendency for candidates to use lengthy statements to describe a structure or process, possibly because they could not recall the correct biological term involved.

Comments on individual questions

1(a) (i) Many were fully capable of correctly describing homeostasis. Some candidates restricted their responses to temperature control. Many did not refer to 'constant' within their answers.

1(a) (ii) A number of candidates were not challenged by this item but some struggled and tended to revert to the temperature control scenario without describing a balance.

1(b)   This was fine for most candidates. No clear pattern emerged for alternate responses.

1(c)   As above, for 1(b).

2(a)   Only few candidates failed to achieve the correct links between the boxes.

2(b)   Very few candidates provided the higher level of detail needed to describe antagonistic effectors but many were able to consider the outcome ie creating a balance or establishing a set point. Few correctly gave a complete description of the loop but obtained the mark for the reversal of change.

3(a)   This was fine for most candidates. No clear pattern emerged for alternate responses.

3(b)(i) Although the majority realised that the pituitary gland released ADH into the blood stream, some chose the hypothalamus. The hypothalamus makes the ADH (along the fibres in the hypothalamic shunt) but does not release ADH directly into the blood stream.

3(b)(ii) There was a tendency for candidates to give a general description of ADH function without relating it to the situation of the scenario. The excessive drinking of water was the key feature. It was reassuring to see that many candidates realised that less water is reabsorbed but few correctly described the nature of the urine as 'more dilute' or 'less concentrated'. A common error involved the account of more urine being produced and thereby considering volume rather than type.

4(a)   This was fine for almost all candidates.

4(b)   Many obtained two out of the three marks due to one error, but no clear pattern emerged.

5(a)   Most were able to appreciate that Jo and Ray gave the best explanation, when put together. However, some put other choices alongside Jo or Ray and failed to achieve the mark. No clear pattern of alternate responses emerged.

5(b)   Many did not describe the response clearly. There were frequent repeats of the stem or a description of haploid gametes and diploid zygotes without a reference to the link via chromosomes or genes or DNA donated. Some candidates, unfortunately, described 'information' being given. This is not sufficient for this question.

5(c)(i)   Although many obtained the mark for eight, this being a frequently rehearsed concept, a number of candidates failed to realise that the organelle numbers have to increase. There was a common confusion with chromosome numbers, but this does not occur (although the DNA does replicate).

5(c)(ii)   Many coped very well with this item. A number obtained one out of the two marks available due to one error, but without a clear pattern across the candidate cohort.

6(a)   Most were not challenged by this item, although some were tempted to choose 'xylem'.

6(b)   Again, this was not demanding for most candidates. In this case, an alternative response was often 'antibodies' or, more likely, 'antigens'.

6(c)   Although most candidates obtained both marks there were some 'doubles' or 'halves' instead of 'stays the same'. On some occasions, candidates crossed out the correct response 'unspecialised' and replaced it with 'specialised'.

7(a)   Many candidates did well with this item. Some chose motor instead of sensory and a few chose heat instead of light. There does not seem to be a clear reason for this confusion.

7(b)(i)   Most did not experience a problem with the correct response. No alternate pattern was seen.

7(b)(ii)   There was a tendency for some to, incorrectly, describe 'protection'. This response was ignored. Most obtained the mark for 'insulates' and slightly fewer correctly described the increase in transmission speed.

8(a)   Some recognised the complete sequence without any apparent difficulty. Some chose B instead of F, thereby preventing them from obtaining full marks.

8(b)   This item was challenging for many, they described the outcome of the stem ie they noted that the impulse travels in one direction. Relatively few realised that the sensory neuron does not contain the specific receptor sites/molecules. Some gave good descriptions without use of the full biological terms and this was worthy of credit.

8(c)   Although many realised that the serotonin does not leave the synapse, they failed to understand that the drug blocks the reabsorption sites. Some struggled and referred back to receptor sites.

9(a)   Many were fine with this item and obtained the correct sequence. No alternative pattern emerged.

9(b)   Some obtained full marks but many achieved one of the two available. There was a tendency to assume, incorrectly, that the bell was used as a primary stimulus, while others considered that there was a direct connection between the conditioned reflex response and the primary stimulus.

A223/01 – Twenty First Century Science Biology A (Ideas in context plus B7) Foundation Tier

General comments

Candidates' performance this year was broadly similar to 2009. Candidates were confident and attempted most questions. There was no indication that time was an issue, candidates seem to have answered all the questions they could on the paper.

Centres had clearly spent time preparing candidates for question 1 based on the pre-release article. Candidates were familiar with the content and made reference to it in their answers. However, for weaker candidates, understanding the requirements of the question proved a challenge and it is recommended that centres practise using past papers as much as possible. Similarly, questions 4b and 6, which demanded longer prose answers, proved very difficult for candidates.

Comments on individual questions

1a   Many candidates tried to answer here using direct quotes from the article. Better candidates understood that habitat destruction reduced the availability of food and places to lay eggs but some lost marks with vague references to loss of "homes".

1b   This was well answered in the main. Some candidates calculated a percentage here and so lost marks.

1c   Why action was needed soon was well understood but fewer candidates could give examples of the type of action needed, keeping albatrosses in zoos and starting captive breeding programmes were common wrong answers.

1d   Most candidates did not understand the problems of estimating bird populations and where marks were scored it was usually for the idea of counting errors.

1e   Many good answers here. However, an appreciable number of candidates lost marks as they failed to communicate their answers clearly or were imprecise eg "don't use drugs on cattle".

1f   This was well answered and most candidates clearly understood the meaning of "extinction".

1gi   Candidates often produced clear answers and gained the QWC mark. Unfortunately, few understood the term "biodiversity" and consequently failed to pick up further marks.

1gii   Few candidates could answer this question. Ideas of ecosystem stability were rare although many candidates referred to food chains; few candidates showed any understanding of species being potential resources for humans.

1h   Many correct responses but £500 was a common wrong answer.

2a   Most candidates knew that plants are autotrophs.

2b   Better candidates gained 2 marks here and many more knew that heterotrophs feed on plants or other animals. However, a significant number of candidates answered in terms of herbivore and carnivore.

2ci   The role of the Sun in providing energy for food chains was poorly understood, many candidates naming plants as the source of the energy – perhaps because they have been trained to start food chains with a plant.

2cii   Most candidates gained a mark here for using the term "eating" in their answer.

2ciii Only the best candidates gained marks here. Many others suggested energy was lost when there was not enough food or because of reduction in populations.

3a   Candidates showed a good knowledge of photosynthesis with many scoring 2 marks here.

3b   The use of the products of photosynthesis for growth and as a food store were relatively well known as was the idea of respiration. However, few candidates recalled all three and so full marks were rare.

3c   Few candidates could give three components of soil but most gained a mark, usually for including "water" or "minerals" in their answer.

4a   Limiting factors in photosynthesis were poorly known. Water was a frequent wrong response and many stated heat rather than temperature and thus gained no credit. The best candidates knew that light and carbon dioxide limited the rate of photosynthesis.

4b   It was encouraging that so many candidates gave full answers here. However, there were very few good answers with references to miscounting of bubbles or an indication that the bubbles would not all be the same size being the most common credit-worthy responses. That 1 minute was not long enough to get a reliable estimate, that some oxygen would be used for respiration and that the actual gases in the bubbles was uncertain were not known.

5a   Only the best candidates gained two marks here. There were many imprecise answers which referred to "living off" or "living on" without making it clear that the parasite fed on the host and benefited from the relationship. That the host was harmed was again poorly understood.

5b   Most candidates could name a parasite, with mosquito and tape worm being the most commonly quoted. Fewer could give two features although some scored for a description of mosquito mouthparts and tapeworms having hooks and suckers on their heads.

5c   That the host was harmed was relatively well understood with many candidates gaining marks for knowing mosquitoes transmit malaria.

6   This area of the specification was poorly understood. The majority of the answers used the four words or phrases in their answer but failed to show any real understanding. Establishing that cystic fibrosis was caused by faulty DNA was the most common correct response.

7a   Most candidates knew the equation for aerobic respiration.

7bi and ii The fact that increased muscular activity requires increased respiration and so the faster delivery of oxygen and glucose through an increase in breathing and heart rates was poorly understood. It was not uncommon for candidates to give answers to bi in terms of increase in heart rate that would have scored in bii so clearly training in reading and answering the question as set would be of help to candidates.

8a   Some candidates did not understand the question and linked the terms in the two boxes with straight lines. Amongst those that did answer the question there were very few correct responses suggesting this area of the specification is not well understood at this level.

8bi   Most candidates gained at least one mark but relatively few showed real understanding by gaining both marks.

8bii   Most candidates knew O was the universal donor or managed to read this off the table.

A223/02 – Twenty First Century Science
Biology A
(Ideas in context plus B7) Higher Tier

General comments

Candidates' performance this year was broadly similar to 2009. Candidates were confident and attempted most questions. There was no indication that time was an issue, candidates seem to have answered

The paper provided candidates with stretch and challenge, enabling more able candidates to show the full extent of their capabilities. Most candidates performed well on this paper and were well prepared for the examination.

There was no evidence that any of the candidates ran out of time. There were however several issues which centres would be well advised to take note of.

The paper is now marked by electronic marking after first being scanned and then fed electronically to examiners. It is now more important than ever that candidates use legible writing and restrict their responses to the boxes, spaces and lines that have been provided rather than writing in margins and other areas that may not be visible to examiners in the electronic copy.

The quality of candidate's handwriting was often poor, making it hard for examiners to credit candidates for correct answers. Also all too often candidates attempted to cross out answers and then write responses in the nearest available space. This is a risky strategy unless the response is clearly indicated. One question required candidates to complete a grid by adding ticks and crosses. Many candidates changed their responses by scribbling their corrections over the top of their original response. This often resulted in a tick with a cross line through it. Examiners were then left to decide if the candidate had indicated a tick or a cross. Unless the alteration was clear, candidates were not credited with the mark. Candidates should be instructed to completely cross out incorrect responses and write the new response after their initial crossed out response and not write over the top of it.

Comments on specific questions

Part (ai) Most candidates scored well on this question. One mark was given for a clear ordered response. The other two marks were given for an understanding that reducing biodiversity resulted in smaller populations, fewer species and linked this to a specific place such as a habitat or an ecosystem. When errors did occur, it was mainly due to candidates writing about biodiversity rather than its reduction.

Part (aii) Candidates gained credit here for writing about the effect of reducing biodiversity on the rest of the food web. Credit was also given for describing a potential resource for humans such as drugs.

Part (b) Most candidates scored this mark. Credit was given for either stating that extinction was forever, world wide, or affected all members of the species.

Part (c) Most candidates scored one of these two marks. Credit was given for testing live and dead vultures for diclofenac and comparing the effect of different concentrations to work out the lethal dose. Those candidates who simply stated "stop using diclofenac to see what happens", or suggest feeding diclofenac to an endangered species, were not credited.

Part (d) To score this mark, candidates had to clearly state that there were no data that indicated when during the 26 year period the numbers were declining. Credit was also given to those candidates who stated that a graph would provide more specific data.

Part (e) Many candidates found this question quite difficult. More able candidates referred to needing to have reliable data or that the results may be atypical and needed replicating. References to accuracy were ignored and not credited.

Part (f) was only answered well by the more able candidates. Credit was given to stating that deaths may occur during migration or at the winter feeding sites. Most answers were vague and simply referred to going to different sites or errors in counting.

Part (g) was answered well by most candidates with at least one mark being awarded. The easy mark was to state that vultures had a smaller body mass than cows. More able candidates went on to state that over their lifetime, vultures would eat lots of cows and the diclofenac would accumulate in their bodies. However, candidates had to clearly state that many or lots of cows would be eaten. It was not enough to simply state that vultures ate dead cows.

2 Credit was given to those candidates who stated that light energy was converted by photosynthesis into glucose or starch. However, to score the second, more difficult, mark candidates had to state what that energy was used for during growth. Good answers included respiration, or to make cellulose or proteins.

3 Part (a) required candidates to correctly identify a food chain, with arrows, and include at least four organisms. Credit was then given for correctly transferring this into a pyramid of biomass with four or five trophic levels, correctly labelled, and being wider at the base and narrower at the top.

Part (b) was not so well answered. Most candidates scored the first mark for stating that a pyramid of biomass took into account the mass or size of the organisms. However, few went on to say that it also gave a better indication of the flow of energy through the food chain.

4 Part (a) was answered well by about half the candidates. Good answers referred to the solubility of glucose compared with starch, and the consequence this would have on the osmotic effect within the cell. Credit was also given for stating that the starch would stay put inside the cell but the glucose would not. Weaker answers referred to using glucose for respiration or that starch was a bigger molecule.

Part (bi) was answered well. Credit was given to any indication that it was noon, or 12 mid day. Credit was not given for 12am or just 12.

Part (bii) was marked so that correct times (numbers) scored one mark and correct use of am and pm scored the second mark. Thus 7.30 and 4.30 scored 1 mark, but 7.30am and 4.30pm scored 2 marks. Credit was also given for correct use of a 24 hour clock or writing morning and afternoon.

Part (biii) was not well answered. Most candidates got themselves confused referring to X and Y, carbon dioxide and oxygen and missed the crucial point that photosynthesis needs to provide more food or energy than is transferred during respiration. Only the more able candidates scored both of these marks. Most candidates who referred to energy stated that it was made or created. Although this was scientifically in error, candidates were not penalised as this was not what was being tested.

5 In part (a) surprisingly many candidates failed to score both of the marks. Incorrect responses included 'heat', 'water', 'minerals' and even 'glucose'. Three correct responses scored two marks and two correct responses were required for a single mark.

In part (b) most candidates scored at least one or two marks. Good answers included miscounting the bubbles, bubbles of different sizes, oxygen being used for respiration, bubbles not being released and that 1 minute was not long enough. Credit was not given to uncontrolled variables such as temperature as the experiment was only running for 1 minute and temperature changes would be minimal. Reference to human error on its own was not credited.

6   In part (a) a wide range of responses were allowed. Those candidates who chose to answer by referring to genetics were credited for stating that the gene was faulty and that the allele was recessive or co-dominant. Those candidates who chose to answer by referring to physiology were credited for stating that the haemoglobin was altered, or the RBCs were misshapen or that less oxygen could be transported.

Part (b) required a more carefully structured response to score all three marks. Candidates had to clearly state that sickle-cell anaemia gave some protection from the malarial parasite. They then had to go on to state that this meant that carriers of sickle-cell anaemia were more likely to survive and pass on their genes to their offspring. Most candidates managed to score at least one or two of these marks.

7   Many candidates did surprisingly well on this question. Credit was not given for simply repeating the words stated in the question. Good answers linked DNA to the cystic fibrosis gene, stated that DNA was extracted from white blood cells, that a gene probe would attach itself to the suspect gene and that the probe could then be identified using autoradiography. More able candidates gave a detailed account of how the DNA was prepared and how the probe would be identified by its radioactive marker. However, candidates who gave incorrect or vague statements such as a probe is inserted into the white blood cell or that the whole process was called autoradiography, or failed to state that the DNA was removed from the white blood cells, did not score those marks.

8   In part (a) candidates simply had to state that ATP was made or that energy was released as heat, in order to score. However, all too often, vague responses such as energy being taken round the body to the muscles were given.

Part (b) simply required that candidates stated that the muscles would contract. Candidates who stated that the muscles contract and relax were not credited.

Part (c) required candidates to state that any differences were due to different levels of fitness, exercise undertaken, different genes, age, gender or that they do different types of sport. Vague answers that referred to environmental and lifestyle factors were not credited.

Part (d) should have been two straight forward recall marks. However few candidates were awarded both marks. Candidates would clearly be well advised to learn this simple word equation. Most answers were liberally sprinkled with oxygen, carbon dioxide and glucose.

9   In part (a) most candidates scored one of the marks. The first mark was awarded for correctly identifying B and A, and the second mark for correctly labelling antigens and antibodies. Only the more able candidates scored both of the marks.

In part (b) credit was given for giving ticks to both the universal donor and the universal recipient. The final mark was given for placing crosses in the remaining boxes. Many candidates changed their responses by scribbling their corrections over the top of their original response. This often resulted in a tick with a cross line through it. Examiners where then left to decide if the candidate had indicated a tick or a cross. Unless the alteration was clear, candidates were not credited with the mark.

In part (c) most candidates scored the first mark for the blood clotting. Only the more able then went on to state that this could then block blood vessels. Credit was also given for stating that this could cause a stroke.

Principal Moderator's Report

General Comments:

The number of candidates being entered for this specification continues to be very large and the balance between the specifications continues to shift slightly towards a higher entry for the separate sciences compared to Science and Additional Science. The sampling procedures have been modified and streamlined this year in the light of new guidance from the Joint Council for Qualifications (JCQ).

As the interpretation and application of the assessment criteria has improved it is not surprising that the there has been an increase in the percentage of candidates achieving certain aspects of the assessment criteria. However, whilst there has been improvement in some areas, other aspects of the criteria continue to be demanding and challenging for candidates and the spread of marks over the cohort allows secure differentiation between grades.

This report will highlight those areas where there has been improvement and also those where there is still significant opportunity for development. The reports from 2008 and 2009 will still be available online at www.ocr.org.uk to provide further detailed guidance.

The skills assessment component of each of the above specifications is weighted at 33% and it was still evident that some Centres were not developing the underlying skills, knowledge and understanding of Ideas about Science in their candidates before an assessment took place.

Structure of the report
Vertical black lines in the margin throughout this report highlight important areas of concern, advice and guidance by the moderating team.

This report is divided into the following sections

- Administrative issues
  - General comments
  - Annotation
  - Internal moderation
  - Type and context of assessed work
  - Nature of practical work
  - Candidate helpsheets and teacher review of coursework
  - Plagiarism
- Assessment and marking framework
  - Calculating the Strand mark
  - Marking strands I and P in Data Analysis and Investigations
  - OCR cover sheet for candidates' work
- Data Analysis
- Case Studies
- Investigations

Administrative issues

General comments
Those Centres that responded to the early introductory letter to establish an email contact between the Centre and the moderator improved the efficiency and effectiveness of the moderation process and this was much appreciated by moderators. However, there were still too many Centres who did not send the paperwork and coursework samples promptly by

the OCR deadline. Centres that followed the advice on the checklist included with the introductory letter and provided all the relevant information, in particular details of how each of the tasks used for assessment had been introduced and presented to candidates, greatly facilitated the moderation process and helped moderators to support the marks awarded by the Centre.

Annotation
Too often there was little or no indication of how marks had been awarded. The minimum notation acceptable is to use the assessment criteria codes, eg I(b)6, at the appropriate point in candidates' work. For Case Studies it was noted that where Centres provided further commentary this was particularly helpful. Suitable annotation makes it more likely that the moderator will be able to support the mark awarded. However, it is important that annotations accurately reflect the criteria. In some cases, it was noted that the annotation was a very generous interpretation of the criteria and occasionally completely incorrect.

Internal moderation
Effective internal moderation ensures that candidates are placed in the appropriate order of merit. If the order is felt to be unsound because marking is inconsistent between different teachers the Centre may be required to provide further samples of work and possibly re-mark the work of all their candidates. There were more incidences of unsatisfactory internal moderation reported by the moderating team this year.

Type and context of assessed work
In line with guidance from the Joint Council for Qualifications (JCQ), coursework can be submitted for as many specifications as it is valid for. In the case of Twenty First Century Science, this means that it has to match both type (ie Data Analysis and Case Study or Practical Investigation) and context (ie Biology, Chemistry or Physics) as appropriate for the specification concerned. Only a few Centres did not meet these requirements this year. Please note that if the same piece of coursework is requested for moderation in more than one specification, then it must be photocopied and put into the appropriate coursework sample package.

Nature of Practical work
The Data Analysis and Practical Investigation must involve candidates having personal first hand experience of collecting data in a practical experiment. **Coursework which does not fulfil this requirement cannot be submitted for assessment.**

Computer simulations or sole use of teacher demonstrations are not acceptable substitutes. In the Practical Investigation, marks awarded for Strategy (S) and Collecting Evidence (C) Strands must be based on an individual's contribution and not on a shared approach or shared class data or data from other secondary sources.

In the Data Analysis an individuals' data can be supplemented with additional data from secondary sources to enable assessment of Strands I and E.

Candidate helpsheets and teacher review of coursework
There was evidence that some coursework from a small minority of Centres had been reviewed and annotated by teachers giving candidates specific guidance about how to improve their marks. **This is not acceptable practice**. The Joint Council for Qualifications (JCQ) have published appropriate guidelines and Centres are required to consult and abide by this document.

www.jcq.org.uk/attachments/published/315/ICE%20Coursework%202007%20FINAL.pdf

The following quotes are from this document:

"Teachers may review coursework before it is handed in for final assessment ... ... provided that advice remains at the general level, enabling the candidate to take the initiative in making amendments …". "Having reviewed the candidate's coursework it is not acceptable

for teachers to give, either to individual candidates or to groups, detailed advice and suggestions as to how the work may be improved in order to meet the assessment criteria. Examples of unacceptable assistance include detailed indication of errors or omissions, advice on specific improvements needed to meet the criteria, the provision of outlines, paragraph or section headings, or writing frames specific to the coursework task(s)."

Candidate help sheets of the generic type which are applicable to any task are allowed. Whilst helpful for lower achieving candidates these can restrict the opportunities for higher achieving candidates. There was evidence that some Centres were providing help sheets which, rather than giving broad headings to guide their candidates, were providing a very detailed breakdown of points and leading questions involving particular words or phrases in the mark descriptions which went beyond the spirit of teacher support and guidance. In these cases Centres sometimes awarded marks when candidates repeated the same words and phrases without demonstrating any understanding. Centre marks could not be supported by moderators in these situations.

Plagiarism

Quoting from the same JCQ document as previously mentioned, "Candidates must not copy published material and claim it as their own work. If candidates use the same wording as a published source, they must place quotation marks around the passage and state where it came from. **Candidates must give detailed references even where they paraphrase the original material"**. There was evidence that in some cases, particularly in the Case Study, candidates were not following these procedures. The JCQ document goes on to say: "These actions constitute malpractice, for which a penalty (eg disqualification from the examination) will be applied".

Assessment and marking framework

Calculating the Strand mark
A significant number of Centres are still not following the correct procedure for calculating the Strand mark from the appropriate aspect of performance marks and are being required to re-mark all their candidates' work.

There was a tendency for some Centres to award marks on the basis of candidates matching one high level aspect of performance description within each Strand without ensuring that the underpinning descriptions had been matched. Each aspect of performance should be considered in turn, comparing the piece of work first against the lowest performance description, then each subsequent higher one in a **hierarchical** manner until the work no longer matches the performance description. Where performance significantly exceeds that required by one description, but does not sufficiently match the next higher one, the intermediate whole number mark should be given if available. Thus, the level of performance in each aspect is decided.

Three aspects of performance per Strand
Where there are three aspects for each of the Strands (which applies to all Strands except
Strands B and C of the Case Study) the following examples illustrate how to convert aspects of
performance marks into Strand marks.

Example	Marks for the three aspects in a strand	Formula to be applied	Mark to be awarded for the strand
1	(a) = 4, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.66 round up = 4
2	(a) = 3, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.33 round down = 3
3	(a) = 4, (b) = 3, (c) = 1	[(a)+(b)+(c)] / 3	= 2.66 round up = 3
4	(a) = 3, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	= 2.0 = 2
5	(a) = 2, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	= 1.66 round up = 2

Two aspects of performance per Strand (B and C of the Case Study)
From experience it is often best to consider both strands B and C together when arriving at the
final strand mark for each. For example, if B(a) = 4, B(b) = 3, and C(a) = 4, C(b) = 2, then it
would be appropriate to award B = 4 by rounding up and C= 3 by rounding down (or vice versa),
for a total of 7 marks for these two strands taken together.

This approach provides a balanced consideration of each aspect of performance involved in
each strand and allows the marker to build up a profile of strengths and weaknesses in the work.
Comparison of teacher and moderator judgements in each aspect allows easy identification of
where a Centre marks too severely, too leniently or where marking is inconsistent. This allows
moderators to make far more constructive reports back to Centres.

Marking Strand I aspect (a)
This aspect involves awarding credit for processing the data which has been collected to display
any patterns. This may be done either graphically or by numerical processing, whichever is most
appropriate in a particular Data Analysis or Practical Investigation. If there is some evidence for
both approaches, then both should be marked with **the better of the two being counted (but
not both marks)**. Some Centres counted both marks which produced an incorrect aggregate for
the Strand.

Marking Strand P aspect (b)
The first row is concerned with recording quantitative data, the second row deals with the use of
conventions and rules for showing units or for labelling in tables, and the third row deals with the
recording of qualitative data. Most Practical Investigations are of a quantitative nature and will
provide evidence for the first and second rows. In these cases, the aspect mark will be
determined by averaging the mark in these two rows only, ignoring the third row completely. For
those rare investigations which include qualitative evidence but no quantitative evidence, the
mark for Aspect b should be based on the average of the second and third rows only. Where
averaging results in half marks, professional judgement should be used to determine the best fit
mark of the two alternatives. Once the mark for aspect (b) has been decided, it can be combined
with the marks for (a) and (c) to provide the average, and so the best fit mark, for the strand.

For example, in an investigation providing **quantitative** evidence

Aspect of performance			Strand P mark
P(a)	7	7	
P(b)	(i) 6 / (ii) 4 / (iii) n/a	5	6
P(c)	7	7	

Sub-dividing aspect (b) in this way allows flexibility in marking the recording of data without allowing aspect (b) to dominate the mark for the whole strand.

Candidate coversheet
All marks must be recorded on the OCR cover sheet which is attached to candidates' work. A number of Centres did not use the latest format of the OCR cover sheet or, in a very few cases, did not use a cover sheet at all.

Data Analysis

General comments
Candidates must have personal, firsthand experience of collecting data by performing a practical experiment. The data that they collect can be supplemented by further data from, for example, incorporating a class set of results. Work which is based purely on teacher demonstrations, computer simulations, given sets of results or similar is not acceptable.

Many Centres used whole class practical activities as a basis for Data Analysis exercises and this clearly worked well. Therefore it is very important that Centres include details of how the task was presented to their candidates eg briefing sheets etc. The better candidates included a description of their experimental method, their own results table and the class data set which made the marks awarded for evaluation easier to support.

It is most important that candidates record and present the data that they have collected and not just plot a graph or do numerical calculations without the inclusion of a data table in their report. It would also be helpful if candidates or teachers included the method that they used to collect data so that marks for E(b) could be more securely supported.

The same Strand I and E assessment criteria are used in Practical Investigations and the same marks for I and E from Practical Investigations can be submitted for Data Analysis in another specification **provided the subject context is appropriate**. Many Centres used this opportunity to obtain the optimum marks for their candidates. In these cases, Centres must indicate this on the appropriate coversheet and also include copies of the work in both samples which are sent to the moderator, if the same candidate is selected.

Data Analysis tasks
There was a continuing variety of data tasks seen by moderators such as:

Resistance of a wire	Stretching elastic bands, springs
Osmosis	Stopping distances of bicycles
Cooling curves	Clotting of milk
Crater impact	Bouncing of squash balls
Rates of reaction	Pulse rate and exercise

Centres are encouraged to be innovative but must consider the science that might be required to explain any conclusion drawn by the candidates. As in all assessments of this type, Centres should match the task to the ability and expectations of the candidates involved.

Those candidates who understood and used the terminology and concepts related to Ideas about Science, such as 'correlation and cause', 'outliers', 'reliability', 'accuracy', 'best estimate', and 'real difference' found it easier to match the performance descriptions of the criteria and gain higher marks.

The majority of candidates at nearly all levels repeated their measurements when performing practical tasks, which is most encouraging. However, many candidates do not necessarily appreciate the reasoning behind such practice and often those results which were clearly outliers were included in average calculations and incorporated into conclusions. It was very rare to see that a candidate had performed further repeats to replace the outlier to ensure that the data was reliable and of the best quality. Plotting rough graphs as the data is collected may help candidates to identify outliers as they are collected so that marks for E(b) can be awarded and their conclusion may be more clearly and confidently established gaining credit in both I(b) and E(c).

Strand I: Interpreting data
I(a): Most candidates analysed their data using bar charts or graphs to illustrate and process the data that they had collected rather than carrying out a numerical analysis. Whilst many candidates now plot all their data and often include range bars, the quality of graph-drawing often shows a lack of care in plotting the points accurately, using suitable scales, labelling axes correctly and drawing a line of best fit accurately and carefully. Many members of the moderating team felt that the standard of graph-drawing had certainly not improved since last year. Many graphs were given high marks when one or more of these aspects were not of the accepted quality and more scrutiny is needed by Centres.

The following guidelines provide more guidance about what is required but they are not intended to be comprehensive and to cover all eventualities:
- I(a) 4 - simple charts, bar charts
- I(a) 5 – a dot-to-dot graph or axes not labelled or incorrectly plotted point(s) or poor quality line of best fit.
- I(a) 6 - graph with correctly plotted points, correctly labelled and scaled axes and correctly drawn line of best fit.
- I(a) 7/8 – in addition to the requirements for 6 marks, candidates must show evidence of awareness of uncertainty in data eg range bars, scatter graphs.

If candidates use a numerical approach to analyse their data it is expected that candidates will be able to correctly calculate averages from repeat readings for 4 marks, do more complex calculations such as calculate percentage differences for 6 marks and for 8 marks calculate gradients from graphs or use simple statistical methods such as box and whisker plots. Those candidates who have drawn a poor line of best fit on their graph but succeeded in calculating a gradient correctly may be awarded up to 5 or possibly 6 marks.

Some candidates included range bars when plotting bar charts and were wrongly awarded 8 marks. At best this approach might merit 5 marks.

The same standards for hand-drawn graphs apply when marking computer-generated graphs ie they must be correctly sized and scaled with suitable grid shown and with the appropriately sized plotting points. However, it is generally better for candidates to hand draw their own line of best fit

Centres are reminded that only one single mark must be used for I(a), either that for graphical or that for numerical work, but not both when determining the overall Strand I mark. Further information about the award of marks for numerical approaches is contained in the 2008 Report.

I(b): The match to I(b)4, 'identifying trends or general correlations in the data', was well appreciated and most candidates could summarise the patterns in their data with a suitable qualitative statement. However, candidates were often given 6 marks with little evidence to support this award. Many candidates referred to 'positive correlation' which only merits 4 marks. For 6 marks candidates should derive a more quantitative statement using their data to show what happens when, for example, concentration or lengths are doubled and noting the direct proportionality between variables.

Very few candidates matched the requirements for I(b)8. Candidates should review any limitations to their conclusions by considering such things as the scatter in the data, overlapping range bars between data points, 'real differences' and values of the best estimate, and whether the best fit line be accurately defined. Candidates who have derived a quantitative relationship should consider what effect the position of the best fit line might have if the scatter in the data is taken into account.

I(c): Many candidates introduced their experiment by describing any related background theory even if it was not all relevant to the particular experiment they were doing. Candidates are better served if they link their conclusion directly with the appropriate scientific explanation that applies. Most candidates could secure a match to I(c) 4 by explaining their conclusion using scientific ideas. However, there was still some very generous marking when matching to I(c)6 and I(c)8 in terms of the detail and quality of the scientific knowledge and understanding shown. It is not just a few key words that must be considered, but the actual meaning and correctness of a candidate's explanation of their conclusion that must be judged when arriving at the final mark.

Strand E: Evaluation
The majority of candidates achieved between 3 or 5 marks for this strand, showing improvement in E(a) and (b) but much less so in E(c). Those candidates who used the appropriate IaS vocabulary, and the knowledge and understanding of IaS 1, invariably achieved higher marks. Those candidates who used sub-headings such as 'Evaluation of procedures', 'Evaluation of data', 'Confidence level of conclusion' were more likely to focus on each area in turn and be more successful in their overall evaluation.

E(a):
The E(a)4 performance description is really the 'gatekeeper' to access the higher marks. It requires candidates to identify any limitations or problems in their procedures that they encountered during their practical work. However, in many cases comments were limited to human error rather than systemic experimental ones. Many candidates suggested possible improvements to match E(a)6 although they were not always of sufficient quality to be creditworthy eg 'do it with a computer' or 'repeat my measurements more times' without any justification or explanation.

E(b):
The majority of candidates generally identified a data point as an outlier either in the table of results or on the graph, but only the better candidates provided an explanation of why a

particular result had been chosen. The majority of candidates now regularly draw lines of best fit and range bars on their graphs but many of them do not make the connection when discussing reliability and accuracy of their data. A limited number of candidates used more objective ways of assessing reliability and accuracy using simple statistics such as variations of the Q test procedure. Candidates' attempts to explain anomalous results were often generously marked and it is important to mark the **quality** of what has been written and not the fact that just **something** has been written.

E(c): Marks were often very generously awarded and this aspect still continues to be poorly addressed. This aspect involves bringing together the discussion about the range and reliability of the data collected and the procedure to establish a level of confidence in the conclusion. Better candidates referred back to their conclusion in I(b) expressed in either qualitative or quantitative terms and used their discussion in E(a) and E(b) to link them all together in establishing the appropriate level of confidence. Those candidates who had expressed a conclusion in quantitative terms had more opportunity to provide a more detailed analysis and evaluation to access the higher marks.

For the award of 6 marks, candidates should bring together a discussion of the accuracy and reliability of their data and the precision of the apparatus they have used to establish a level of confidence in their conclusion. Further support for this can come from awareness in I(b) about the limitations in the conclusion. In addition, for 8 marks weaknesses in the data should be identified, eg a limited range or not enough readings at certain values, or degree of scatter too large or variable, as well as detailed suggestions about what more data could be collected to make the conclusions more secure for the particular variable under investigation.

Some candidates used other data from secondary sources to support (or otherwise) their conclusion. Some candidates recognised that their conclusion could only apply to the range of values that were studied because outside this range, other factors may act. For example, in chemical reactions the rate is bound to slow down as one of the chemicals gets used up, rubber bands that are stretched will eventually break, more exercise cannot always mean that pulse rate continues to increase etc.

Case Studies

General comments
The Case Study is a critical analysis of a controversial scientific issue in which candidates use their knowledge and understanding of Ideas about Science. Those candidates who were able to use the language and concepts related to IaS, such as 'peer review', 'replication of evidence', 'correlation and cause' 'reasons why scientists disagree', 'precautionary principle', 'ALARA', and 'risks and benefits' found it much easier to match the performance descriptions of the criteria and gain higher marks.

Most candidates title their Case Study in terms of a question but many still tend to present a report describing a topic rather than collect evidence for both sides of a case and use their own judgements to derive a personal conclusion. There is, of course, not always a right or wrong answer in these controversial issues and marks are awarded for the way that the candidate has presented and argued the case.

Many Centres provided a short list of appropriate Case Study titles for their candidates to choose from, thus allowing them to select one which is the most appealing on an individual basis. It is important that titles for Case Studies do provide the necessary focus for candidates and, rather than just illiciting a yes/no response, encourage a more thoughtful response with possible suggestions of future action. Those Centres who allow a more open selection of topic must closely monitor their candidates' choice to ensure that it is appropriate and firmly embedded in a scientific context, with opportunities to gather evidence both 'for' and 'against'. Surprisingly, many candidates did not make full use of the relevant information and material in their student textbook, often preferring to use only material from the internet.

A number of familiar examples were seen again this year but some, such as 'should smoking be banned in public places?', were seen much less frequently as their relevance diminishes.

Some examples of Case Study titles included this year:

Should human cloning be allowed?
Are mobile phones bad for your health?
Is nuclear power the answer to our energy needs?
Should we spend more developing alternative energy resources?
Is the MMR jab safe?
MRSA – is hospital the best place to be when you are ill?
Is global warming natural or man-made?
Is sunbathing safe?
Does pollution from traffic cause asthma?
What killed the dinosaurs?

The approach adopted by candidates who presented Case Studies on the following issues seemed to provide limited access to the higher levels of the assessment criteria:

Is organic food best?
Aspects of diet eg "Is obesity inherited?"
Should animal testing be allowed?

Assessment

In general, candidates continued to perform better in Strands A and D compared to B and C. Higher achieving candidates described the relevant science needed to understand their chosen topics and produced high quality, clearly structured, well resourced and illustrated reports involving critical analysis and individual thought with considerable personal input. It was this latter aspect of personal analysis and evaluation which often differentiated candidates in terms of level of performance.

Lower achieving candidates relied too heavily on copying and pasting information from sources without the appropriate level of individual analysis and evaluation. Those candidates who did not acknowledge their sources either when they copied and pasted information or when paraphrasing original material could be regarded as plagiarising material and risk incurring a significant penalty.

Those reports which were presented simply as PowerPoint printouts almost always lacked sufficient detail to access the higher marks.

Strand A: Quality of selection and use of information.

There was continuing evidence of improvement in the marks awarded for this strand compared to last year.

A(a): Candidates must select and use sources of information to provide evidence to support both sides of the argument in their Case Study. They must select relevant extracts to quote directly and then, in their own words, explain what its relevance and importance is to the developing arguments in the report. It was this latter aspect that the better candidates were able to show.

If no sources are credited then a maximum of 1 mark will be allowed by moderators. Higher marks require that sources represent a variety of different views or opinions and it is quality, rather than quantity, which separates the award of 2 or 3 marks. Many candidates who were awarded 4 marks incorrectly often made token reference to reliability but did not explain why they thought their sources were reliable. Those candidates who used the language and ideas from IaS 4, eg ideas about peer review, the nature of the source or the status of the author, were much more likely to secure the top mark.

A(b): The majority of candidates included a bibliography of sources at the end of their reports. Candidates who identified their sources using incomplete references, eg website homepages, should be awarded 2 marks. If only one or two incomplete references are given then one mark should be awarded, and if no references are given then zero marks are appropriate. For 3 marks candidates included complete references to the exact url address of the webpage and,

when referencing books, the title, author and page references were given. For 4 marks it is expected that candidates include some information about the nature, purpose or sponsorship of the website. Candidates should also be encouraged to record the date when they accessed the information from an internet site.

A(c): Candidates were still not very good at clearly showing where sections of text were directly quoted. Use of quotation marks, use of a different font or colour highlighting, were some of the methods used by the better candidates. The better candidates also included references within the text to show the source of particular information or opinions, quoting the specific author and then using, for example, numerical superscripts linking to detailed references in the bibliography. Credit is given, not so much for the quotation itself but for the comment made by the candidate to explain why it was chosen, and how the candidate thinks it contributes to the arguments being compared in the study.

Failure to discuss reliability of the sources, failure to fully indicate and reference quotations and failure to indicate the relevance of the quotations selected in the study prevented many candidates from being awarded 4 marks in this strand.

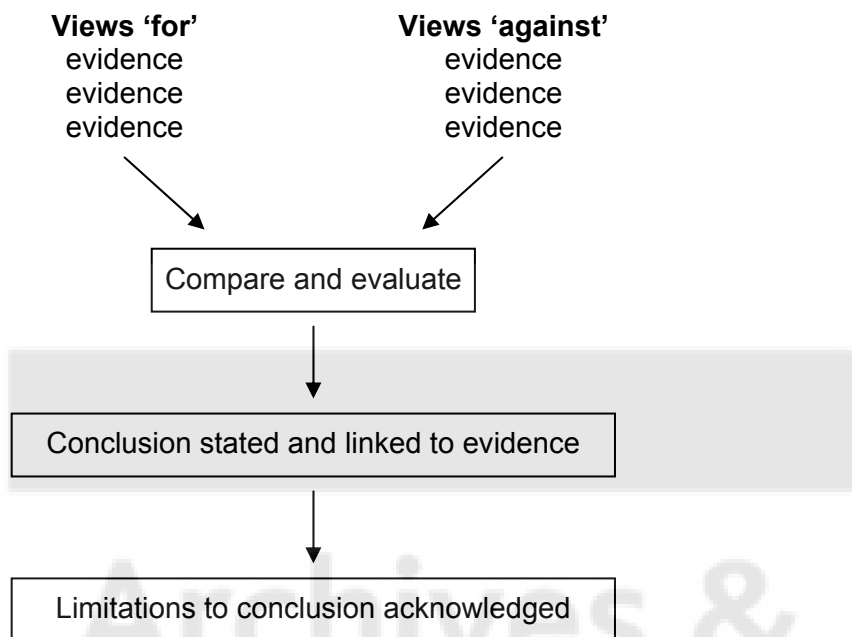### Strand B: Quality of understanding of the case
The majority of candidates described the relevant background science in the introduction to their Case Studies. However, it was only the most able who could integrate their scientific knowledge and understanding with the claims and opinions reported in their studies or extend the scientific knowledge base to more advanced concepts. Reporting was too often still at the 'headline level', simply repeating claims without looking behind the headline for the underlying science and/or evidence. It is useful before marking candidates' work to look at the appropriate pages in the Twenty First Century Science specifications about Science Explanations and the Ideas about Science, and also the published OCR exemplars to know in advance about what material should be included. The most successful Case Studies are usually closely related to topics in the course and it can be taken as a general guide that 6 marks in B(a) requires all of the relevant science from the student book. The seventh or eighth mark will come either for applying and integrating this correctly to the case, or for finding and explaining some additional science related to their Case Study.

Aspect B(b) focuses on candidates' ability to identify, report and evaluate the scientific evidence that any claims and opinions are based on. Most candidates were able to recognise and extract relevant scientific content from their sources and were awarded 4 marks. Candidates who were awarded 6 marks referred to the evidence base of the various claims and opinions providing generally quantitative information from research studies. Candidates obtaining 7 or 8 marks looked more critically at the quality of the evidence. They used terms like 'reliability' and 'accuracy' when considering data, they looked at the strategies involved in collecting the data and they also compared the reliability of data between sources. For many 'life-science' studies, for example the popular MMR study, the evidence is largely drawn from epidemiological studies and good candidates should be looking for evidence of factors such as sample size, or how subjects were selected to evaluate the importance of the evidence. Even strong candidates tended to rely too much on summaries of conclusions rather than describing the evidence base.

Strand C: Quality of conclusions
Strand B gives credit for the level and detail of the relevant science described and for reporting the associated evidence underpinning the various claims and opinions. Strand C awards credit for candidates who provide individual input comparing and evaluating the evidence, considering its significance, importance and reliability and using their own judgement to arrive at a suitable conclusion on a controversial issue. There was evidence that many candidates were not using and applying their Ideas about Science sufficiently, particularly IaS 5, to warrant the higher marks in this strand.

Those Centres who had guided their candidates to organise their reports with the following headings in mind and to encourage them to develop their critical skills invariably achieved higher marks.

Views 'for'   **Views 'against'**
evidence   evidence
evidence   evidence
evidence   evidence

Compare and evaluate

Conclusion stated and linked to evidence

Limitations to conclusion acknowledged

Most candidates could sort the information that they had gathered into views 'for' and 'against' and were awarded 4 marks in C(a). Better candidates started to compare similar aspects in both their 'for' and 'against' list and were awarded 6 marks. The best candidates built on this foundation and provided detailed comparisons and evaluation demonstrating considerable analytical and evaluative skills.

When making their conclusions, many candidates referred to the evidence that they had gathered and were awarded 4 marks in C(b); those who omitted any reference were limited to 2 marks. Better candidates described their own viewpoint or position in relation to the original question justifying this by reference to the sources and to the evidence that the claims were based on. Far too often the conclusion was limited and too brief. Alternative conclusions should be considered where appropriate and recommendations for action in the future should also be included. Many candidates simply chose to report information about their topic, without any real analysis of the scientific evidence and incorporation of personal decision making.

### *Strand D: Quality of presentation*
D(a): The majority of reports included headings and/or sub-headings (2 marks) to provide the necessary structure. There was a definite improvement in this aspect and the better candidates included a table of contents and numbered the pages in their report (3 marks) to help guide readers quickly to particular sections. Those candidates who, in addition, presented a report which had a coherent, logical and consistent style were awarded 4 marks.

D(b): Many candidates only included images which were decorative rather than informative and therefore failed to clarify difficult scientific ideas and improve effective communication. If there are no decorative or informative images included then zero marks is awarded. If one image is included, a decorative front cover or other low level attempt to add interest then one mark is appropriate. Two marks would be awarded for the inclusion of decorative images only, or perhaps for the minimal use of informative images. Three marks would be given for including a variety of informative illustration, eg charts, tables, graphs, or schematic diagrams, and 4 marks if this is fully integrated into the text, referred to and used. Too often downloaded images from the internet were not clear, too small and not referred to in the text.

D(c): The assessment of the use of scientific terminology and the level of spelling, punctuation and grammar was generally very fairly assessed by Centres.

Practical Investigations

There was continuing evidence this year that Centres were moving away from the previous Sc1 methodology to investigations and a more open ended exploratory approach was being developed. The importance of candidates doing preliminary work to inform the strategy of the main experiment was clearly being recognised and encouraged.
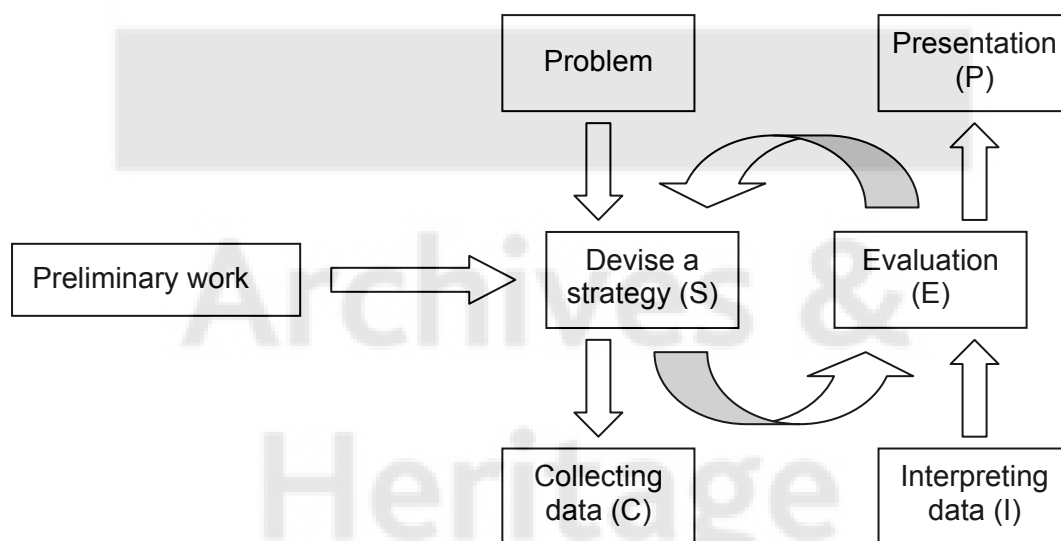

From an assessment point of view the 'performance descriptions' should be used to reflect the quality and performance of candidates' work, rather than a formal/legalistic interpretation of particular words and phrases. There were a number of examples where credit had been incorrectly given for the inclusion of a key word or phrase but, on reading the context in which it was written, it was clear that the candidate had not understood or appreciated the correct meaning.

Rates of reaction, resistance of a wire and osmosis were still the most common investigations seen from Centres. However, there was evidence that other topics were being developed by more Centres who had gained confidence from previous years, for example, stretching of plastics and other materials, exercise and fitness routines, efficiency of wind turbines, objects rolling down slopes or ski jumps, electrolysis, investigations involving titration and electromagnets.

Strand S: Strategy
Centres were generally matching candidates' work correctly to the 6 mark performance description but higher marks were being very generously awarded.

The intention is to encourage a more independent approach to investigations and the mark awarded for the aspect, S(c), should reflect the 'value added' by the candidate, beyond the initial teacher stimulus. To justify high marks in S(c) candidates should show independent thinking and the importance of preliminary work cannot be over emphasised in the introductory phase of an investigation; the appropriate amount of time must be given to this aspect.
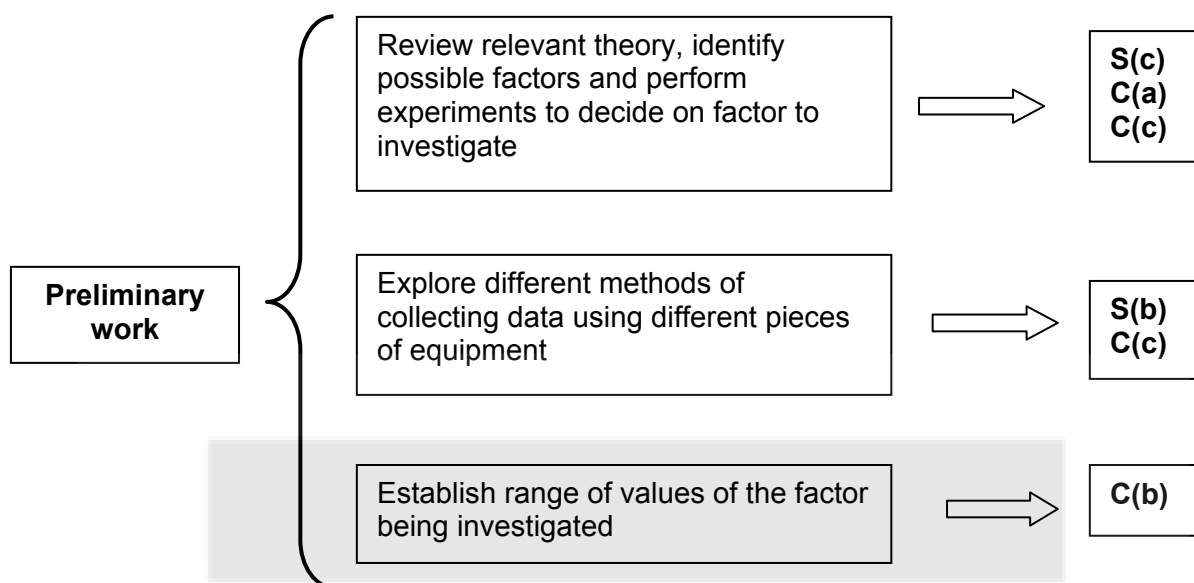
Candidates should consider what factors or conditions might affect the results they will get. This will usually involve a brief review of the relevant scientific theory supported by one or two simple practical experiments to compare the magnitude of the different effects and ease of experimentation. This will allow candidates to decide which factor it would be best to study and also provide evidence which can contribute towards credit for C(a) and C(c).

High marks cannot be supported unless the Centre has provided details of how the task was presented to candidates (eg copies of briefing sheets etc.) or moderators, after inspecting different scripts in the sample, can see that candidates had freedom of choice between different approaches and apparatus. In too many cases moderators noted that candidates had identical ranges and values of the same variables without any further discussion or justification indicating that limited individual decision making had occurred, yet high marks were still being awarded. This necessitated a downward adjustment to the marks for S(c) in a number of Centres. Where candidates had been given the opportunity to show autonomy they performed well across many of the Strands.

It is important for candidates to record their preliminary data and to use it to inform and develop the main experiment. Often preliminary work appeared to provide just a limited extra set of results and did not shape the investigation in any way. Sometimes preliminary work was carried out but it was clear that candidates had not really understood why they were doing it.

Many candidates provided a list of appropriate apparatus for their investigations but had not linked it to their preliminary work or indicated why it had been selected in preference to alternative equipment. Those candidates who exerted some choice over the apparatus they used were in a better position to achieve higher marks in S(b) and also when evaluating their procedures and methods in E(a). Candidates need to explore different methods and choose between different pieces of apparatus to find the best way to collect good quality data. Some candidates provided very simplistic justifications and Centres are reminded that it is **quality** of response in this context that is being rewarded. Many Centres provided a fixed, limited set of apparatus for candidates to choose from and this did not allow candidates the flexibility to try various approaches to obtain the best quality data set.

The complexity of a task, S (a), represents an overall judgement about the way a candidate has approached the task. Therefore, two candidates doing the same investigation might approach it differently and therefore achieve different marks. Complexity depends on the demand and

challenge involved in the approach adopted by the candidate and includes such indicators as the familiarity of the activity and method, the skills involved in making observations or measurements, single or multi-step procedures, the nature of the factors which are varied, controlled or taken into account, the precision of the measurements made, and the range, accuracy and reliability of the data collected. Too often 7 or 8 marks were awarded for straightforward approaches to the task. 'Resistance of a wire' investigations were frequently over marked in this aspect.

Strand C: Collecting data
It was pleasing to see that the majority of candidates used suitable ranges of the appropriate variable to study, and appreciated the need to repeat their measurements to obtain a wide range of data. However, a discussion of the factors to control was often rather limited for C(a) and only by inspection of the results table could any evidence be found. Better candidates described in detail how the factors had been controlled and, even more importantly in some cases, monitored them during the experiment. Weaker candidates often stated that factors such as pH, surface area, current or temperature were kept the same, but failed to explain how this was actually done or monitored. Often room temperature was mentioned as being the 'variable controlled' in rates of reaction or resistance investigations which was not the key 'temperature' variable involved.

Preliminary work is essential because, if done properly, it can allow candidates' access to the higher marks of 7 or 8 in aspects (b) and (c). There was more evidence this year that candidates were doing preliminary work to establish the range of values of the appropriate variable to be used C(b). However, although some candidates presented their results in a table they did not use the results to explain how it informed their main method. Centres are reminded again that it is the quality of response and its relevance that is rewarded, and not just that preliminary work has been done so 'jumping through hoops' is not sufficient criteria for success. Too often, candidates did not consider their results as they were being collected so that obvious outliers were either ignored, or included without comment when calculating average values. It was very rare to see that a candidate had performed further repeats to replace the outlier to ensure that the data was reliable and of the best quality. Plotting rough graphs as the data is collected may help candidates to identify outliers as they are collected which can contribute towards credit for E(b), towards defining the trend in the results more clearly, I(b), and for an improved level of confidence in the conclusion E(c).

From inspection of results tables it was pleasing to see that candidates were taking more care and data was generally of good quality. However, there was little evidence of candidates performing preliminary work which involved making decisions about the type of apparatus, equipment and method to choose, to ensure the collection of the most accurate and reliable data [C(c)]. Preliminary work was often simply a shortened version of the main experiment with no attempt to use it to decide on a technique.

Strands I and E.
In general, candidates achieved their poorest marks in these two strands. For more details see the comments in the Data Analysis section. Many candidates still followed the previous Sc1 approach to investigations and used scientific knowledge to make predictions about the outcome of the investigation at the beginning of the investigation whereas the Twenty First Century Science model aims to give credit for candidates who process their results, look for patterns and then suggest explanations using their scientific knowledge and understanding. Very often candidates did not link their conclusions with their scientific explanations, I(c); detailed explanations using relevant scientific theory are best left until they are needed in Strand I.

Some candidates provided further comment about the confidence level E(c) in their conclusions in terms of how close the agreement was to their predictions using scientific theory. Some candidates whilst investigating the effect of length on the resistance of a wire plotted appropriate data and calculated resistivity, and compared this with data book values.

Strand P: Presentation
This Strand was generally fairly and accurately marked by Centres. Spelling, punctuation and grammar were sound and the majority of candidates' reports were well structured and organised. However, experimental methods were rather briefly described and lacked sufficient detail. Diagrams of apparatus were not always included and although data was generally accurately recorded and presented in appropriate tabular form, units were occasionally incorrect or missing.

Final comment
All members of the moderating team recognise the considerable effort needed by Centres in assessing and presenting candidates' work for moderation. We would like to record our thanks and appreciation for a thorough and professional job carried out by the majority of Centres. However, there appeared to be an increase in **errors in calculating the Strand marks for candidates** which resulted in considerable extra work for both moderators and Centres (please consult the administrative issues section in this report).
Attendance at cluster group meetings and OCR INSET meetings both in- and out-of house, using the OCR consultancy service for checking marked scripts, consulting and using the teacher guidance booklets and exemplars on www.ocr.org.uk are all available methods to improve the awareness and understanding of the assessment procedure. It is highly advisable that staff have time during the year for internal standardisation meetings to share and develop expertise in the Science Department.

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