RECOGNISING ACHIEVEMENT

GCSE

Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J241**

OCR Report to Centres

June 2013

Oxford Cambridge and RSA Examinations

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

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

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

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OCR REPORT TO CENTRES

Overview

This is the final session in which the 'mixed' units A141 – A143 are assessed, but these reports will be of use to centres for two reasons:

1 Candidates being submitted for GCSE Science, who will in future be entered for A161, A171 and A181, will still be entering the Science coursework A144, which is different from the requirements for the other Science GCSEs. The Principal Moderator's report on that component for this summer should be read carefully as it contains important pointers for performance in that component.

2 Many of the points raised in this report will be valid for candidates taking biology, chemistry or physics examinations in the next two sessions. This is because the separate-science papers follow the same specifications as the current science papers, and are designed to the same degree of rigour as these papers. It is therefore recommended that Centres look carefully at the Principal Examiners' Reports for all examinations in the 21st Century Science suite – Science, Additional Science, Biology, Physics and Chemistry – together with the relevant papers, as there are generic recommendations which Centres will want to take account of in preparing for future examinations.

There are three generic comments on candidates' performance which were made by the principal examiners, and these are collected here rather than repeated in the general comments for each paper.

1 All examiners commented on the fact that candidates had not seemed to be short of time , and that they had generally used their time wisely, attempting most questions and leaving very few blank.

2 Six-mark extended writing questions are now being done with greater confidence, and greater success, than in the first examinations to feature them, and there are fewer scripts where these questions have been omitted. Centres are to be congratulated on their preparation here, which has resulted in their candidates' greater facility with these questions. However, less well-prepared candidates often limit the marks they can achieve to level 1 by limiting their answers to one aspect of the question rather than the two or three which need to be addressed. It was also noted, particularly but not exclusively on Foundation Tier papers, that the lack of structure provided meant that some candidates gave answers which contradicted themselves.

3 In both Foundation and Higher Tiers, there were a number of instances where candidates had failed to read the specific requirements of the question (such as trying to explain where asked to describe and vice versa) resulting in an incomplete or irrelevant response and a consequent loss of marks. In every examination, at every level, it is always essential for the candidate to scan all parts of each multi-part question before starting it, so that the 'story' developed in it is clear.

A141/01 Science A Modules B1, C1, P1 (Foundation Tier)

General comments:

The time available for the paper appeared to be adequate and the vast majority of candidates completed the paper. In most cases the quality of written communication was satisfactory.

Comments on individual questions:

1 (Cells) – (a) Some candidates were able to give the correct sequence and scored both marks, but there were many incorrect responses containing almost all possible sequences. A common incorrect response suggested that candidates thought the DNA molecule was larger than the chromosome. A number of candidates had failed to recognise the importance of the line above the answer indicating that the largest item should be placed first and listed the items from smallest to largest (albeit correctly), subsequently they gained no marks. In many cases there seemed little understanding about the relative sizes of the structures listed.

1(b) Many candidates gained 1 or 2 marks for this question. Candidates appeared to struggle more with recognising that collagen and enzymes were proteins and a common mistake in the second sentence was mistaking a gene for a chromosome.

2 (Huntington's) (a) The vast majority of candidates correctly identified that Heather's father could not have a genotype of hh.

2(b) Many candidates were able to correctly recall one or more symptoms of Huntington's disease. The full range of symptoms highlighted on the specification was seen, though very few candidates referred to late onset. Some candidates were confused with the symptoms for Huntington's disease and Cystic Fibrosis and, more often than not, if candidates failed to score this was the reason. A number of incorrect responses also showed a lack of understanding of the term of *symptom.*

2(c) This was the first and most challenging of the six-mark extended writing questions on this paper. Candidates made a good attempt at this question, most were able to identify an implication of having the genetic test for either Heather or her family and many identified implications for both Heather and her family. A number of candidates however thought that the genetic test was being carried out on Heather's unborn child, rather than Heather herself. There was also some misunderstanding about the chances of Heather developing Huntington's disease and it "jumping" a generation. Interestingly most candidates focussed on the negative aspect of obtaining a positive result for the genetic test. Candidates found it more difficult to develop their discussion around the implication and many of the responses focussed on Heather and her 'potential' family. Few candidates scored high marks (Level 3) on this question as they failed to consider implications in more than one area, such as insurance issues and job prospects.

3 (Birth Weight) – (a) Candidates scored well on this question, very few candidates did not gain a mark and a large proportion gained full marks.

3(b) A large number of candidates did not score any marks on this question. Many candidates failed to understand what was meant by "a baby's birth weight". Many marks were unfortunately lost as candidates failed to make explicit reference to the *mother's* intake of food/drink/drugs. In addition many incorrectly stated that it would '*depend on how much the baby eats'*

3(c) Candidates scored well on this question and recognised that the father's genes were also an influence in the birth weight of the baby. This was often inelegantly put, but none the less the understanding was there.

3(d) Few candidates appeared to understand what was required from this question and consequently this was not answered well. The majority of candidates failed to score any marks and only a small proportion scored both marks. There were many references to the babies being identical which would therefore result in the same birth weight; or reference to the fact that if there were two babies, it would be double the weight of a single baby. On occasion some candidates recognised that with twins it was likely that the birth weight would be less than that of a single birth, a suggestion of why this would occur was rarely seen.

4 (Hydrocarbons) (a) Many candidates scored at least one mark. Where only one mark was awarded this was more frequently for the correct identification of carbon particulates rather than water.

4(b) Candidates found this question demanding. A large proportion failed to score any marks. There were however, some clear, precise diagrams evident, but many failed to 'balance' the diagram by adding the second molecule to gain the second mark.

5 (Power station pollutants) (a) Candidates found this question very difficult with very few candidates scoring any marks. The question asked why the engineers used the same amount of coal and air in both experiments. Many candidates simply stated that this was to ensure it was a *'fair test'*. Candidates were unable to develop this point further to identify how altering the variables would have had an impact on the outcome of the test.

5(b) The majority of candidates gained both marks for this question. Those awarded one mark gained this for identifying that the more sulphur there is in the coal, the more sulphur dioxide is made. Few candidates failed to score on this question.

5(c) This was the second of the six-mark extended writing questions and required candidates to consider both the pollutants produced by power stations and suitable methods to reduce the amount of pollution produced. The difficult part of this question proved to be in naming the pollutants and many candidates only stated one pollutant thus preventing them from reaching the four marks or moving to Level 3. Most candidates recognised that carbon dioxide and sulphur dioxide were pollutants and on occasion carbon monoxide was mentioned, but fewer candidates referred to nitrogen oxides and carbon particulates.

There were some good examples of methods used to reduce the level of pollutants with candidates recognising the role played by a reduction in coal consumption or use of renewable energy sources. Some candidates misinterpreted the question and discussed the role of catalytic convertors or the effect that the gases had on the environment.

6 (Fuel consumption) (a) Correlations have clearly been taught well with the vast majority of candidates gaining the mark for this question.

6(b)(i) Candidates seemed well practised using graphs to determine data and as a result this question was answered well by most candidates.

6(b)(ii) This question proved troublesome for candidates; the majority did not score as they failed to fully understand the terminology *fuel consumption in miles per gallon*.

6(c) The confusion over the terminology *fuel consumption in mpg* continued into part c and led to many incorrect responses. Candidates failed to realise that at higher speeds the fuel consumed by a car would be greater and that a car travelling at 70mph would consume less fuel over the same distance than a car travelling at 80mph. Many candidates thought that the faster car would use less petrol and would therefore produce less pollution. As a result many candidates failed to score any marks.

7 (Earthquakes) (a) and (b) Both sections were answered well by the majority of candidates.

7(b)(i) The majority of candidates could not recall that both P-waves and S-waves could travel through solids.

7(b)(ii) Many candidates scored 1 mark for using the information presented to correctly deduce that S-waves were slower than P-waves, but a significant number were unable to calculate that S-waves would therefore travel 15km in 3 seconds to score the second mark.

8 (Comets) (a) Many candidates correctly identified that as the distance from the Sun increased the time taken to orbit increased, however few were able to develop this further and discuss that the line in fact got steeper as the distance increased.

8(b) Many candidates failed to plot Encke or did not plot it accurately: as a result few candidates scored two marks. Many did however correctly identify that the data did not fit the pattern because the comet '*did not go round in a circle'*. Often candidates did not score as they simply stated that it was because '*a comet is not a planet'.*

9 (Rock changes) Candidates found this the most difficult of the six-mark extended writing questions to construct a response. This could, in part, be as a result of this question appearing towards the end of the paper, but may also be a result of candidates finding it difficult to make links between evidence observed and the processes involved in producing these features. Many candidates were able to recognise the features that provided evidence for the change over time or gave some idea of the processes involved, but candidates found it difficult to describe the processes in a concise and correct way and link this with the features observed. Many appeared to either describe the features **or** processes only. Very few candidates concluded that these processes must have taken place over many more years than suggested or indicated that the Earth is now thought to be about 4.5 billion years old. As a result few candidates scored at Level 3.

10 (Stars and Parallax) (a) The majority of candidates scored at least 1 mark on this question for using the data to identify that Betelgeuse is closer to the Earth than Rigel. Many candidates failed to develop their answer and explain that this is the reason it '*appears*' brighter. Some candidates lost marks for stating that '*it is brighter'*.

10(b) The majority failed to score on this question. This question proved to be very demanding and demonstrated a lack of understanding of this topic. Those that did gain marks did so for citing the word 'parallax'. Most candidates found it very difficult to explain how parallax could be used to determine distance, though a few candidates did give a very pleasing description of parallax. Rarely were full marks awarded for this question.

A141/02 Science A Modules B1, C1, P1 (Higher Tier)

General comments:

Viewed in subject terms, candidates were equally successful on average in the Biology and Physics questions, but scored only half as well on the Chemistry questions. Candidates did not seem to have found the paper too long.

Comments on individual questions:

1 (Genes)

Although this question was entirely based on simple recall, the marks were generally not good. Even though this specification is now in its fourth examination series, it was clear that few candidates had learnt the new science content that is specified; even in the straight-forward join-the-boxes exercise designed to test recall of the definitions of heterozygous and homozygous, and genotype and phenotype, most candidates earned only one or two marks out of the three available, and only one candidate in nine could write down the name of a structural protein and a functional protein.

2 (Huntington's disease)

In part (a), the Punnett square was generally completed correctly, and most candidates could then infer the probability of inheriting the Huntington's allele. In the six-mark extended-writing part (b)(i), which was also on the foundation tier paper, most could suggest implications to Heather and her family but only about one in ten candidates developed the consequences sufficiently well to get level 3 marks. Part (a)(iii) proved very demanding, with only the very best candidates appreciating that the late onset of symptoms meant that people with the disorder had usually had children and passed on the responsible allele by the time that symptoms appeared.

3 (Birth weights)

Many candidates referred to positive correlation in (a) without specifying what the variables were: others thought the data implied more that was present, giving answers such as 'the mother and baby weighed about the same at birth'. Most could suggest at least one reason for the anomalous values suggested in (b)(i) and (ii), but few in (iii) could justify its inclusion. It is worth noting that Idea about Science 1.6 suggests that data should be used unless there is a reason to doubt its accuracy and not just discarded as an outlier.

4 (Car fuel consumption)

This question proved very difficult for virtually all candidates. Having started with a question identical to 3(a), the difficulty arose because the term 'fuel consumption' implies that a higher value would give a greater use of fuel. This is an understandable reading, but the units of miles/gallon imply the opposite. Candidates who used common sense and the data tables were able to score well, but credit was also given for candidates who notice the change in trend, provided that they used the actual graph y-axis label, ie 'fuel consumption' because those who translated that into 'the amount of fuel used up' would have the wrong answers.

5 (Wet scrubbing to remove sulphur dioxide)

In part (a) many candidates eliminated the incorrect statement (c) but only one candidate in six was able to get the entire sequence correct. In part (b), better candidates chose sensible variables that needed to be controlled and suggested what would happen if they were not: less successful candidates chose inappropriate variables such as time of day, or the amount of sulfur dioxide present. The calculations in part (c) proved too difficult for all but the very strongest candidates, and many who clearly knew what to do had failed to note the emboldened **'before'** and **'taken out'** in the command lines and so calculated the wrong quantities.

6 (Ethene)

In part (a) most candidates recognised that hydrocarbons contain only carbon and hydrogen, although some lost the mark by inappropriately referring to a mixture rather than a compound, or by confusion between atoms and molecules.

In the six-mark extended writing part (b) many revealed good understanding of the effect of the level of oxygen in reactions although not many could get beyond naming carbon dioxide and carbon monoxide. For those that followed the question instructions, molecular diagrams were often well done (formulae were accepted) and a few could balance the equations.

7 (Stars in Orion)

Part (a) was generally well done, and in (b) many recognised that parallax was being indicated (and so gained one mark) but very few could explain how it was used.

8 (Darwin's erosion calculation)

In this six-mark extended writing question, only the very strongest candidates were able to use the data given to show that the Earth must be very old - credit was given even if there were errors in the calculation, as there were a number of steps to incorporate. Many candidates could suggest why the scientific establishment might have rejected the argument but often gave very vague justifications, such as 'Darwin didn't have even evidence'. A number thought that the speech bubble's use of the words 'I assume' implied lack of certainty on Darwin's part.

9 (Earthquakes)

Part (a) was well completed, but in (b)(i) many candidates did not notice that each suggested statement had two components which needed consideration. In (b)(ii) most candidates could identify one of the two correct statements, but only about one in eight got both.

10 (Planetary orbits)

Most gained marks in part (a), but many of the best-fit curves were very scrappy, or consisted of several superimposed attempts. As this was a difficult curve to check, this part was marked leniently, but straight lines were definitely rejected. In part (b) many candidates could perform the tricky calculation correctly, but few could then draw the conclusion, which was that Jo's rule (Jo = Johannes Kepler, whose third law this is) did work – many correctly calculated the value for Jupiter and then said the rule didn't work, because the answer should be different, or stated that the rule didn't work because the values were not all exactly identical. Error carried forward was allowed if the candidate's calculated value was wrong, in which case 'The rule doesn't work because the value for Jupiter is very different' gained credit.

A142/01 Science A Modules B2, C2, P2 (Foundation Tier)

General comments:

The paper was well attempted with few blank spaces.

Comments on individual questions:

1(a) This first question was testing the candidates' knowledge about crude oil. Many candidates ticked the correct boxes for all three questions and few got all three wrong. Most candidates said crude oil was refined by drilling or filtering. Possibly they don't understand the word refined. The sea was a common incorrect response.

1(b)(i) This question was looking for the properties of metals and plastics that makes them suitable materials for plates used by people who go camping. It does not ask for general properties but specific ones linked to camping. eg unbreakable, lightweight and non-toxic. Many candidates gave general properties.

1(b)(ii) Here candidates were asked how cross-linking in a plastic change the properties of a plastic. The ticks should have been placed in the harder and less flexible boxes. Many candidates ticked the correct two boxes.

1(c) Candidates were asked to explain how adding plasticiser lowers the melting point of the plasticiser. They did not understand the role of a plasticiser. Most candidates did not equate a lower boiling point to a lower temperature. Most responded by saying there were more particles so this would INCREASE the boiling point. Few mentioned forces or distances as asked in the question.

Some candidates did not attempt this question.

2(a) Many candidates scored well, but of the incorrect responses, common ones were giving kinds of material such as rubber or metal.

2(b) This was the first of the six-mark extended writing questions. The question gave a lot of information and asked candidates to use the information to explain why they would chose one cord and not the others. Most candidates scored two marks as they considered only the reasons for selecting their chosen cord. Quite a few candidates didn't even mention the other cords. Very few explained why any of the other cords were unsuitable. Most candidates failed to consider in their answers the three safety rules asked for in the beginning of the question and answered the question from the information provided immediately below the table. They wrote very little about how stretchy the cords were. Most pupils went for cord D with the reason it can hold the most mass and is therefore the strongest.

2(c)(i) A well answered question by most candidates.

2(c)(ii) Candidates were asked why the minimum mass was a more useful piece of information.

This was poorly answered. It was obvious that quite a few candidates understood what was being asked of them but had no idea how to word their answer. Most said the range and mean were not precise numbers and did not link to the fact that the

minimum mass would be lower. Many said that the minimum showed the least amount the cord could take. They could not explain that the minimum mass to break the cord was the maximum it could hold. Safety was not mentioned very often.

2(c)(iii) 'Why do you test five pieces of cord rather than one?' was the question asked. There were lots of answers about fair tests and saying that you have to do five to make it accurate. If a mark was scored it was usually for saying it was reliable or for a mention of outliers.

3(a) Digital and analogue signals constituted the focus of this question. Candidates were asked to place five signals into one or other category. It was done reasonably well but a large proportion of candidates scored 1 mark for getting the signals the wrong way round.

3(b) The advantages of digital signals was asked for. Very few candidates scored a mark. Most commented on digital signals not picking up noise, or made something up about digital being faster or clearer. Quite a few simply used knowledge about digital TV. Another common response was the idea that digital is either on or off; 1 or 0.

4(a) This question is about the ozone layer and how it protects living organisms. This was reasonably well answered and many candidates scored all 3 marks. Most candidates scored at least 1 mark. The damage to living cells was most often correct. The most common wrong answer used 'transmits' instead of 'emits'.

4(b) Candidates were asked why radio waves do not damage living cells. There was a bit of guesswork here as some got this right, but not a huge number.

4(c) Data about the ozone layer over the North Pole was given and the question wanted to know how to reduce the increased risks to health as a result of a hole in the ozone layer. Most candidates did not understand the question and were discussing ways to reduce carbon dioxide levels and linking to global warming. They talked about burning less fossil fuels and the greenhouse effect. One mark was given for an action eg applying sunscreen and the second for the action preventing UV radiation from getting to the skin. Some candidates did not attempt this question.

5(a)(i) The question is about the Sun's energy and its effect on the planets closest to it. Most candidates scored one mark for saying that half of 12000 is not 3000, but 6000. Not many candidates correctly identified the correlation. The strongest candidates did identify the correlation but many did not go on to say that half of 12000 is 6000 etc.

5(a)(ii) In this question there was no mark for stating whether Jim is correct or incorrect. The justification is what is important. Many candidates scored one mark for identifying the 1500, however a larger number of candidates simply guessed and linked the value to Earth's distance of 150 million km saying the numbers were similar. Of the candidates who did understand why 1500 was the correct answer many did not compare the distances to score two marks.

5(b) This is the second of the six-mark extended writing questions. Information was given about various gases found in the atmospheres of Venus and Earth. Candidates were asked why Venus is so hot and why this makes scientists concerned about the future of the Earth. Nearly all candidates scored two marks for saying the Venus has lots or 97% carbon dioxide. Many candidates then went on to write about Venus exploding or passing its carbon dioxide to Earth as the Earth is 'close'. Not many candidates used a comparison of CO_2 levels linked to the greenhouse effect or consequences for the Earth.

6(a) This question asks about on which walls is blood pressure measured. It was very poorly answered, and there was no clear trend in wrong answers.

6(b) The reason for the two different values given in a blood pressure reading was unknown to all but a handful of candidates. There were many different wrong answers, such as heart beating fast / slow.

6(c)(i) Given a table of data, candidates were asked to make a conclusion about Joanne's blood pressure. The straight forward answer of normal was not always given.

6(c)(ii) A calculation was required here but few candidates calculated the correct answer of 90 - 79 = 11.

It is hard to say whether this was a mathematical issue or an understanding issue, probably a little of both.

6(c)(iii) After being given medication to lower blood pressure by his doctor Candidates were asked how effective this had been. The idea of partial effectiveness scored one mark. Few candidates commented on the effect it had on **both** higher and lower values or they just gave the values and no comment on category.

6(c)(iv) The question asks how a lower blood pressure would benefit health. Most candidates did not score as they had misunderstood the question and were writing that he should exercise more, or should have a healthy diet, etc, instead of it lowering the risk of various illnesses.

6(d)(i) This question asks candidates to draw a line on a graph to show the correlation between the number of fizzy drinks consumed and the risk of having higher blood pressure. Most candidates drew a positive correlation, although few used a ruler.

6(d)(ii) The answer 'yes' or 'no' did not score but the correct explanation was needed to scored the marks.

Most candidates scored one mark for saying that other things could be causing his high blood pressure, some but not many mentioned Andrew is just one case. The idea that the correlation between high blood pressure and fizzy drinks does not ***mean*** that fizzy drinks cause high blood pressure was hardly ever seen.

7(a) This is the third and last of the six-mark extended writing questions and it was the highest scoring six-mark extended-writing question on the paper. It asks how vaccination will work to protect girls against the HPV virus. Overall the vast majority of candidates had some knowledge of vaccination and frequently accessed Level 3 marks. Some candidate got key words like antibody/ antigen mixed up and quite a few gave poor vaccine contents by saying it contained the cancer or the disease. Often the immunity or the role of memory cells was missing.

7(b) After giving some information, the question asks which person is basing her decision on scientific facts. Most candidates identified Anne and said she knew about the side effects. Not many then went on to state the benefits. Tracey was the most popular wrong answer as candidate clearly saw seeing a Doctor as scientific. Candidates were not as clear on benefits outweigh risk, mentioning only the low risk of side effects.

7(c) Despite a death after a vaccination, the programme was continued. Candidates were asked for the two best reasons. This was answered well with no clear trend in wrong answers.

A142/02 Science A Modules B2, C2, P2 (Higher Tier)

General comments:

The examination started with a six-mark extended writing question, and candidates should be congratulated at not being put off by a challenging first question.

There was no evidence of a lack of time, the questions most commonly left blank were Q8(c) and Q6(b), and there was very little evidence of responses finishing in mid sentence, indicating that candidates generally paced themselves appropriately.

Candidates usually chose the correct number of options with few common rubric errors, with the exception of Q4(d).

Comments on individual questions:

1(a) This question asked candidates to explain their choice of bungee cord, and why they chose this cord "and not the others". Unfortunately many candidates gave detailed answers for their choice, but only addressed the properties of that one cord thus severely limiting their marks. Weaker candidates tended to choose cord D as it was the strongest although it did not extend enough. A distractor for the better candidates who realised that extending the cord was important in bungee jumping was cord B although it stretched too much. A weak response considered only 1 cord; a better response considered other cords, but not completely or selected an inappropriate cord; a good response considered all the cords and came to the correct conclusion (cord C).

1(b) In this calculation, many candidates correctly obtained 9.6 cords and the majority recognised the need to round this up to 10 cords. Those who did not gain credit were characterised by an inability to correctly substitute into the given equation.

1(c)(i) Almost all the candidates recognised the outlier correctly, but many were focused on the idea of fair tests or statistical arguments rather than considering the purpose of the experiment in relation to real life, and how the need for safety overrides these statistical ideas.

1(c)(ii) In this question of overlapping ranges, Carly was a distractor for weaker candidates with a generically true statement that did not address the question of "Are they different?". Anna and Dan talk about the right sort of ideas so were a distractor for the candidates with an incomplete understanding. Ed is simply wrong, but was chosen by a significant number of candidates, possibly the result of poor reading rather than wrong knowledge.

1(c)(iii) This question about "wear and tear" was well answered. The most common error was choosing response D, a plausible response but not the best answer available.

2 This question asked the candidates to use ideas about "forces and molecules" in their response. Many candidates failed to do this and so limited the credit that could be awarded.

Many weaker candidates failed to refer to boiling points at all, and were therefore unable to get credit for explaining why the boiling points were different. Other candidates described the process of fractional distillation rather than addressing the question.

The idea that higher boiling point relates to stronger forces was often seen, while the relationship between chain length and boiling point was also grasped by the strongest candidates.

A common confusion was using intramolecular rather than intermolecular forces.

3(a) A question about polymer strength where most candidates correctly chose the second response "The forces between polymer molecules are larger". However, underlining the issue of intramolecular forces in Q2, many candidates chose response five "break bonds in the molecules" rather than response six "pull the molecules apart".

3(b) In this question on flexibility, many candidates correctly chose "addition of a plasticizer" for 1 mark, but fewer referred to chain length or cross links. Temperature change without an explanation linked to the structure did not achieve credit.

4(a) Many candidates scored well on this question about the process of ionisation, showing a sound understanding of the concept.

Common errors included transposing the first two responses, "high energy electrons can remove photons..", while "molecules" and "ions" were correctly selected by many for the third and fourth responses.

4(b) Most candidates correctly identified that "radio photons do not have enough energy"; the most common mistake was to say that "radio waves do not consist of photons".

4(c) Despite the question referring to ozone and health risks, many candidates gave answers about carbon dioxide (eg "use less fossil fuel") and so gained no credit. Those who related their answer to ozone depletion issues usually also gave an appropriate explanation and so scored both marks eg "use sunscreen because it absorbs UV".

4(d) This question about how UV affects ozone proved surprisingly difficult for many candidates who drew three lines even though the need for **one** line was in bold in the question.

5(a)(i) Here candidates were expected to identify that the solar constant is the same as intensity, and although this was the most common answer, the other responses all appeared as wrong answers with no obvious pattern.

5(a)(ii) Most candidates were unable to continue the pattern in the data and get 500J/s/m^2, with many having a suddenly change in correlation and the solar constant increasing with distance.

5(a)(iii) The correct response "Moon is much smaller" was the most common response, with "Earth has an atmosphere/oceans" a common distraction.

5(b) This question asked the candidates to explain the processes behind the difference in temperatures, and was looking for the global warming effect.

As a six-mark extended writing question, there were many ways to respond, but generally identifying CO_2 as the key gas got some marks, realising that it trapped heat got more credit, while explaining how IR radiation gets in but not back out was needed for full marks. Links to concerns of global warming were generally correct.

Many candidates seemed to misread the question and described photosynthesis, ie they explained the difference in atmospheres, not the difference in temperatures.

Weaker candidates were persuaded that the proximity of Venus to the Sun was important, even though they were told that it was much hotter than would be expected at that distance. Talking about the amount of ozone was also a common error.

6(a)(i) Many candidates struggled to identify that digital signals have a binary state, either 1 or 0. Common mistakes included repeating the question "the y axis is not needed", or that it was an analogue signal.

6(a)(ii) This question asked for differences between the two signals and had 2 marks, a disappointing number of candidates only made one observation. The usual correct response was "noise", far fewer candidates recognised that A had a higher frequency.

6(b) Candidates struggled with this question about the reasons for using IR and radio waves. A large number of candidates gave uses rather than explaining the different circumstances, ie that radio waves are used in the atmosphere and IR in optical fibres, as the media do not attenuate the signal excessively. Of those who scored only one mark, the majority had the radio idea. Many candidates left this question blank.

7(a)(i) A great many candidates successfully described "normal", although a few contradicted themselves with phrases such as "normal hypertension".

7(a)(ii) Candidates had to calculate how much a pressure of 90 has to be lowered to get to 79. Most candidates who failed to gain credit used the wrong numbers supplied, rather than making arithmetic mistakes. For example "moderate hypertension" goes from 90 (the value given) upwards while normal goes from 60 upwards, which probably explains the commonly seen wrong answer of 30. The wrong answer 40 (the gap for the higher value for blood pressure) was comparatively less common, perhaps suggesting that candidates knew what was expected but struggled to interpret the numbers.

7(a)(iii) Most candidates scored in the question on effectiveness, but most only got one mark for "partially effective" and then failed to supply the justification that the higher value was unchanged while the lower value had reduced to normal, to gain full credit.

7(b)(i) Most candidates managed to draw a suitable line on this graph. The main error was in putting a series of crosses with no line drawn, suggesting that those candidates may have come to the examination without a ruler.

7(b)(ii) In this question on confidence in scientific studies there were several common mistakes. Many candidates put that the study being done in the USA or in 2011 made them less confident, while being funded by a juice company or being peer reviewed made no difference.

7(c) Candidates had to use data from a graph to describe how age affects the risk of heart disease death for men and women. Most candidates realised that age increased the risk, while far fewer also noted that the gap between the genders closed with age. Many candidates gave explanations rather than describing the trends for example "the increase is because as you get older you exercise less".

Q8(a) Many candidates failed to identify that the pituitary releases ADH. Common mistakes were kidney, brain or bladder.

Q8(b)(i) This question on the mechanism of controlling water level during exercise proved challenging, even though candidates were only required to select the correct word from a choice of two, for each of the five stages. Many candidates could correctly select the response for "what happens to the concentration of urine when exercising", and "the amount lost in sweating" but then made errors when looking at the role of ADH.

8(b)(ii) This question on ordering the process of water control again exposed weaker candidates' problems with the role of ADH. There was no obvious pattern of wrong responses.

8(c) This question on negative feedback caused problems for many weaker candidates. It was apparent that many were confused about the meaning of "negative feedback" for example saying it was "something with unwanted consequences", "unhealthy" or "not good feedback". Of those who were successful, most realised that it described the link between water level change and ADH production, but struggled with the idea that this would reverse the change. This question had a significant number of blank responses.

9 This six-mark extended writing question about the benefits and risks of vaccination needed more detail from many candidates. It was common to see the risks extensively addressed "Why girls should not be worried", but to have the benefits ignored "why the vaccination programme should continue". Candidates with structured answers tended to score better than those who made a series of points. A low level response considered EITHER benefit or risk; a better answer considered benefit AND risk for a girl; a full answer also addressed the best outcome for the greatest number of people, such as herd immunity, elimination of the virus, reduced NHS costs, etc. Many weaker answers focussed on how the vaccine works, rather than reasons for using the vaccine.

A143/01 Science A Modules B3, C3, P3 (Foundation Tier)

Comments on individual questions:

1(a) Almost half the candidates selected 230V as the mains voltage. The most common mistakes were probably the 500V and 2300V options.

1(b) Many of the weakest candidates left the power calculation blank, but those who did attempt it often scored both marks. There was some evidence that some candidates did not have access to a calculator. A mark was available for showing correct working in the case of candidates who did not get the answer correct, but this mark was very rarely accessed. A significant number of candidates omitted this question.

1(c) The calculation of the cost of operating the saw performed in a similar same way to the power calculation. The most common response was to multiply number of hours by cost but not by the power of the saw, and so get an answer of 200. A significant number of candidates omitted this question.

2(a) While a significant number of candidates mistakenly chose biofuel as a non-renewable resource, most candidates were able to correctly select at least one of the options. Coal was strongest recognised than nuclear.

2(b) Many candidates appeared to have problems with the concept of sustainability. “Using natural resources” and “using as few resources as possible” were the most common choices.

3(a) Most candidates were able to put ‘furnace’ into the correct place in the block diagram, while “motor” was often selected instead of “turbine”. The strongest candidates were able to score all three marks.

3(b) A large majority of candidate correctly selected the advantage of a hydroelectric power station as being that it does not give off carbon dioxide.

3(c) Very few candidates seemed aware of what hydroelectric power stations did. Very few realised that access to water or a suitable terrain would be significant with many suggesting a shortage of wind as the main problem, or the disposal of radioactive waste. The most common response was to suggest that it was too expensive. A significant number of candidates omitted this question.

4 This was the first of the three six-mark extended writing questions on the paper, and it allowed candidates to show that they can interpret data. Almost all attempted at least one comparison and it was rare to see responses that just turned data into sentences.

However, this question did also expose some severe weaknesses. Many candidates did not discuss the possible effect of rising fuel costs. Re-reading the question at the end to check that all points had been covered would have enabled many candidates improve their response and receive more marks.

There was also confusion over the meaning of the table. Some candidates assumed that the choice was between installing 270 mm of insulation and installing 100 mm. Many candidates also confused the time taken to pay for itself with the time the insulation would last, or with the time by which it had to be paid off. A common suggestion for the effect of increasing fuels costs was that it would increase the cost of the insulation, without reference to any possible savings.

5(a)(i) This question proved surprisingly difficult for many candidates to read off the fall in bee numbers from the graph and there was a huge variation in responses.

5(a)(ii) Strongest candidates realised the significance of the instruction to "justify your answer" and linked the drop in bee numbers to a fall in fruit production. However, many candidates appeared not to read the statement in the stem that bees pollinate fruit trees and suggested that the bees ate the fruit, or did not link the fruit production to bees in any way.

5(a)(iii) Strongest candidates were able to point to the sudden drop on the graph as the evidence for when the mites were introduced.

5(a)(iv) A significant number of candidates were able to suggest one reason for the levelling off in the rate of decline of the bee population, with the death of mites and adaptation by the bees being the most common suggestions. However, many candidates discussed reasons for the decline rather than the levelling off of that rate of decline. A significant number of candidates omitted this question.

5(b) This part was very well answered; most candidates were able to identify which statement was talking about data and which about an explanation. The most common mistake in 5bii was to tick one box only, even though the instruction to choose two options was **emboldened.**

5(c) Many candidates were able to describe monoculture or to offer some suggestion as to why it might reduce biodiversity, and the strongest candidates went on to do both. A large minority of candidates omitted this question.

6(a)(i) This question differentiated well, with a large number of candidates able to correctly classify some of the adaptations as behavioural or physical, and far fewer able to classify them all. Candidates had most difficulty in realising that the oil glands which were used to spread oil over feathers were both a physical adaptation and also behavioural.

6(a)(ii) This was the second of the three six-mark extended writing questions, and it allowed candidates to express their understanding of how penguins have evolved. Examiners allowed two different approaches, either a description of the evolutionary process in general or an explanation of the particular adaptions in Adelie penguins. Most candidates went down the latter route, and while the weakest candidates limited themselves to repeating material which was given in the question, the strongest candidates were able to put forward their own reasons for each adaptation being an advantage.

Examiners were surprised by the number of candidates who suggested that penguins have fur.

6(b) Many candidates were able to suggest ways in which changes to the environment would lead to Macaroni penguins becoming extinct. The most common changes were warming of the ice sheet leading to loss of habitat, and the effect of new predators or of man.

7(a) Most candidates were able to link the geological processes to their descriptions, though they had much more difficulty in identifying the ripples on the rock for 7(b). "Water evaporating" was the most common choice.

7(c) This question was generally well answered, with many candidates giving good descriptions of the movement of tectonic plates. Weaker responses concentrated on the fit between continents, missing the ideas of both tectonic plates and of movement.

8(a) Filtering or evaporating were common suggestions for the method of getting salt from water. Examiners did not allow evaporating, as the question so specifically referred to the salt, not to the water.

8(b) Candidates showed surprising difficulty in suggesting problems that might be caused by salt subsidence. While collapse of houses and risk to people were the most common credit-worthy answers, many marks were lost by general statements such as harm to the environment or loss of habitats. Some candidates merely repeated the stem of the question.

8(c) A significant number of candidates omitted this question, and many more suggested that people accepted the risk of living in a subsidence area because of the chance of cheap salt.

9(a) This question clearly differentiated between candidates of different abilities. The strongest candidates commented on the graph in detail using dates and number of deaths as reference points and clearly understood the effect of chlorine on typhoid bacteria. Weaker candidates could describe the decrease in deaths and were able to link this to chlorination, but only at the level of "chlorine cleans water".

Some candidates were concerned about possible dangers of chlorine to the exclusion of its benefits, and not only blamed the deaths on chlorination but also thought that the graph showed an increase in deaths.

9(b) While half the candidature could correctly extract the numbers from the graph, that half was equally spread across the whole ability spectrum. A common error was to put a series of zeros after the 30 and the 7.

9(c) Most candidates were able to identify at least one reason why chlorine is added to water even though it is itself harmful, and the strongest candidates identified both. A significant minority only ticked one box, even though the instruction to choose two options was emboldened.

A143/02 Science A Modules B3, C3, P3 (Higher Tier)

Comments on individual questions:

1(a) Candidates were asked to identify key stages in the generation of electricity in a coal-fired power station. The majority scored at least 1 mark for identifying two stages correctly. Candidates had problems identifying the furnace, although any idea of combustion was accepted for this stage. Steam was a common incorrect answer.

1(b) Few candidates were able to make a full comparison between wind and coal as energy sources and a significant minority did not score.

2 This was a six-mark extended writing question. Candidates were required to use data on loft insulation in houses with no insulation and topping up existing insulation, to give a comparison of cost-effectiveness and also consider the effect of rising fuel prices. There were some good answers, where candidates addressed all aspects of the question, but others failed to mention the effect of rising fuel costs, and so the available mark was limited.

Most candidates were able to make correct comparisons, although some thought that pay-back time referred to loans / financing for the installation, and again that column 2 was better because the householder had longer to pay! References to fuel costs were often vague, with many candidates focussing on possible increasing costs of insulation rather than increased savings.

3(a) Candidates were required to state why an efficiency calculation using power was equivalent to one using energy. The relationship between power and energy was very poorly understood and very few correct answers were seen. The majority of candidates said that power and energy were the same thing or that both can be used to calculate efficiency.

3(b) This question called for a calculation of efficiency of a transformer using input voltage and current, and output power. Only a very small number of correct answers were seen. Many candidates just divided the output current by the output power. Credit was given for the use of an incorrect value of the output voltage of 110V and some candidates scored a mark here.

3(c) As this question asked for a statement AND an explanation about how a saw would perform with a low efficiency transformer, very few candidates scored this single mark. Many thought that the saw would work better, faster or more efficiently at 25%.

4(a) Most candidates were able to identify at least some statements about nuclear power as true or false and scored at least 1 mark.

4(b) This question required candidates to explain why contamination is more hazardous than irradiation, and the majority of candidates failed to score. Some candidates started off well by saying that contamination gets inside the body but then talked about irradiation only touching the outside or your skin. Several also referred to radiation getting inside your body or inhaling radiation rather than waste or material. A few candidates had the idea of being *infected* by contamination and being able to pass the contamination on to other workers/family or to unborn children.

5 This was another six-mark extended-writing question asking how and why scientists classify newly-discovered organisms. Most candidates scored at least two marks and there were many good descriptions of how classification is carried out, but fewer correct reasons why. Weaker candidates made reference to behaviour, habitat, food chains and dangerous species, presumably because of the mention of venomous sea snakes in the stem.

6(a) The majority of candidates were able to identify correct statements based on a graph showing the decline of bee colonies in the USA.

6(b)(i) Most candidates could use the graph to explain a decision as to whether mobile phones could be the cause of the decline of bee colonies.

6(b)(ii) This question was not well answered - few candidates could give two reasons why people are concerned about the use of land for monoculture. Some candidates answered this question with information about bees and how monoculture affected their population. Correct answers included a disease wiping out the whole crop, loss of habitat or reduced biodiversity. A few candidates mentioned reduced soil fertility, spoiling the landscape or monoculture not being sustainable. Some candidates clearly did not understand what is meant by the term monoculture, so answered that a monoculture would remove land that was needed for food production.

7(a) Candidates were able to decide whether features of a penguin are physical adaptations, behavioural or both.

7(b) Using information provided, candidates were asked to suggest and explain what effect whale hunting would have on penguin populations. This question was very well answered, although some candidates felt that whales or krill would eat the penguins.

7(c)(i) This question was less well answered – only the strongest candidates appreciated that the definition of a species includes a requirement not just to breed together but to produce fertile offspring.

7(c)(ii) The great majority of candidates were able to suggest man-made and natural changes to the environment which might contribute to the extinction of the penguin, but weaker answers failed to fully explain how penguins would be affected. Problems also arose where climate change was given as an answer but the candidate failed to explain whether it was a man-made or natural change.

8(a) Candidates were required to identify and explain which of two samples of sandstone was formed in a desert and which under water. One mark was readily available for a comparison of the appearance of the stones shown in the two diagrams, but correct references to erosion were rarely seen. Few candidates were aware that water had acted as a cushion or that there would be more violent collisions in the desert. Most candidates appeared to think that water would cause more erosion and make the stones more rounded, possibly from experience of pebbles on a beach.

8(b) In this six-mark extended writing question, candidates were asked to describe and explain conclusions from data on the age of rock and the angle of the magnetic field. The trend was easily identified for Level 1 marks. An explanation in terms of moving land masses was less commonly seen, for Level 2 marks. Credit was also given for suggesting the changes in the earth's magnetic field was the cause and this was more commonly seen. Level 3 required candidates to support their idea with a clear reference to the data- as might be expected, few candidates met the full requirements for 6 marks but most were able to score at least 5 marks.

Some candidates confused angle of magnetisation with strength of magnetism, eg "there was no magnetism in the beginning and magnetism has been getting stronger". There were also suggestions that magnetism pulled the rocks to different positions.

9(a)(i) This proved to be a quite demanding question – rather surprisingly, few candidates were able to obtain correct figures for deaths per 100 000 in 1890 and 1945 from a graph of typhoid deaths. The fact that the graph showed deaths per 100 000 often led candidates to multiply by this number.

9(a)(ii) Very few candidates could then use these figures to calculate the total number of deaths in those years. Some candidates failed to score because of mistakes in the number of zeros.

9(a)(iii) Most candidates were able to select at least some correct reasons why the graph is plotted per 100 000 rather than the total number of deaths, but few scored both marks.

9(b) The question asked for reasons why it took 50 years after drinking water was first chlorinated to stop deaths from typhoid in London. It was not well answered, with few candidates giving two clear credit-worthy suggestions. Use of muddled language often prevented candidates scoring. An example would be where they stated that it would have taken a long time to chlorinate all the water in London, rather than to supply chlorinated mains water to all houses. Candidates often said that it would take that long to find the correct dose.

9(c) This question was very well answered. The benefits of using chlorine, despite its risks, were well known.

10(a) Few candidates were able to suggest reasons, apart from the availability of salt, why the chemical industry started in the North-West of England. Despite the question, many candidates referred to the presence of salt reserves or the possibility of extracting salt from the sea. Others suggested the area is not populous, so industry would not affect too many people. Some candidates were thinking in terms of providing employment where there were not many opportunities. Availability of transport was a popular way of scoring a mark.

10(b) This question asked candidates to complete a flow diagram showing the process of extracting salt and using its products. Most scored a mark for one or other of the first two responses (dissolving and electrolysis). Few could identify sodium hydroxide being produced to make soap, and thus two marks were rarely awarded.

A144 Science A Controlled Assessment

General comments:

In this session, many Centres are to be commended for the way in which the Controlled Assessment unit has been administered, implemented and assessed, but the transition from A219 'coursework' in the previous specification to A144 Controlled Assessment in this specification has proved difficult for some.

Overall, Centres are to be commended for their dispatch of samples; these began to arrive very shortly after the 15th May deadline for the submission of marks, and most were very well organised. A number of arithmetical errors and clerical errors were noted, however, which is a little disappointing, as only nine marks needed totalling.

Rather fewer Centres this year provided their Moderator with detailed accounts of how the tasks and levels of control were administered; where present, these aided the moderation process. Candidates' scripts from a small number of Centres were overly long, in particular for the Case Studies, and though timings indicated in the specification are for guidance only, it was clear that in some instances these had been exceeded markedly. It must be impressed upon candidates that producing reports in this skill area is an exercise in conciseness.

In some instances, there was clearly some confusion as to guidance and collaboration permissible in phases of limited and high control. As a general rule, research and the collection of data are under limited control; candidates' write-ups, ie their analysis, evaluation and review of collected information, are under high control. These issues are discussed further in the respective sections of the report.

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

> *'It is important that all internal assessors of this Controlled Assessment work to common standards. Centres must ensure that the internal standardisation of marks across assessors and teaching groups takes place using an appropriate procedure.'* Page 114 of the specification suggests some ways in which this can be carried out.

The application of marking criteria was good across many Centres, but it is also clear that many have misinterpreted the marking criteria or have not applied these in a hierarchical manner. Centres are also reminded, when developing skills, to incorporate Ideas about Science (pages 130-138 of the specification) into teaching schemes, and pay due consideration to requirements of Grade Descriptions (page 96-97 of the specification) and Quality of Written Communication (page 97).

The effect of the different method of aggregation of marks across strands (with a totalling of marks from each strand/aspect of performance in A144, instead of an averaging of marks across a number of aspects of performance to provide each strand mark in A219) also warrants caution. This session has seen a significant lowering of instances where there is an exact correspondence of Centre and Moderator marks.

Annotation of candidates' work was excellent in many instances, but variable from Centre to Centre, and sometimes within a Centre. It should be noted that 'each piece of internally assessed work should show how the marks have been awarded in relation to the marking criteria'. It is also an important 'means of communication between teachers during internal standardisation'.

On a presentation note, Centres should also take particular note of the submission of candidates' scripts. It would greatly assist the moderation process if these were presented in cardboard wallets or cut-flush folders, or bound with treasury tags; please do not enclose this material in plastic wallets.

The Case Study

Centres are reminded that it is essential that candidates should carry out the task corresponding with the year of submission indicated on the front page of the News Sheet and on the Information for Teachers documents.

The choice of three topics for the Case Study for 2013 was:

Vaccinations

The use of nanoparticles in personal care products

Earthquakes

The Vaccinations Case Study was the most popular with Centres, and generated many interesting questions, but also produced the science of most variable quality.

The 'News Sheet' provides candidates with a starting point for their study. Please note that its presentation to them is under limited control. On the basis of discussion, candidates choose a question for investigation based on the material provided. Candidates should be encouraged to state clearly their question for research at the beginning of their reports, which would help to focus their response. In this session, problems arose where:

- the title quoted for investigation did not truly represent a question
- the content of reports sometimes seemed to move from one question to another, or did not represent the title of the study
- candidates had chosen areas of the topic that did not lend themselves to gathering information to represent opposing viewpoints, or where scientific evidence was limited.

It is suggested that a little more discussion during this limited control phase would have led to fewer inappropriate questions; Centres are advised that 'candidates should be encouraged to develop their own titles to study, *in consultation with the teacher*' (Science A: Guide to Controlled Assessment, page 11).

Section 2 – Comments on individual skills' areas:

Comments on specific strands

Strand A: Finding sources of information

A(a) – Planning and research to collect information/data

In this Aspect of Performance, it was pleasing to see most candidates having supplemented information from the News Sheet with additional references. Many candidates had sought information sources that clearly represented opposing views. Centre marking was largely accurate, though assessors should be careful in their award of four marks; information must be selected from information sources that provide a balanced coverage of a range of views. Clearly, this criterion cannot be awarded if a limited set of information sources is used or the information sources representing one side of the argument are of questionable quality.

A(b) – Acknowledgement and evaluation of sources

Many candidates demonstrated good practice in referring to information sources used. Those working at higher levels should be compiling these in a references list as well as citing them in-text. An acknowledged system, such as the Harvard System or Vancouver System should be used (the latter, numerical system, is recommended at this level owing to its ease of use). Candidates were generally very good in identifying quotes.

To obtain full marks, referencing should be fully detailed. For Internet sources, as well as books, authors, titles or articles and dates of publication should be cited (where these are given), as well as full URLs. Book references were rarely fully-detailed, although in most instances, there was sufficient information to lead the Moderator to the source material.

References lists can be produced under limited control and taken into the high control phase, to obviate problems with replicating website URLs accurately, and also to reduce high control time devoted to this. It is likely, of course, that the sequence of these will need to be changed as the report is compiled.

For 3-4 marks, candidates should attempt to give some comments on the validity of the information sources. These may be in the form of an addition to the reference, in a table, or in the text. While many Centres were justified in their award of three marks, some candidates were awarded four marks where evaluative comments were limited and/or replicated from one information source to the next. A document to help to develop candidates' skills in evaluating information sources is provided as Appendix I.

Strand B: Science explanations

Candidates are expected to use scientific knowledge and explanations in two areas. Ideally, they should begin the report by describing and explaining the background science to the topic area, so as to put the question into context, ie

- the nature of the vaccines and the immune system, and if referring to a particular disease, a description of the disease and the importance of vaccination against it (as appropriate to the question posed)
- the nature of nanoparticles, a reference to their size, surface area: volume relationship and properties; and an overview of their use in personal care products (as appropriate to the question posed)
- tectonic plate movement and the nature of earthquakes; seismic waves; measurement of the magnitude of earthquakes (as appropriate to the question posed).

This introductory science used by candidates was often comprehensive, but problems arose where candidates did not fully appreciate what was to be included in this section, or perhaps omitted it altogether. For instance, candidates reporting on a question pertaining to the MMR vaccine described the immune system well, but did not describe the impact of the diseases, or vice versa. Candidates undertaking the Nanoparticles Case Study often referred to their size, its relationship with nanoparticle properties, or the use of nanoparticles in personal care products, but more rarely, two or all three of these. The science of earthquakes was often more comprehensively covered.

It is suggested that diagrams should be used to support the communication of these concepts; in general, these were rather limited. A good deal of erroneous or over-simplified science was seen in these introductory sections.

Scientific knowledge and understanding should further be illustrated in candidates' review of the evidence for and against their questions. As stated in the Information for Teachers, candidates' marks would be limited by concentrating solely or mainly on ethical issues. This was a particular

problem for some candidates undertaking the Vaccinations Case Study. Discussions often lacked precision, though many candidates working at higher levels analysed data supporting opposing sides of the argument. It is also good practice for candidates to refer more often to the scientists or bodies carrying out the research that produced the evidence. In many instances, there was little evidence of use of Ideas about Science.

In this strand, Centres sometimes over-estimated the level of science used, and hence were over-generous with the award of marks. In the 7-8 mark band, candidates are expected to analyse and interpret information presented on respective sides of the argument, which will necessarily involve the use of numerical data.

The quality of written communication used by candidates is assessed in this strand. This often worked to the benefit of candidates, with the quality of spelling, punctuation and grammar helping to support Centre marking where the mark given for science was rather less secure.

Strand C: Conclusions and recommendations

In Strand C, marks would be expected to be the lowest of the strands, though this was not always reflected in Centre judgements.

C(a) – Comparing opposing views and evidence

In this Aspect of Performance, candidates are expected to organise the information they have collected to present opposing arguments. Most candidates chose to present this in clearly identified, separate sections, then make comparisons in an additional section or table (comparisons in tables were often good, though organisation of information was sometimes inaccurate or indiscriminate, so no true comparison was offered). While marks awarded by Centres at the 3-4 mark level were generally secure, marks in 5-6 mark band were often not, and some Centres were over-generous with marking. At this mark band, comparisons must not only be detailed, but also truly compare opposing points addressing the same parameter. Candidates working at higher levels often presented a sequence of opposing arguments showing a clear evolution of pertinent points. Commendably, these were often linked with ‘connectives’, and a document is attached, as Appendix II, to assist further in the development of these skills.

In the 7-8 mark band, candidates are expected to critically review the evidence presented supporting the respective sides, evaluating its validity, and making decisions as to which information sources to use for drawing the conclusion in Aspect C(b). Questions relating to the safety of the MMR vaccine could have generated almost ‘textbook answers’, but in this, and other Case Studies, Centres rarely appreciated the level of critical comparison required here. As a consequence, marks in the uppermost mark band were less often supported. As with Aspect of Performance A(b), the Centres’ attention is drawn to Appendix I, and also Ideas about Science.

C(b) – Conclusions and recommendations

In this Aspect of Performance, candidates should draw on selected information sources to draw a conclusion. Candidates usually presented this in a ‘Conclusion’ section, but this was often lacking in detail, even by otherwise high-scoring candidates. At the 3-4 mark level, the conclusion should be based ‘on the extent to which the views or opinions are supported by scientific evidence’. The marking criterion, at the 5-6 mark level, states that the conclusion must be ‘clearly linked to evidence in the report’. Although conclusions had been drawn, this was often not the case. The recommendations made based on candidates’ conclusions were often vague, and Centres should note that the marking criterion refers to recommendations, plural.

In the 7-8 mark band, candidates working at higher levels often discussed limitations to the conclusion, and alternative recommendations, but different interpretations of the evidence were more rarely seen. Candidates struggled to accrue marks at this level.

Practical Data Analysis

The Practical Data Analysis task requires candidates, based on the hypothesis provided, to design, carry out, interpret, evaluate and review an investigative practical experiment in which they have collected primary data. The tasks provide a foundation for progression to the full-scale individual investigations in Additional Science A, and Separate Sciences.

OCR provided a choice of three topic areas that have generated hypotheses to be tested by candidates.

For 2013, these were:

How do plants affect each other's growth?
Hypothesis: When the distance between growing plants is small, the plants will reduce each other's growth.

Why do some liquids flow more freely than others?
Hypothesis: Liquids containing long or large molecules are more viscous (ie they do not flow so freely).

Immersion heaters
Hypothesis: The temperature rise of the water is dependent on the energy transferred.

The Controlled Assessment rules state that tasks can be 'contextualised', which means that centres can adapt them slightly to fit with local conditions (including the types and amounts of equipment available, lab space, and safety considerations). They should not, however, be modified.

Centres should note that if the choice of variables related to the investigation is limited, it must be ensured that candidates are still able to test the hypothesis provided and access the full range of marks. For example, opportunities must be provided for candidates to decide for themselves how many of a range to test, or the range itself, how many repeats to do, and which chemicals/materials/equipment to use. Higher-scoring candidates must be able to justify these selections. Two major problems were seen this session in the way in which Practical Data Analyses were carried out:

- Why do some liquids flow more easily than others?
  Candidates in many Centres were presented heterologous combinations of liquids to test (rather than a homologous series of chemicals, for instance, alkanes, alcohols or carboxylic acids). This usually precluded the collection of valid data and/or the application of appropriate science when reviewing the hypothesis.
- Immersion heaters
  In some Centres, candidates used potential difference as the independent variable, rather than energy. In these instances, ideally, somewhere in their write-ups, candidates should have discussed the relationship between potential difference and energy (or power), and/or assumptions made if their measurements were based on different potential differences alone. This was not always done, and without this qualification, strictly speaking, they did not truly test the hypothesis.

Centres are also reminded that it is essential that candidates should carry out the task corresponding with the year of submission indicated on the front page of the Information for Candidates and Information for Teachers documents, but this was not a serious problem in this session.

Strand D: Choice of methods, techniques and equipment

In this session, this strand was often generously marked. Candidates often discussed variables, attempted to justify equipment used, and included other aspects in their write-ups, but neglected to include a coherent method. Also, a common oversight was failing to specify the measurements to be made. On occasion, candidates had alluded to these without providing detail, so moderators could go some way in supporting Centre judgements; in other instances however, Centre marks were significantly lowered. Please note also that to secure marks in the 5-6 mark band, repeats should be described in the method, and data collected must be 'of generally good quality'.

Good scientific justifications of the method, range of values, equipment and techniques selected must be provided for candidates to be awarded marks in the 7-8 mark band. Some candidates carried out preliminary work prior to the experiment proper. Although not a requirement, if it is practicable to do so in the allotted time, this can help to candidates to justify the method, equipment or range used. Justifications, however, were often weak, and the reasons for the use of a particular method, in particular, were often not provided. Many candidates produced tables, ostensibly to justify the equipment used, but these often listed every piece and some very mundane statements were seen. In this mark band, candidates should be using terminology such as 'resolution', 'accuracy' and 'precision' in their justifications. It should be emphasised to candidates that the way in which the criteria are accrued is hierarchical, so they would be better to focus their efforts in ensuring that responses to the lower marking criteria are in place and adequate.

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

Please also note the hierarchy of awarding marks here; hazards must be identified for 3-4 marks, with 'some precautions' to minimise risk for 5-6 marks. While the word 'some' is used, it was not possible to support Centre marks where arguably the most important safety precautions were omitted. For instance, for the Practical Data Analysis on viscosity, a very large number of candidates failed to mention eye protection when using the chemicals, a safety measure that would have been almost universally applied.

For 7-8 marks, for a Risk Assessment to be 'full', it must refer to *all* potential hazards and risks. Here, candidates should be encouraged to use statements such as 'low hazard' and 'limited risk'. Though not applicable in this session, candidates should also consider hazards and risks of a final product of the experiment, eg the products of a chemical reaction or incubated agar plate. For a Risk Assessment to be 'appropriate', the hazard/risk must be appropriate to that for the chemical/equipment/activity used or undertaken. A good illustration of this is when referring different concentrations of acids, where the hazard varies from 'corrosive' to 'harmful/irritant' to 'low hazard'. In this session, candidates often grouped members of their homologous series of alcohols into one row of their Risk Assessments, and cited hazards, erroneously, for the whole homologous series, as 'toxic' and 'flammable'.

Strand E: Revealing patterns in data

Many Centres need to take note on how marks are awarded in this strand. Candidates should follow one of two routes, for either graphical or mathematical/statistical analysis of data (though the 'dividing line' could be crossed, for instance, by the candidate producing a good graph on the upper row, then calculating a gradient and using this to reveal patterns in data on the lower row), and the higher mark achieved across the two rows carried forward to the unit total. A small number of Centres averaged the two marks or even added these to produce inappropriate marks.

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

Some graphs seen were of poor quality. There was clear evidence that some Centres had not checked the plotting of points carefully before awarding marks. Graphs drawn without appropriate scales, eg where these were non-linear, or without one or more labelled axes, and poorly-drawn lines of best fit, were often, incorrectly, awarded high marks. If the scale is inappropriate, or points are plotted incorrectly, the candidate mark cannot exceed four. Likewise, if an inappropriate line of best fit has been applied, a mark above five cannot be awarded, irrespective of whether the candidate has drawn range bars. For marks to be awarded in the highest mark bands, range bars must be drawn accurately (in addition to there being minimal errors in the plotting of data). The scales chosen by candidates often made difficult accurate plotting of data, as did crosses drawn with unsharpened pencils, particularly where millimetre graph paper was used.

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

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

It is strongly recommended that all Centres ensure that candidates are taught skills, and emphasise care and accuracy in drawing graphs. Perhaps a check-list could be issued to candidates?

Strand F: Evaluation of data

In this strand, any discrepancies between Centre and Moderator marks resulted from Centres' misinterpretation of the marking criteria and candidates' failure to fulfil the requirements.

In the new (2011/2012) specifications for Twenty First Century Science, statement 1.6 in the 'Ideas about Science' has clarified the definition and treatment of outliers (compared with the version in the legacy (2006) specifications) to state:

> *"If a measurement lies well outside the range within which the others in a set of repeats lie, or is off a graph line on which the others lie, this is a sign that it may be incorrect. If possible, it should be checked. If not, it should be used unless there is a specific reason to doubt its accuracy."*

Potential outliers in data collected during a Controlled Assessment should be handled in accordance with this statement.

Candidates are permitted to draw a graph of their results during the (limited control) data collection stage of the Controlled Assessment task. This may help them to identify potential outliers. Ideally, any data points that look to be potential outliers should be re-measured, and this is easiest to achieve if they are identified during the data collection session.

For 3-4 marks, candidates should identify outliers, either in tables of results or by written identification. If no outliers are deemed to be present, justification must be provided. The marking criterion states quite clearly that the candidate should identify 'individual results' that are beyond the range of experimental error; some candidates, erroneously, designated means plotted on graphs as outliers.

For 5-6 marks, although there were some often good discussions of spread of data, 'repeatability' was not always discussed. Candidates should discuss the spread of data qualitatively at this level, and quantitatively to obtain the highest marks. Many candidates had often made an attempt to account for outliers, in order to address the top mark band, discussing possible sources of error arising from experimental techniques, but as marks are awarded hierarchically, high Centre marks could often not be upheld, as candidates had not matched fully the criteria at the 5-6 mark band level.

Candidates' evaluations were often very long, but many covered the pertinent points in the first few sentences. There were many instances where candidates had also written lengthy sections on improvements to the experiment, when this is *not* required for the Practical Data Analysis (but is for the Practical Investigation).

Strand G: Reviewing confidence in the hypothesis

This strand was also over-generously marked by some Centres. Candidates should be encouraged to re-state their hypothesis at the beginning of the review section to provide focus for this strand. Candidates often discussed findings but did not refer the hypothesis at all, or say if their data supported it. In some Centres, the hypothesis had been translated into a prediction (which is accepted under the marking criteria), but Centres should exercise care in ensuring that it is an appropriate translation of the hypothesis provided by OCR.

All candidates should make at least a statement referring to whether the hypothesis has been supported (or not), and the extent to which the data support the hypothesis. Candidates working at higher levels should discuss this in terms of data increasing confidence in the hypothesis. At the 3-4 mark band upwards, candidates should make reference to some science when explaining their results. On many occasions, very little science was evident. For the 2013 tasks, the relevant science should include:

- **How do plants affect each other's growth?**
  Here, there should have been an understanding that there is a competition for resources between plants (light, water, mineral nutrients, etc).

  Those measuring biomass collected data that supported the hypothesis, but candidates measuring height observed that if light is lacking, plants may grow taller (so this might suggest evidence of the hypothesis having been refuted). It was commendable, here, that some candidates chose to modify the hypothesis, referring to the health or appearance of the plant. Although not covered in the specification until B5, some candidates discovered that etiolation is associated with auxins.

- **Why do some liquids flow more freely than others?**
  Many candidates were familiar with ideas about the structure and properties of hydrocarbon chains, and how the forces between molecules are affected by molecular size. Many candidates related the increasing viscosity with increasing chain length to the increasing number of intermolecular forces. Some described this, or 'chains becoming tangled' and a few drew diagrams to illustrate the principles.

Some candidates referred to van der Waals' forces, between the hydrocarbon chains, and polar –OH groups in alcohols. The science, however, was very often confused.

- **Immersion heaters**
  Many candidates were familiar with the ideas about electrical power and energy transferred, ie energy transferred (joules) = power (watts) [which many calculated from current x voltage] × time (seconds). At the 5-6 mark level, many candidates related the rise in temperature to the increase in (average) kinetic energy of the water molecules.

In addition to this Principal Moderator's Report, OCR also offers several avenues of **free** support, including:

- A 'Guide to Controlled Assessment' handbook for Unit A144 (Case Study and Practical Data Analysis). The direct download link is http://www.ocr.org.uk/Images/68604-guide-to-controlled-assessment.pdf
- Candidate-orientated guidance on evaluating sources and articles during their research. The direct download link is http://www.ocr.org.uk/Images/68542-unit-a144-case-study-preparation-evaluating-sources-of-information.pdf
- INSET training materials from our 2012 events are all now available to download for free from the OCR website.
  The direct link to the Unit A144 INSET training materials is http://www.ocr.org.uk/Images/72970-inset-materials-oscs6-unit-a144-getting-started-managing-controlled-assessment-case-study-and-practical-data-analysis.zip
- OCR offers a Controlled Assessment Consultancy service, in which candidate work that you have marked will be reviewed by a senior moderator prior to moderation.
  To make use of this service, post photocopies of three marked pieces of work to the following address: *Carolyn Brawn, Science Team, OCR, 1 Hills Road, Cambridge, CB1 2EU*.

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

Appendix I: Judging a source of information

	 The further to the right, the more reliable the source is likely to be				
Publication / source	Website or newsletter of a private individual, 'blog' or forum entry from unknown writer.	'Respectable' pressure group web-site or newsletter.	'Quality' media, e.g. the BBC, The Guardian.	School textbook or science magazine, e.g. New Scientist, Catalyst.	Peer-reviewed journal or government report.
Nature of the data	Little or no data given.	Data of doubtful reliability, e.g. based on small or unrepresentative sample.	Based on a single study, or little information about design, procedures or samples.	Clear indication of valid design e.g. large samples, extended period of study.	Studies by different teams of scientists, give consistent, i.e. reproducible, results.
Science explanations	No explanation or data to support claim.	Explanation not yet tested or confirmed.	Can be compared with other possible explanations.	Agreed by most of the scientific community.	Fully agreed by almost everyone.
Status of the author	Individual of unknown background, or known extremist.	Science student or well-informed person.	Teacher / professional scientist with expertise in a different field.	Scientist working in this field.	Recognised expert in the field.
Author's affiliation or institution	Non-science related.	Representing a particular view only (e.g. manufacturer, organisation with interest, or pressure group).	Independent, science-related source.	University, medical school, science institute.	Leading research centre / major company / government research centre.

Use this guide when comparing different articles in the media or other sources.

It will help you to decide which articles are most likely to be giving reliable information to support any claims made or opinions given.

Appendix II: Connectives

Illustrating

for example,
for instance
such as
as shown by
as demonstrated by
in the case of

Adding to

and
also
as well as
in addition
moreover
what is more

Comparing

(similarities)
compared to
similarly
likewise
in the same way
equally
as with

Cause and effect

because/as
as a result
so
therefore
since
consequently
thus

Emphasising

in particular
significantly
more/most importantly
notably
especially
indeed

Comparing

(differences)
compared with
however
but
in contrast
on the other hand
whereas
alternatively
instead
nevertheless
despite this
in spite of
even so
otherwise

Sequencing

firstly/secondly...
initially
finally
subsequently
after/afterwards
meanwhile
eventually

Qualifying/Restricting

although
except
yet
apart from
however
unless
only if

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