CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT

GCSE

Science A

Session: 2010 June
Type: Report
Code: J630

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GCSE

Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J630**

Reports on the Units

June 2010

J630/R/10

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GCSE Science A (Twenty First Century) (J630)

REPORTS ON THE UNITS

Chief Examiner's Report

The general comments about the performance of candidates in June 2010 are best divided into three separate sections: papers A211 – A213, the Ideas in Context papers A214, and the skills assessment A219.

Papers A211 – A213

All Principal Examiners reported that candidates and centres are now more familiar with free-response questions, which were first examined in January 2010, and that higher tier candidates performed much better in these. Foundation tier candidates, however, continue to find free-response questions taxing. It is also important that candidates are entered for the correct tier of paper; D or E grade candidates perform better on higher-grade objective questions than they do on higher-grade free-response questions.

These issues will be particularly important in the new specification because free-response questions will constitute a larger fraction of each paper, and some will be for more marks – 6 instead of 3 or 4 – so centres will need to develop techniques for supporting weaker candidates in developing the skills of working out exactly what such a question is asking, and in planning their response.

Candidates in all papers showed ability to score well in the objective questions; although these will form a smaller proportion of questions in the new specification, they will continue to be used in the forms currently employed by examiners ('tick the correct box', 'put a ring around the correct term', sequencing, 'talking heads' and comprehension of a short article).

Ideas in Context

Centres are now familiar with this paper, and candidates were generally well prepared for both tiers. There was, as in previous years, a significant proportion of candidates entered for the higher tier paper who found the demands of the paper too difficult and who would have been better entered for the foundation tier paper.

Skills Assessment

The Principal Moderator's report details a number of concerns which he wishes to communicate to centres, relating to administrative issues (including task setting, internal moderation and the use of candidate support materials), marking and candidates' performance (referencing, use of data and evaluation in particular).

It is important that centres read the Principal Moderator's section of this report, as there is much helpful guidance there; some of these issues recur every year, so it is clear that this advice is not always getting to the people who need it.

A211/01 – Twenty First Century Science A (B1, C1, P1) Foundation Tier

General comments

The paper was well attempted and scored a good mean mark, although many struggled with the free response questions. Candidates are now experienced at this style of paper and few make basic errors such as ticking the wrong number of boxes or linking statements with more than 1 explanation.

Comments on individual questions

1a Very few candidates knew that a gene is an instruction for making a protein. Most thought it was an instruction for making DNA.

1b The majority of candidates could correctly identify the two questions which can be answered by a scientific approach.

1c Few candidates were able to identify both an advantage and a disadvantage of having a genetic test for heart disease. Most students confused the test result predicting heart problems with actually having the disease and gave the advantage being that Colin could be treated for this. Most credit came from the disadvantage with worry, inaccurate results and financial considerations being the most popular.

2a More able candidates were able to correctly identify the symptoms of cystic fibrosis. Twitching muscles seemed to be a good distracter.

2b Most candidates were able to identify one of the true statements about carriers of the defective CF allele but few could identify all three. Common errors were the dominant rather than the recessive allele and the development of symptoms later in life instead of the absence of symptoms altogether.

2c Very few candidates were able to clearly identify advantages and disadvantages of using cloning techniques to treat cystic fibrosis and only a small number scored more than 1 mark. The disadvantage mark was achieved most often with references to moral / religious implications. The concept of embryonic cloning was largely misunderstood and it was frequently interpreted as cloning to make a new human not to produce cells, producing answers referring to 'doubles' or reduced life expectancy. Many did not gain the advantage mark because they referred to the treatment of CF rather than the cure.

3a Better candidates were able to identify the process leading to non identical twins but many thought they were produced from two eggs fertilised by one sperm.

3b Better candidates were able to see which statement would lead to a similarity between the twins and which would lead to a difference. The most common error was to think that a unique combination of alleles in each sex cell would make the twins similar.

3c Most candidates knew that Josh and Ryan were male due to a Y chromosome from their father. When a candidate did get it wrong it was because they put X or XY or a word such as sperm in the space provided.

4a Many candidates had no idea about the composition of gases in the air. Many thought that carbon dioxide was very abundant or that oxygen was the most abundant.

4bi The name for compounds containing only carbon and hydrogen was well known. All incorrect responses appeared with hydrogen oxides being the most common.

4bii The method of production of the pollutants was very poorly understood with only a tiny number of candidates correctly linking all four.

4biii Only the most able candidates had any idea about the production of sulfur dioxide from coal-burning power stations. Many ignored the request to identify where the sulfur came from, often just repeating part of the stem (from coal burning power stations). Few used the term react and many simply mixed sulfur and oxygen to form sulfur dioxide. Carbon dioxide was frequently thought to be part of the process.

5ai Most candidates were able to identify the closure of factories and power stations as the cause of the reduction in air pollution in China. 'No cars on the road' was the most common incorrect answer and now and again both this and the correct answer were ticked.

5aii Most candidates were able to identify at least one of the reasons why scientists collected data on air quality during the Olympics. Their use to detect changes in air pollution was the most common correct choice with finding the effect on athletes being a common distracter.

5aiii Only the more able candidates could move beyond the idea that the rain 'washes the pollution away' and descriptions of where it went were rare. Many had not read the question and so some answers referred to weather conditions that would keep people off the roads, reducing pollution.

6a Although many candidates correctly realised that the best explanation for the observations was that a comet or asteroid had exploded high in the air, just as many thought that it meant that one had crashed into the ground.

6b Most candidates realised that asteroids are smaller than planets, with better candidates also realising that they orbit the sun. Common distracters were orbiting the Earth rather than the Sun and coming from other planets.

6ci The global effects of a large asteroid strike were very poorly understood. Most just described the local effects of a normal asteroid strike. Mass extinction and tsunami were the most popular credit-worthy responses.

6cii The reason for the low risk of loss of life due to a large asteroid strike was very poorly understood and correct answers were very rare. Many answers were along the lines of being able to see the asteroid coming and either moving out of the way or blowing it up. Others said that the asteroid would land in the sea or a desert where nobody lives.

7ai/ii Most candidates understood that Copernicus thought that the Sun was at the centre of the planets' orbits while Ptolemy thought it was the Earth. The most common mistake was Sun and Earth the wrong way round. It was rare to see the moon as an answer.

7b Most candidates realised that early astronomers were reluctant to abandon Ptolemy's ideas as they had always worked well. A surprising number misunderstood the question and thought it was due to Copernicus' good powers of persuasion.

8a Very few candidates did not realise that earthquakes are common in Costa Rica because it is on the edge of a tectonic plate.

8b Few candidates were unable to correctly identify mountains or volcanoes as a common feature of places that often have earthquakes and many identified both. ‘Cities’ was the most common incorrect selection. Sometimes a mark was lost because only 1 box was ticked.

8c Most candidates were able to identify both of the actions which should be taken by governments of earthquake prone countries to avoid loss of life from future earthquakes. Some weaker candidates chose to ‘move everyone to another country’.

A211/02 – Twenty First Century Science A (B1, C1, P1) Higher Tier

General comments

This was the second A211 paper to included opportunities for extended writing as opposed to a completely objective question paper. Candidates continue to show confidence in approaching the objective style questions with very few instances of candidates misunderstanding or misreading the rubric. Candidates also appeared well prepared for the free responses questions. However, these questions are generally proving to be more challenging than the objective style questions.

Candidates showed familiarity with the ideas about science tested but in some cases found expressing these ideas in continuous prose difficult eg Q5cii.
The paper assesses understanding of Ideas about Science. Some of the more searching questions on the paper suggest understanding of how scientists judge whether differences in results are real and how risk is estimated is not as embedded in students thinking as the examiners would hope.

The extra challenge provided by the change in style of the exam from last year continues to make it important that candidates are entered for the correct tier of paper.

Comments on the individual questions

1a Disappointingly, few candidates could correctly identify the definition of a gene.

1b This question was well answered by nearly all candidates, who could correctly distinguish between questions science can and cannot answer.

1c This proved to be a difficult question. Some candidates appear not to have recognised that it was a two mark question. They were content to give unqualified answers and so lost marks. Where candidates made reference to employers or insurance companies they often scored two marks, although many thought that Colin might want to keep the results to himself out of embarrassment.

2a The symptoms of Huntington's disorder and cystic fibrosis were well known by the majority of candidates.

2b Weaker candidates tended to repeat the information from the question stem without adding an explanation. However, there were many good answers that showed understanding of the recessive nature of the alleles causing cystic fibrosis and that two were needed to cause the disease. Poor expression often resulted in candidates not gaining credit for the idea that both parents must be carriers.

2ci Most candidates worked out that there was a 50% chance of inheriting Townes-Brocks syndrome, with 25% being the most common wrong response.

2cii Identifying the alleles proved more difficult than calculating the probability. Almost all candidates knew that each individual would have two copies of the gene but a significant proportion thought two dominant alleles were necessary to inherit the syndrome.

3a This question was well answered.

3b Weaker candidates made a variety of errors, many did not recognise that clones can be produced by asexual reproduction or simply misread the question and assumed Josh and Ryan were identical twins.

3ci Only better candidates knew that embryonic stem cells are unspecialised with others suggesting they are “specialised”, “universal”, “clones” or “multi-use cells”.

3cii This proved to be a very difficult question. Many candidates thought that therapeutic cloning involved adding a nucleus from an embryonic cell to an egg cell (options 2 or 4).

4a Well answered by the majority of candidates. Thinking that 1% of the atmosphere was carbon dioxide was the most common error.

4bi All but the weakest candidates correctly answered with hydrocarbons.

4bii Most candidates scored at least one mark. The least well known part of the question was that particulate carbon and carbon monoxide are the products of incomplete combustion.

4c There were many excellent answers to this question, giving correct diagrams and balancing the equation. Weaker candidates did not attempt to balance the equation but most scored at least one mark for correctly drawing carbon dioxide.

5a This question was well answered by almost all candidates.

5b Relatively few candidates were able to explain the effects of weather with many confused references to acid rain.

5ci This question proved to be surprisingly difficult with candidates not being able to correctly read information from the graph, perhaps a skill that needs more time spent on it in lessons.

5cii The idea of overlapping ranges suggesting differences in means may not be real has been examined many times and is a feature of data analysis and investigation coursework. It was disappointing that so few candidates could use these ideas in the context of this question. Most candidates simply compared the means, with very few candidates even mentioning ranges and fewer still using ranges to assess whether differences in the mean were real.

6a Most candidates scored at least one mark here by being able to explain that ice would melt leaving no trace or the absence of a crater suggested a loose structure. However, others lost marks through poor expression or simply repeating information from the table without a qualifying explanation.

6bi Most candidates mentioned only local effects and so gained no credit or managed to gain one for a passing reference to tidal waves or climate change. Answers explaining that large quantities of dust would spread globally and block sunlight causing climate cooling were rare.

6bii Very few candidates recognised that although the consequences are serious, the probability of an asteroid collision is so small that the actual risk is low. This is surprising as similar questions have been asked before. Perhaps a greater emphasis needs to be places on the teaching of risk.

7a Most candidates correctly identified the Sun, Earth and Mars.

7aii This proved more demanding than 7ai with many candidates suggesting A was Mars.

7bi Most candidates correctly identified one correct statement. The most common error was thinking that Ptolemy’s ideas made better predictions than those of Copernicus.

7bii Most candidates gained at least one mark and many two.

8a Most candidates gained at least one mark and many two, with the last statement being the most common wrong answer.

8b Most candidates gained at least one mark for correctly identifying the effects of two of the four actions. Many candidates thought that improving predictions about when earthquakes occur would reduce damage to property.

A212/01 – Twenty First Century Science A (B2, C2, P2) Foundation Tier

General comments

Centres are reminded that this was the first summer session for A212 in the new format, with around a third of the marks from this paper being awarded on open response type questions. Please refer to the OCR website for further details, including specimen assessment materials.

The paper was well attempted and produced a good spread of marks.

Most candidates seem to have been well prepared for the objective style of questioning. A lot of candidates seemed significantly less confident when tackling open response questions. The change in format has produced a lower mean score than last summer.

Candidates should be aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously.

Any marks that are ambiguous – possibly made with the intention that the examiner could give credit for either of two possible responses, where only one is correct – will not gain credit on this paper.

The level of difficulty was appropriate for the ability range and most questions were accessible to candidates across the ability range. The majority of candidates generally performed well and marks were awarded across a reasonable range, demonstrating satisfactory differentiation.

Most candidates correctly followed the instructions in the questions and most made their responses appropriate to the number of marks available. Some, however, did not read the questions carefully enough.

All candidates seemed to have made good use of their time. There was no evidence of candidates running out of time.

Comments on individual questions

1 Most candidates performed well on all parts of this question on plastics. Weaker candidates typically got one of the two correct statements in part (c) and two or three out of the correct choices to part (d). There seemed to be no real pattern to the wrong answers provided.

2. Almost all candidates correctly identified cotton as a fibre made from a living thing. Very few candidates could provide a satisfactory answer to part (bi), which was a free-response question on controlling the experimental procedure. Most candidates repeated the same factor already given (constant length of fibre) or suggested keeping the mass the same throughout. Only better candidates correctly identified the range in part (bii). The final part of this question was also free-response, with a significant number of candidates getting the idea of George's results being less spread out. Unfortunately most then confused the terms 'accurate' and 'reliable' and therefore failed to score the second mark.

3 This question on the electromagnetic spectrum differentiated well at foundation level across all parts. More able students tackled part (a) very well, scoring close to full marks. Weaker candidates seemed to choose almost at random from the list provided, performing best at (aii). Weaker candidates tended to pick up the mark for 'reflects' in part (b) but then mixed up the other two answers.

4 This question was about global warming. The sequencing question in part (ai) was poorly answered across the ability range, unusually for this style of question. Most candidates scored at least 1 mark on the free response question (aii), but weaker candidates failed to identify a clear consequence of flooding. Part (bi) clearly asked for two choices, however many weaker candidates only provided one answer. It must be emphasised to candidates to look carefully at the instruction before answering.

5. Most students responded well to this free response question. The vast majority of students were aware of the possible damage to the skin from sunbathing and most could give a reason why people would choose to sunbathe.

6. The majority of students were able to demonstrate understanding of infection in parts (a) and (b) of this question. Weaker students often could not complete the last sentence correctly. More able students successfully used the information in the graph to answer (ci) whereas weaker students found this a challenging task. In (cii) some candidates presented their answer as two disadvantages rather than one advantage and one disadvantage. Part (d) was generally well answered across the ability range.

7. Part (a) proved easy for all but the weakest of candidates, whereas part (b) differentiated well across the ability range. Weaker candidates got confused with the information provided; often suggesting that aspirin could cause heart attacks. A surprising number of candidates failed to identify Oxygen as the gas needed for respiration to take place.

A212/02 – Twenty First Century Science A (B2, C2, P2) Higher Tier

General comments

Candidates performed well on this paper. There were only a few who would have been better entered for the foundation tier. The paper discriminated well as there was a wide range of marks. All the questions were attempted by almost all of the candidates, with none appearing to have run out of time.

There were better answers to the free response questions than in January. Candidates do need to practise this style of question. They need to understand what they are being asked to do and then write their scientific ideas clearly and concisely.

Candidates, across the whole ability range, do need to be reminded to read questions carefully. Marks were lost on this paper by candidates not following instructions.

Comments on individual questions

1 a Most candidates could correctly identify the statements that explained why polystyrene was chosen in preference to LDPE and HDPE. Many, who did not score on this question, only ticked the first correct box. They needed to work through all the statements ticking each correct one.

b Most candidates scored 1 mark in this question for 1 of the 2 correct answers. The most common wrong answer was that molecules had to be broken when polyethylene was melted.

c Very few candidates scored 3 or 2 marks on this free response question. The majority did not gain any marks. This seemed to be for a number of reasons:

- only giving statements about one of the materials, usually cardboard
- picking different factors for each eg 'cardboard is made from trees but polystyrene comes from a non-renewable source'
- mentioning disposal but not biodegradability or recycling
- saying wrongly that polystyrene cannot be recycled
- lack of comparative words
- some thought sustainability was about how long the material lasted as they wrote about its strength, molecular properties and whether it melted.

2 a Few were able to answer this question correctly. Many wrote that the weights had to be kept the same. Others wrote that the same stand must be used or that it should be kept at the same height. A few wrote that the fibre or the length should be constant. It was evident that many candidates had not appreciated that the aim of the experiment was to find the breaking force for each fibre and therefore this value changed as the fibres were changed. Of those who gave a correct factor about half were able to explain why it should be controlled.

b This was well answered. Most candidates were able to comment on the smaller range of George's results, though fewer continued to say that this made them more reliable.

c The calculation of a mean was also done well. Some of those that failed to score gave impossible answers, such as 9.0 and 0.45. Both numbers lie outside the range of results. Candidates should always check that their numerical answers look sensible.

3 a Many scored at least one mark on this question about the Life Cycle Assessment of polypropylene products. Some incorrectly ticked boxes that applied to the general manufacture or disposal of polypropylene.

b Many candidates across the whole ability range lost the mark on this question because they drew lines from all the left hand boxes. In this style of question the rubric is always clear telling candidates whether each box must be joined or, as here, only one line is needed.

4 a Many scored one mark on this question on the greenhouse effect by putting the first two statements in order and some gained both marks. There was no common wrong answer. Statements put in many different orders were seen.

b This was very well answered with most candidates able to recognise a correlation and a cause. In part ii it was recognised that there were two correct answers. Candidates were given credit for recognising either or both of these.

5 a Many candidates could explain why the ozone layer had thinned, scoring one or two marks. A number of candidates wrongly thought that it was natural chemicals in the atmosphere that reacted with ozone.

b Most candidates were able to name a benefit of sunbathing, but failed to say that this benefit outweighed the risk of skin damage. Some did not read the question carefully. They wrote about sun creams reducing the risk or the perceived risk of sun damage being higher than the real risk. Neither of these answered the question.

6 a This was the most discriminating question on the paper. Most strong candidates gained all three marks. Part ii was the most difficult to score on as many failed to list all three ionising radiations.

b About half of all candidates could identify one true statement about the X-ray of a hand. Fewer could identify both true statements. Common wrong answers were that X-rays are reflected rather than absorbed by bone and confusion over how the light and dark parts of an X-ray are produced.

7 a Most could name the type of microorganism that causes measles. Those that answered incorrectly usually said bacteria.

b Many candidates scored a mark on this question about microorganisms though few were able to complete all the sentences correctly. Incorrect words often found in sentences 2 and 3 were antigens, antibodies and mutations.

c Part i was a common question with the foundation tier and was well answered on the higher paper with most correctly indicating the true and false statements. Part ii was a free response question. Many picked up a mark for spread, but were not explicit enough in their answers to get any more marks. They were too vague or often just repeated the stem of the question. Some able candidates were able to score both marks by writing that the virus mutates so the vaccine no longer works. Part iii was well answered, many candidates

scoring all three marks. Common mistakes were to tick the ‘risks of vaccination to children’ box for the ‘measles vaccine does not work against the flu virus’ and ‘some parents choose not to have their children vaccinated’.

d Another well answered question on this topic with many ticking both correct boxes and almost all being able to identify one.

8 On this question about a blind trial most candidates knew that it involved someone not knowing whether the drug or a placebo had been administered to the patient. Some wrote that neither doctor nor patient knew which drug had been used, confusing blind and double blind trials. The reason why placebos are not used was less well known, with many not answering that part. Some were too vague, saying it was wrong or unethical without explaining why. Those who answered correctly usually said ‘false hope’ or ‘does not cure’ or ‘unfair not to give drug’, but quite a number opted for the psychological effect of the placebo and hence did not get a mark.

A213/01 – Twenty First Century Science A (B3, C3, P3) Foundation Tier

General comments

The paper allowed candidates to perform well and the spread of marks was wide, showing good differentiation.

Most candidates managed to complete all the paper, although there was evidence that a limited number of candidates were short of time, in that those questions which were not attempted were towards to end.

The great majority of candidates seemed to understand the way the questions were designed to be answered, although, in some cases, candidates failed to score because they failed to note key aspects of questions – for example Q5(b) asked candidates to suggest two reasons apart from competition, and many still gave answers related to competition. Likewise, although Q9(c) asked for factors apart from diet, many answers were still diet-related.

Comments on individual questions

1 In part (a), candidates were asked to identify the reason for using radiotherapy. The great majority of candidates were able to do this successfully, although making cancerous cells healthy was a popular wrong answer. 1(b) required candidates to recognise that beta radiation is more effectively absorbed by cancer cells than gamma. This was less well known, and only a minority made the correct choice.
The identification of factors leading to a bigger radiation dose was required for 1(c), and most scored at least 1 mark. In 1(d), candidates were inclined to confuse X-rays with radiation from radioactive materials and failed to score the mark for the job with a risk from handling. Some candidates confused radiation with disease and referred to ideas of infection. Despite this, most scored quite well.

2 Part (a)(i) was well answered – most candidates across the ability range could identify the reasons why electricity is useful. 2(a)(ii), on the other hand, was very poorly answered – few candidates appreciated the idea that electricity is a secondary energy source. Many thought that it was a fossil fuel or renewable. All parts of 2(b) were reasonably challenging, requiring the interpretation of a graph on energy sources. In 2(b)(ii), which asked for a year when gas generated the most electrical energy, a significant minority named a fuel eg coal.

3 Parts (a) and (b), regarding evidence for evolution, were well answered by most. In 3(b) a significant proportion chose the option of “needing to do breeding experiments with mammoths” as a reason why scientists do not agree about the status of the steppe mammoth.

4 Most candidates scored at least 1 mark for part (a), although a minority gained both marks for identifying nervous and hormonal as communication systems in mammals. Very few candidates scored both marks for part (b), by correctly completing the sentences using the terms receptor/response/effector.

5 Part (a) required candidates to indicate 2 observations providing evidence for competition between Neanderthal man and early Modern man. Most were able to give at least one correct suggestion. For 5(b), for reasons other than competition, many candidates still referred to ideas of competition so failed to score. Only a minority scored on this question.

6 In 6(a), most candidates were able to give at least one of two observations supporting ideas of natural selection. Part (b) was not well answered. The requirement was to give reasons why people rejected natural selection. The most popular correct answer was that of religious convictions. Some candidates failed to score as they gave vague answers such as “they did not believe in it” or “there was no evidence” (rather than not enough). There seemed to be some confusion between natural selection and genetic engineering – some seemed to think that natural selection means choosing or not choosing features of children. Few candidates scored both marks.

7 7(a) was not well answered – surprisingly few identified water and vegetable oils as the two ingredients which would need an emulsifier. 7(b) parts (i) and (ii) were well answered – most candidates had a reasonable understanding of food additives and E-numbers. “Colourings to improve appearance” was the most popular correct idea. Candidates giving sweeteners as an answer often did not score the second mark as they said “to make it sweet” rather than “as a sugar substitute”. Fewer were able to draw lines to indicate the elements in carbohydrates and fats for 7(c).

8 Most candidates were able to give at least one way of reducing food poisoning - keeping food cool and maintaining hygiene were the most popular correct answers, but many thought that food should be stored at high temperatures.

9 Parts (a) and (b) were answered correctly by the majority - candidates who were successful were able to handle ideas of risk and benefit. In 9(c), the most common correct answer for a lifestyle factor increasing the risk of diabetes was too little exercise, but many candidates seemed to miss the key part of the question and discussed aspects of diet, while others referred to exercise without saying too little exercise.

A213/02 – Twenty First Century Science A (B3, C3, P3) Higher Tier

General comments

This was the second session in which this paper, as with all Twenty First Century Science papers which had previously been made up only of objective questions, contained about one-third free-response questions. It was clear that candidates were better prepared for this paper and many better answers on the longer questions were seen.

The change in format in these papers will continue in the new specification, with a larger fraction of the papers dedicated to longer, free-response questions, so it is important that centres note in particular the comments on those questions in this paper.

Comments on individual questions

1 (Radiotherapy) The properties of alpha, beta and gamma radiation needed for (a)(i) were well known, but the idea of radiation dose tested in (a)(ii) proved difficult. The free-response part (b) on the ALARA principle was well done by better candidates, who could not only explain the principle but also suggest and explain methods of protecting surgeons in the operations described. Weaker responses to (b) often suggested protection methods such as thick lead screens which would not be practicable in operations.

2 (Generating electricity) The four parts of (a), analysing the energy production graphs, were well done. Most candidates found it hard in (b) to select the two correct statements about Combined Heat and Power stations.

3 (Radioactive decay) Only the better candidates were able to relate isotopes with nuclei containing the same number of protons (a), but more were able to do the free-response half-life calculation in (b). A number of candidates gained one of the two marks in (b) for correctly attempting repeated halving, but a number showed no method at all. Providing this latter group got the answer '60 days', they received both marks, but if they were wrong, they gained nothing: candidates should be encouraged to show their working.

4 (Mammoths) Most knew 'DNA' in (a), and most gained at least one mark in identifying which of Jade's comments in (b) were correct and which were false.

5 (Communication systems) This question focused entirely on knowing the correct biological terms: stronger candidates were well-prepared for this, but average and weaker ones showed considerable gaps in their knowledge.

6 (Natural selection) This question was completely free-response and was successfully attempted by many, with most citing religious belief as a factor in rejecting Darwin and Wallace's theory. The best answers cited also the lack of evidence, or reluctance to accept descent from ape-like ancestors, or the slow pace of evolution preventing its being seen.

7 (Neanderthals) Both parts here were free-response. Part (a) was the most difficult in the paper, targeted at the very highest grade and requiring, for the single mark available, two good reasons for being sceptical about the research. However, most could suggest at least one reason for the extinction of the Neanderthals in (b). Many lost marks in (b) for giving reasons based on competition with early Modern man; this was precluded by the question.

8 (Ice Cream) All parts of this objective question on additives, carbohydrates and digestion were well tackled; in (b)(ii) the difficulty with selecting ‘absorbed’ rather than ‘mixed’ or ‘precipitated’ may have been linguistic rather than scientific for many.

9 (An egg a day) Most recognised Tessa as applying the precautionary principle in (a), but the free-response parts (b) and (c) proved harder. In (b) most could suggest a benefit of eating eggs, but only the best candidates were able to comment on the risk and assert that the benefit outweighed it. In (c), only the best candidates were able to suggest factors needed to assess the risk due to eating eggs: some successfully recognised that you need to know the likelihood of contracting diabetes with and without eating eggs, and also the consequence of the condition; some gained marks by identifying factors that needed to be controlled in a proper investigation of the matter.

A214/01 – Twenty First Century Science A (B3, C3, P3) Foundation Tier

General comments

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.

Centres should be aware that this paper is marked by electronic marking after first being scanned and then fed electronically to examiners. It is most important than 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.

Most centres had clearly used the pre release material to their full advantage and had prepared their students to answer the questions. Most candidates were very good at referring to the pre release material in their answers. However centres should be aware that not using the pre release material to the full, seriously disadvantages their candidates.

Comments on individual questions

1 Part (a) was generally well answered, with most correct answers referring to less people being vaccinated or people entering the country from places that did not vaccinate the population. Other good answers included antibiotic resistant strains appearing and the vaccine not being 100% effective. Answers that referred to badgers and cattle being a possible reservoir of infection were also credited.

Part (b) was not answered quite so well. Correct answers had to refer to the vaccine and not badgers, cattle or antibiotics. Those candidates who read the question and gave answers that referred to the vaccine generally scored at least one of the marks.

Part (c) was well done and most candidates scored both the two marks by correctly identifying Peter and Ranjit.

Part (di) was not well done. Most candidates gave the incorrect answer of Stella rather than Peter. This may have been the result of many candidates being reluctant to use the same name that they had given for the previous question. It was clear that most candidates did not understand correlation and cause.

Part (dii) proved somewhat easier with a large proportion of candidates identifying Ranjit as the correct response.

Most candidates struggled with part (e). Only the most able candidates correctly stated that this would give a more accurate or reliable estimate of the results. Credit was also given for stating that the results vary or that there was a range of results or for stating that outliers may exist and these could affect results.

Part (f) was not well answered. It was clear from question (di) that most candidates did not understand the idea of a correlation. This was repeated in part (f). Only the most able candidates stated that as badgers were culled, or wandered about more, the incidence of TB in cattle increased. Most incorrect answers were just vague statements lifted from the pre release material.

Part (g) was generally well answered. Credit was not given for better cattle control as a more specific response was required. Good answers included less movement of cattle, testing cattle prior to movement, quarantining cattle or more frequent TB tests.

2 Part (ai) was answered well by most candidates. However, all too often candidates failed to read the instruction, that two ticks were required in each row. Indeed, some candidates even read this to mean two ticks per column. These two errors often resulted in lost marks. It cannot be emphasised too strongly that candidates must read each question carefully and fully understand the instructions, before attempting the questions.

In part (aii) it was evident that some candidates had failed to read the question carefully. The question was asking about the effect on cells and answers that did not refer to cells were not credited. Credit was given for stating the cells would be killed, become cancerous, or could be damaged or harmed in some way. Any candidate that correctly referred to ionisation in cells was also credited.

Part (b) was about the effect on human beings. Once again many candidates failed to read the question carefully enough and continued to refer to effects on cells. Credit was given for referring to radioactivity, causing cancer or mutations, or some specific illness such as radiation sickness. Death was also credited. Answers that referred to damage caused by the blast were not credited.

Part (c) discriminated well. Many candidates simply stated a benefit such as an untouched marine environment and were awarded one mark. Those candidates who referred to both benefit and risk were awarded the QWC mark, and those candidates who stated that the risk was low eg the same as background radiation, were awarded the third mark. Candidates who only stated that there was a risk, did not score.

Most candidates answered part (di) well by giving the answers 20% and 14%. These should have been two easy marks for every candidate but a significant proportion, were unable to extract the correct data. It was clear that some less able candidates need to practice their graph reading skills.

Part (dii) was not well answered. Only the most able candidates correctly referred to 10% and even less went on to say that 10% is one tenth of one hundred. Most answers included no reference to numerical data whatsoever and just referred vaguely to sand and coral.

3 Part (a) was well answered with most candidates scoring both marks.

Part (b) was also well answered. However this was mainly due to examiners being instructed to ignore rather than reject answers that referred to making it taste better, smell better or last longer. Far too many candidates took a risk by listing lots of incorrect reasons as to why colouring was added. All that was required for a correct response was to say that it made it look better, to make people buy it, replace natural colours or make the colour match the flavour.

Part (ci) was also well done with most candidates correctly identifying sodium benzoate as the correct response.

Part (cii) was not so well done. Because the question did not state how many food colourings were present in both drinks, many candidates gave an additional third response of sodium benzoate. This immediately negated one of their correct responses. Candidates who gave one correct and one incorrect response, scored one mark. Credit was also given to those candidates who used the correct E-number instead of the name of the colouring.

Part (ciii) was surprisingly well done. The most able candidates gave clear answers about using water as a control to compare with drinks A and B to see what effect the additives had. However, credit was also given for more simple answers that simply stated to see what effect water had or gave an indication of comparison or that water acted as a placebo.

Most candidates scored one mark in part (d). The most common correct response was that the study was too small. Other correct responses included that only children were used or that the study was only carried out in one geographical area. Answers that referred to needing more research or not having enough information did not score.

Part (ei) had five different ways in which the candidates could score the two marks. Most simply stated that it was what the children wanted or that parents gave into the children or gave it as a treat. Credit was also given for stating that the FSA had stated that they were safe, parents did not know the risk, or that the drinks were cheaper or lasted longer. A surprising common incorrect answer was that parents gave the children the drink deliberately to increase their energy or be better at sporting activities.

Part (eii) was not well answered. Once again, there were five different ways the candidates could score the two marks. Correct answers included the idea of an allergy, an unknown contamination such as plasticisers or pesticides, an effect of a named ingredient, such as sugar rotting teeth, unknown long term effects, or even choking hazards. Most candidates failed to score on this question and very few scored both of the marks.

A214/02 – Twenty First Century Science A (B3, C3, P3) Higher Tier

General comments

The performance of candidates was similar to that in 2008 and 2009, showing a slight increase in the mean mark. Candidates are now leaving parts out much less often, but markers report that a number still seem to be struggling with the higher tier paper, and would have been more profitably entered for the foundation tier.
Although about 1 in 10 of the candidates omitted the last page, it is not clear whether this reveals that they were short of time or whether they found these more open parts of question 3 too daunting.

As last year, a number of weaker responses also did not use the pre-release material more than just simply quoting it: although this is often appropriate in the foundation tier paper, higher tier candidates must expect to extend the ideas in the articles using their knowledge and understanding of science.

This paper lays considerable emphasis on 'Ideas about Science', and candidates' responses to question parts assessing IaS 1 (Data), IaS 2 (Correlation and Cause), IaS 5 (Risk) and IaS 6 (Making Decisions) were mixed. Most were able to obtain some marks on these topics, but the more demanding aspects of Ideas about Science, such as data in 1(g), correlation in 1(f), experimental design in 3(b) and risk/benefit analysis in 2(e) and 3(e)(i) rarely received the detailed and considered response needed for full marks.

Comments on individual questions

1 (Badger Culling) Part (a), identifying how cattle may become infected with TB, was well done by most.

Part (b) required candidates to suggest reasons for lack of effectiveness of a vaccine in cattle; part (c) was (very appropriately) about herd immunity and part (d) was about the difficulty of vaccinating badgers. Candidates were often unclear about these three separate issues, and would write answers that might be appropriate for one of the three in the answer space for one of the others.

Most candidates could suggest in (e) a factor responsible for the variation of percentage of cattle infected with TB (badgers moving about was probably the most common) but some thought it was due to there being different numbers of cattle in the different areas.

In part (f), candidates were asked to write down a correlation suggested by Stella's comment ('If I were allowed to kill the badgers I am sure that I could stop my cattle getting TB') and often just repeated or rephrased her statement: only the best candidates realised that a correlation required 'more badgers, more cattle with TB', 'more badgers culled, fewer cattle with TB' or some such statement implying a quantitative link.

Part (g) was very revealing: candidates are good at calculating means, and in higher tier papers can eliminate outliers unbidden. However, this question, asking why an average is a useful measure, proved baffling to many. Only the best realised that an average allows a range of data to be represented by a single 'best estimate' value and allows the elimination of outliers during processing – less than 1 in 10 candidates managed to give two marking points.

Part (h) implied (would it prove that badgers spread TB to cattle?) that the study was incomplete, but only the best candidates addressed this issue: some got one mark for 'No', but got no further, while many answered 'Yes, the badgers act as a reservoir for TB' without realising what the question was asking.

2 (Cleaning up the Marshall Islands) In part (a), most candidates could quote two effects of ionising radiation on living cells, but some referred to effects on the entire organism e.g. 'produces radiation sickness'.

In part (b), few suggested that the degree of contamination varied considerably or that much of the islands were uninhabited, but a number gained credit for stating that soil was needed for plants to grow. The reason for the greater clean-up in England, following the Windscale accident, was usually attributed (correctly) to the greater population and wealth of England, and the closeness of neighbouring countries; relatively few addressed the potential ethical issue that the Marshallese people were few in number with little say in international affairs.

Part (c) required candidates to apply ideas of half-life to thickness in coral, and a number did get the idea of repeated halving, but miscounted the number of stages. A simple '12.5%' with no working gained both marks, but many candidates just wrote a bald answer with no working and got nothing – if they had shown working, they may have gained some credit for the method.

In part (d), a number of candidates confused alkali metals with their compounds, and were concerned about the chemical hazard these metals presented. Many gained credit for recognising that the solubility of these compounds would remove them from the ground in (i), but a number used ideas from (ii) instead to suggest that they were removed by the plants, which was accepted. In (ii), many gave convincing explanations that plants, deprived of potassium, would absorb caesium instead, and that this would then enter the food chain.

In part (e), nearly all were able to state that there was significant benefit, for divers or for Marshallese, in tourists being able to dive in an untouched marine environment, and may also have mentioned the risk of irradiation. Only the strongest candidates correctly addressed the question and explained that the risks were slight in comparison with the benefit.

3 (Food colourings) In (a), many realised that the third drink was a control and gained a mark, but few realised that drinks A and B were both mixtures of additives, some different and some the same.

In part (b), the most frequent points given were that the study was too small, or that it was restricted to two age groups. A number of random answers such as 'you should be cautious because additives can make your child hyperactive' were seen.

Part (c) was well addressed; most realised that removal of these colours made the drinks look less attractive, and the manufacturers might therefore lose money. Some stated that the FSA had tested the additives, so therefore they were safe. A number confused colourings and flavourings.

Part (d) also scored well, with many candidates picking up 2 marks of the 3 for suggestions that: removal of these colourings was possible, they should be replaced with natural colourings, drinks should be labelled so that parents can make informed choices, but that they may be less economic if this were done.

In part (e)(i), many gained the first mark for 'better safe than sorry' or an explanation of the precautionary principle in those terms. Few gained the second mark for stating that it is applied when the risk is unknown, but that the consequences could be serious. Part (ii) gained a mark for many for suggesting an allergic response or choking, but many suggested the presence of sugar as a potential risk, without stating what that risk might be (eg diabetes or obesity) and so did not gain the mark.

A219, A220 Principal Moderator's Report – Skills Assessment

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 help sheets 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
- Grade Thresholds

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, e.g. 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 (i.e. Data Analysis and Case Study or Practical Investigation) and context (i.e. 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 help sheets 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 (e.g. 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, C(a) = 4 and 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	**6**
P(b)	(i) 6	5	

	(ii) 4 (iii) n/a		
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 e.g. 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 i.e. 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, e.g. 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

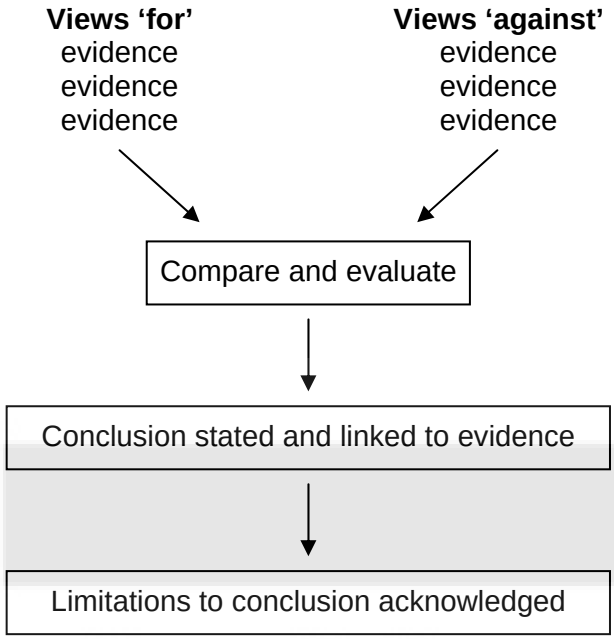
The majority of candidates described the relevant background science in the introduction to their Case Studies. However, it was only the most able who could integrate their scientific knowledge and understanding with the claims and opinions reported in their studies or extend the scientific knowledge 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.



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

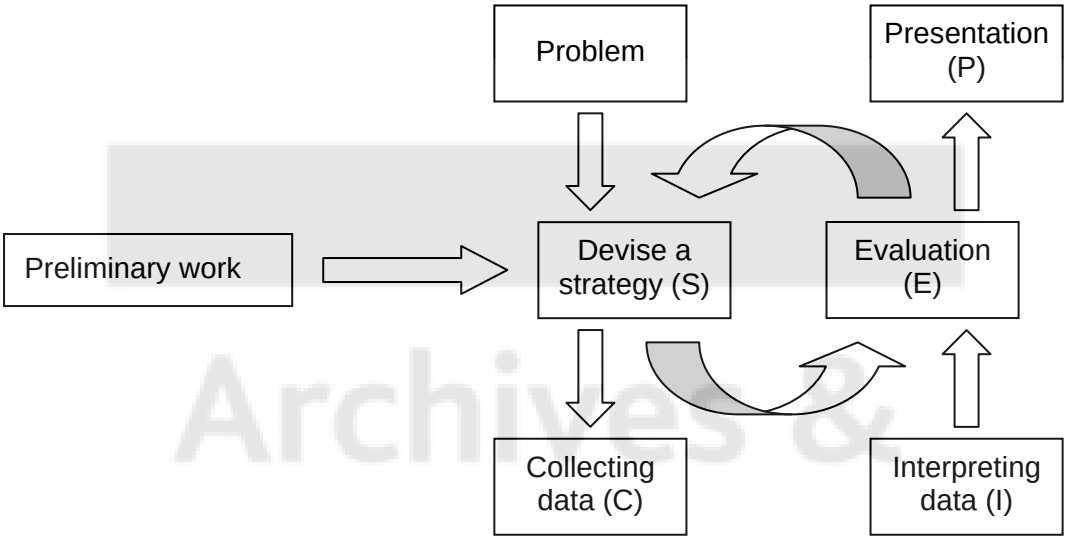
D(a): The majority of reports included headings and/or sub-headings (2 marks) to provide the necessary structure. There was a definite improvement in this aspect and the better candidates included a table of contents and numbered the pages in their report (3 marks) to help guide readers quickly to particular 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, e.g. 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.

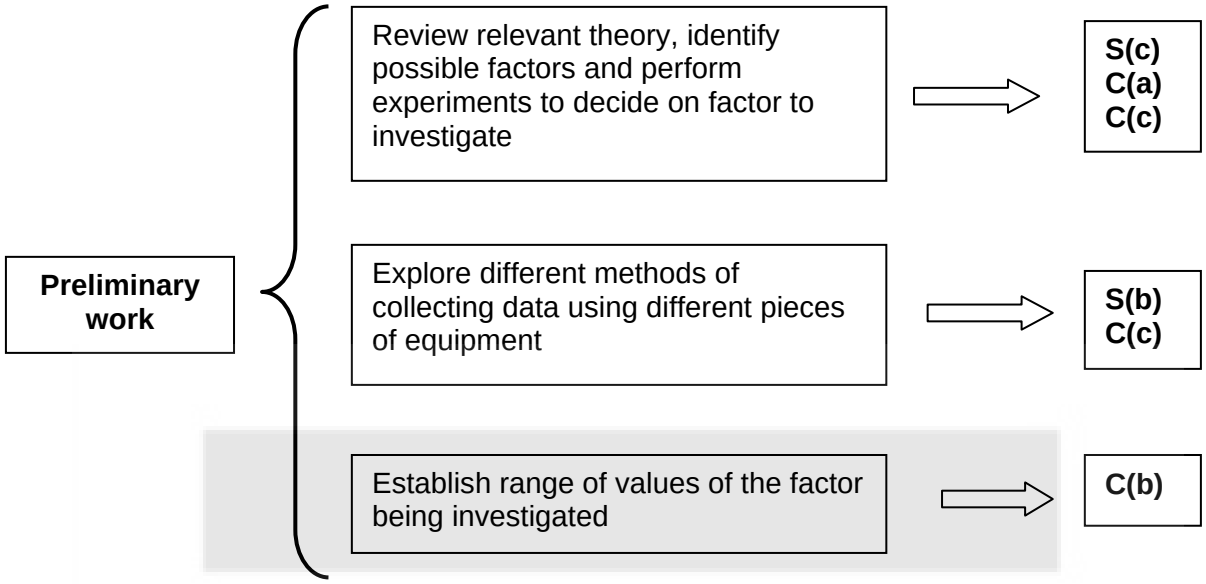


From an assessment point of view the 'performance descriptions' should be used to reflect the quality and performance of candidates' work, rather than a formal/legalistic interpretation of particular words and phrases. There were a number of examples where credit had been incorrectly given for the inclusion 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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