RECOGNISING ACHIEVEMENT

GCSE

Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J241**

OCR Report to Centres

June 2012

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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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General Certificate of Secondary Education

Science A (Twenty First Century Science) (J241)

OCR REPORT TO CENTRES

Overview

This is the first session in which all units of this new specification have been assessed, and many candidates have now re-sat units taken in January. In the Controlled Assessment, candidates had been well prepared by their Centres and consequently performed well. In the written papers, all Principal Examiners report that many good attempts at questions had been made, but that candidates are still having trouble in gaining good marks in the extended writing, Level-of-Response questions worth six marks. It is essential that candidates read the instructions to these questions carefully, as they frequently require an answer with two distinct 'threads' – possibly an explanation of some science and an evaluation of its impact in the context given.

Extended mathematical questions are another area in which candidates could improve their performance considerably by refining their examination technique. They are advised to look carefully at the structure of the mathematical questions: If part (a) of a question is divided into sub-sections (i), (ii) and (iii), for example, it is clearly intended to indicate a developing story, so that answers obtained in one part must be used, or at least referred to, in the subsequent parts.

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

General Comments

This paper was appropriate for the ability range of the entry and most questions were accessible to candidates across that range. There was little evidence to suggest that candidates were short of time. The spread of marks across the whole paper suggested that it discriminated well across the grades. Most questions were attempted by all candidates. A few (namely 4aii, 5aii, 7bi and 7bii) were left blank by a significant number of candidates.

As in previous sessions, candidates were well prepared for the objective style of questioning. Candidates need to be reminded to tick the number of boxes that they are told to tick. Otherwise they are likely to lose marks. Candidates also need to ensure their answers are legible. Examiners may struggle to decipher a 'B' that has been written over in an attempt to make it into a 'D'. Candidates would be better to cross out and rewrite their new answer to ensure that they are awarded the appropriate number of marks.

A pleasing number of candidates made substantial attempts at the extended answers and the Level of Response questions. However, many answers to the free response questions lacked appropriate scientific detail and clarity. For example, words such as 'it' and 'they' are often used rather than candidates stating exactly what they are referring to. The Level of Response questions (six marks) were attempted by most candidates. It was clear that candidates had been prepared for this style of question and Centres are to be congratulated for this. It is worth noting that Level of Response questions often ask candidates to give at least two strands of an argument. A candidate who only deals with one strand will be restricted to the lower levels. Centres might find it useful to encourage candidates to read a range of Level of Response questions and get them to identify the different strands they might be expected to talk about.

Comments on Individual Questions

1 (a) This proved to be a more difficult start to the paper than expected. Most candidates attempted the question but rarely mentioned proteins. The most common incorrect answer was DNA, chromosomes or 'what you look like'.

1 (b) (i) The majority of candidates scored two marks here. It was pleasing to see that candidates are confident in using a Punnett square correctly to work out the outcomes of a genetic cross. A few candidates were unable to recall the genotype of the father as XY and so XX was seen on occasions. Whilst this didn't score a mark, one mark was awarded if they then went on to complete the Punnett square correctly for their incorrect genotype. A small number of candidates scored one mark in this way.

1 (b) (ii) The majority of candidates were able to correctly calculate or recall that the probability of being female is 0.5.

1 (c) (i) The majority of candidates were able to correctly calculate that 358 babies were boys (720 – 362 = 358). Few candidates showed their working. It was not really required to score in this question but it is good practice to encourage candidates to show all the stages of their calculations.

1 (c) (ii) Candidates were less confident about using ratios to express their answers. A significant number of candidates copied down 350:350 but failed to cancel this down to 1:1.

1 (c) (iii) A significant number of candidates correctly selected hospital C but were then unable to explain clearly why they chose that hospital. Many noticed the large number of girls but compared this across the hospitals rather than recognising that the number of girls was much higher than the number of boys in that particular hospital. Credit was not given for comparison with the other hospitals.

2 This was the first Level of Response question on the paper and it asked candidates to compare sexual and asexual reproduction. The question was very discriminating across the grade range and most candidates made an attempt at the question.
Many candidates were able to describe sexual reproduction as a process that occurs between two parents/organisms. The most common example of an organism that carries out sexual reproduction was a human. A few candidates were able to correctly describe the process as the fusion of egg and sperm and some made reference to the genetic variation that this leads to. There were too many vague statements about 'doing it' or 'having sex' rather than a scientific description. Candidates should be encouraged to use the correct scientific terminology in questions of this type.
Fewer candidates were confident about asexual reproduction. Many seemed to know that it takes place in some plants but they then confused their answer by talking about flowers. Some candidates clearly thought that asexual organisms are those that lay eggs, like chickens and fish. A small number of candidates used the term asexual to describe processes like IVF. Poor responses included the idea that sexual was 'natural' and asexual was 'unnatural'. However, there were some excellent responses that referred to clones and the formation of runners.

3 (a) (i) Candidates are familiar with this style of question. The majority scored a mark here by correctly identifying Den.

3 (a) (ii) Equally the majority of candidates identified Beck as the correct answer here.

3 (a) (iii) The majority of candidates correctly identified Eve here. However, candidates found this part of the question more difficult than (i) or (ii) and Frank was the most common distractor.

3 (b) The majority of candidates scored two or more marks here. It is clear that candidates are becoming more confident about answering these 'arguments for and against' questions. A few only described the arguments for or against, but the majority took care to cover both arguments.
The most common arguments for the test were to find out if the baby had the disease and to allow the parents to plan what they might do. Candidates do need to make sure they express themselves clearly and unambiguously as there were occasions when it was difficult to work out whether the candidate was talking about the baby being tested or the parents. Clearly those candidates that were talking about the parents being tested were describing the wrong idea. The most common arguments against the test were the risk of miscarriage and the idea that some people would rather not know.
Some candidates allowed the earlier part of the question to confuse them and they described the process of embryo selection instead of fetal genetic testing. A few candidates incorrectly thought that having the genetic test would enable the baby to be cured of the illness or the disease to be removed from the population as a whole.

4 (a) (i) A significant number of candidates correctly identified the diagram of sulfur dioxide. The most common distractor was the last diagram (one atom of sulfur and one atom of oxygen).

4 (a) (ii) This question was rather poorly answered. Few candidates identified that the sulfur atoms come from the fuel with many instead suggesting that they come from the burning of the fuel. There were a significant number of candidates who thought that sulfur reacted with carbon dioxide to produce sulfur dioxide. Those that correctly identified the reaction between oxygen and sulfur failed to describe a reaction and instead talked more vaguely about the gases mixing. This was not given any credit. Equally those that described the sulfur reacting with air were not awarded any marks. A significant number of candidates left this question blank.

4 (b) (i) This question proved to be a reasonable discriminator. A significant number of candidates scored all three marks but the majority scored two. The most common error was suggesting that the last statement was true.

4 (b) (ii) The majority of candidates identified the decrease and scored one mark. Far fewer scored two marks for a description of the fluctuations or the identification of an increase in 2000. This is a good example of where the number of marks available can act as a clue to the candidates about how much detail to include in their answer. It is unlikely that a simple description of the decrease would score two marks and candidates should be encouraged to write more and develop their ideas if more than one mark is available.

4 (b) (iii) Again this was a reasonable discriminator. The majority of candidates scored a mark here. If the mark was lost, it seemed to be the last box that was most often ticked incorrectly. Occasionally two ticks were seen so the mark could not be awarded.

4 (b) (iv) The majority of candidates scored one mark here but only the most able scored two. The most common incorrectly ticked box seemed to be the third one.

5 (a) (i) Candidates found this question difficult and the majority got it incorrect. Hydrogen was most commonly ticked as the product of burning hydrocarbons. It was interesting that some candidates who got this incorrect then went on to correctly talk about the production of water in part (b)(ii).

5 (a) (ii) Candidates also found this question difficult with the majority scoring no marks. The most common correct answer was the production of CO_2 or H_20 (which was partly given in **(i)**). Few candidates described the formation of CO and hardly any candidates described the production of carbon or soot. However, it was pleasing to see some candidates using the term incomplete combustion correctly. A significant number of candidates left this question blank.

5 (b) This was the second Level of Response question on the paper. Most candidates attempted the question but few scored above Level 1 (two marks). The most common responses were those that described the data. This alone was sufficient for two marks provided that all the data was described correctly. Some candidates failed to notice that the amount of CO_2 actually increases after passing through the catalytic converter. For a response to be awarded Level 2 or 3, the candidates had to give some explanations for the data. Some candidates chose to approach the question by describing the damage that some of the gases can cause. Others approached the question in a different way by describing the chemistry that is occurring in the catalytic converter. Both approaches were given equal credit but candidates did not need to talk about both to score six marks.

Those responses that were awarded Level 2 most commonly talked about how carbon monoxide and nitrogen oxide are more damaging than carbon dioxide. Some of the better responses identified CO as poisonous or that NO can cause breathing difficulties. Some of the best responses had a clear understanding of the reactions occurring in the converter and these were expressed in detail to be awarded Level 3.

6 (a) This question was well answered with the majority of candidates correctly identifying that the older fossils would be at the bottom of the photograph. However, many candidates did not link their arrow to the box as they were told to. This is a reminder that candidates need to read and follow the instructions in the rubric. A few candidates left this question blank probably because there was no obvious 'space' to write their answer.

6 (b) Very few candidates scored two marks here. A significant number scored one mark, usually for the idea that erosion or weathering leads to the rocks becoming exposed. For the explanation as to why the layers are no longer straight, many described a rather vague idea about plate movement or the idea that layers build up on top of each other. Neither of these was sufficient for a mark as there had to be an implication of force or distortion of the layer.

6 (c) This was very poorly answered with hardly any candidates scoring a mark. Those that did score referred to religious beliefs and a very small number wrote that people didn't believe the ideas. The most common incorrect answers were the idea that there is not enough evidence or vague descriptions of how the Earth doesn't look old enough.

7 (a) This question proved to be a very good discriminator with candidates either scoring two marks or no marks. Candidates should be reminded that the equations needed to perform these calculations are given at the beginning of the exam paper. Candidates are not expected to recall the equations. Too many candidates tried to use all three values given, despite being told clearly that they only needed to use some of the data. That said, those candidates who knew what they were doing did it very well and it was pleasing to see many candidates showing their working. A small number of candidates were awarded one mark for their working even though their final answer was incorrect.

7 (b) (i) It was usual to award two marks here if a candidate scored two marks in part (a). Again, the equation that candidates needed to use was given at the beginning of the paper. A larger number of candidates got this question correct compared to (a). This is probably because there were only two values given in the question. A significant number of candidates made no attempt at this question.

7 (b) (ii) This question was assessing the candidates' ability to draw conclusions from their own calculations. Therefore this mark could be awarded even if the calculation in (b)(i) was incorrect. Unfortunately the majority of candidates failed to score here. Conclusions were very confused and poorly expressed. Few candidates seemed to appreciate that the question was asking for the link between tightness and speed, i.e. what happens to the speed as the tightness increases. Some candidates incorrectly made reference to time and to wavelength. It was also apparent that not all candidates realised they had to look back at (a) as well. A few candidates were able to recall the correct answer, i.e. that speed increases as the rope gets tighter, but they could only be awarded the mark if this conclusion matched their own calculations. A significant number of candidates left this question blank.

8 **(a)** This question proved to be a good discriminator with the majority of candidates scoring one mark, and fewer scoring both. The most common error was to tick Dr Adams instead of Dr Baker. Dr Das and Professor Eddington were usually correct.

8 **(b)** More candidates scored two marks here. This part of the question was often correct even if (a) was not. Candidates appeared to be confident about the idea that the Sun is a star and that galaxies are made up of stars.

8 **(c)** The majority of candidates got this incorrect with the most common answer being the fourth box down. It is likely that some candidates tried to use all of the data rather than that which is relevant to the Solar System.

9 This was the final (and perhaps the most demanding) Level of Response question on the paper. A significant number of candidates either made no attempt at the question or scored no marks. Candidates had two strands to discuss and needed to include both a description of the accepted model of the Solar System and also suggest why this model is now accepted.
The weakest candidates were confused by the diagram in the question and thought that it represented the accepted model. Their descriptions of this model did not score any credit. A number of candidates were able to describe the Sun in the centre of the accepted model and the idea that the planets orbit the Sun. Some of the better candidates also talked about the moons and asteroids and described their correct position and/or movement. Descriptions of the model were enough to achieve Level 2 without any reference to the reasons why the model is now accepted. Equally some candidates talked about the use of satellites, better telescopes and space travel to suggest reasons why the model is now accepted but did not describe any features of the model. This also achieved Level 2.
Few candidates were able to talk about both strands and this was significant in limiting the level that could be awarded, hence few candidates scoring at Level 3. As mentioned at the start of this report, it is important that candidates are encouraged to fully answer these Level of Response questions to maximise their chances of achieving the higher levels.

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

General Comments

In this second examination of this unit, the number of entries was considerably down on January, and the standard was a little lower, particularly in the extended writing six-mark questions. A substantial fraction of the small entry were re-sit candidates. As in January, the shorter free-response questions, particularly the mathematical ones, were found taxing and quite often left without any attempt to answer them. Objective questions were generally well done on this paper, but markers did report that candidates frequently gave the impression of not having read the questions properly.

Comments on Individual Questions

1 (Genetic tests) The objective part of this question was well answered by most candidates. In parts (b) and (c), many candidates confused the two different scenarios, giving answers relating to foetal testing in the section on PGD.

2 (Animal clones) It was clear in this six-mark question that many candidates had not learnt the appropriate material, with many writing about IVF, and a number just referring to adding one cell to another. Uses that scored credit were relatively rare.

3 (Boy:girl ratios) The Punnett square was usually done well, although very few candidates could see the structure to the question. Having correctly deduced that the sex ratio ought to be 1:1, many candidates did not know what to do with the hospital data and only the very best recognised that sample size was the issue being examined.

4 (SO_2 emissions) In the objective part (a), few candidates scored both marks due to lack of precision in reading the graph and realising that the year-on-year decrease between 1992 and 1997 was not constant. Parts (b) and (c) were generally well done, but many answered part (d) incorrectly by saying that the SO_2 levels were increasing.

5 (Catalytic converters) In (a), only the best candidates actually addressed the question, explaining the reaction in the car engines which produced NO, while many wished to talk about incomplete combustion of the fuel. In the six-mark question part (b), many candidates were tied to Level 1 by limiting their answers to description of the changes indicated by the data, without the scientific explanations needed to gain Level 2 or 3. It is worth pointing out that both the 'chemical' explanation in terms of oxidation and reduction, and the 'biological' explanation in terms of the damage caused by the pollutants, would have given access to Level 2 or 3.

6 (Age of the Universe) This objective question was well tackled by most, although a surprising number found it difficult in (b) to combine the information given by the 'Talking Heads', including their uncertainties, to give a best estimate for the age of our Solar System.

7 (Water waves) This question proved the most difficult on the paper. Many candidates did calculations without showing any working and, if the answer was not then correct, got no marks. In (a), any indication of attempting to divide 50 cm by a number was showing an understanding that 50 cm was a certain number of wavelengths, and gained 1 mark. Very few candidates realised that the frequency of a wave is the number that are produced in 1 second and struggled in (b) trying to manipulate the equation speed = frequency × wavelength. In (c), even fewer realised that, if the frequency of a wave doubles while its wavelength halves, then the speed must be the same.

8 (Magnetic sea-floor stripes) Although the objective part (a)(i) was deliberately demanding, (ii) did not depend on it, and it was disappointing that only about one candidate in six could suggest one reason why the correct answer to (a)(i) might be inaccurate. The six-mark question part (b) was misread by many candidates. Many jumped into an automatic response without reading the actual question, which did not require details of Wegener's ideas other than that continents may have moved: the question asked for why his ideas were at first rejected, and then later accepted. Candidates were also keen on using a religious argument for rejecting a new theory; this is often an appropriate argument, but it is not so here. The scientific community had good scientific reasons for rejecting Wegener, apart from the more dubious (but quite acceptable) reason that he was an outsider and his ideas therefore suspect.

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

General Comments

The great majority of candidates attempted all questions and there was no evidence that shortage of time was an issue.
The paper allowed candidates to perform well and there was a good spread of marks. It was pleasing to see a good spread of marks in the Level of Response questions.

Comments on Individual Questions

1 Candidates were required to consider processing of crude oil. In parts (a)(i) to (a)(iii) they were asked to identify correct statements about the crude oil. Candidates were generally able to identify a description of crude oil as a mixture of hydrocarbons, but were less successful with descriptions of refining and polymerisation.
Part (b) asked them to indicate which step would make a polymer more flexible. Approximately half of the candidates made the correct choice of “using a plasticizer”.

2 This question concerned materials used for climbing rope and making judgements from data. In parts (a)(i) and (a)(ii), most candidates were able to identify particular rope material from their properties. Part (b) asked why the lowest value for tensile strength was more useful than a range or mean. This proved very difficult – many candidates simply restated that it showed the lowest value, rather than recognising that, in a climbing rope, the minimum is critical in terms of safety.
Reasons for doing a test five times were required for part (c)(i). Reliability and the idea of outliers were looked for, but many poor answers mentioned fair test and accuracy, and only a minority were able to score. In part (c)(ii), candidates were asked to derive a range from the set of 5 results. Many simply gave the range from the first to the last value rather than from the lowest to highest.
Part (c)(iii) was a Level of Response, six mark question concerning the choice of material for the climbing rope. Candidates tackled the question well, using information from the table to make a choice. A full range of marks resulted, with a pleasing number at Level 3. Candidates at Level 1 often confused benefits with disadvantages, such as giving low density as a disadvantage, or gave contradictory statements. A common error was to assume that all data with the higher number must be better. At Level 3, a clear practical reason for the significance of the property was required. Tensile strength was not relevant, as the range of values overlapped considerably; this was mentioned by many candidates.

3 The principle of nanotechnology was not generally well known. Some candidates were able to select a description of nanotechnology for part (a), and in part (b) a minority gave a use for nanoparticles, and fewer were able to express disadvantages in terms of possible rather than proven risks. Many stated that they are harmful, cause cancer or pollution or are expensive. Some candidates realised that insufficient evidence is available to judge safety.

4 In part (a)(i), candidates were asked to say why a signal was digital rather than analogue. Only a minority were able to express their answer clearly in terms of zeros and ones. In 4(a)(ii), few were able to give a clear reason why a second signal, despite some distortion, was the same. The most successful candidates recognised that the pattern was the same. Part (b) required candidates to convert a pattern into a binary code, and a majority were able to do this.

5 Candidates were asked to complete sentences about a beam of light, in terms of photons, energy and speed of light. Most scored at least one mark, but only a minority gained all three marks.

6 The majority of candidates were able to place X-rays in the spectrum for part (a), and risk of cancer was given as a reason for concern about X-rays in part (b). Fewer gained the second mark in part (b), by stating that X-rays are ionising or high energy.

7 In part (a), candidates were asked to calculate how much radiation reaches the Earth given the figure for the amount reaching the atmosphere and the amount absorbed by the atmosphere. This proved straightforward for most candidates. Part (b) was more demanding, requiring candidates to carry out a calculation and make a comment as to whether a statement about a 50% increase in CO_2 emissions was correct. There were a number of successful approaches, but few candidates gained both marks. Part (c) asked candidates to explain the way in which burning fossil fuels are changing the Earth's climate. This was perhaps less well done than expected, and many incorrect references to the ozone layer were seen. Other candidates just restated part of the question, and said the burning is causing climate change.

8 This was another six mark, Level of Response question, regarding risk of exposure to ultra-violet radiation and reasons why people take the risk. This produced a good range of responses. Most candidates seemed aware of cancer risk and the desirability of getting a tan, and this generally allowed them to reach Level 1. A small number produced Level 3 answers, by including points of scientific detail such as vitamin D production, the ionising nature of UV radiation, change in DNA and mutation, uncontrolled cell division leading to skin cancer and also reference to sun lotions absorbing UV radiation.

9 In part (a), candidates were asked to give two ways in which urine production is affected by taking Ecstasy. Few candidates seemed aware of the effects, and often stated that urine volumes would increase, or made vague statements such as the colour would change. Part (b)(i) required candidates to indicate that the link between alcohol consumption and urine production is a correlation. Only a minority made the correct choice. Part (b)(ii) involved making a judgement about a survey investigating this relationship. Many answers were vague and often seemed to focus on whether men within the sample drank the same amounts. Some were able to score by suggesting that a wider range of ages should have been investigated or that women too should have been included. Relatively few specifically referred to sample size.

10 This was a question about vaccination. Part (a) required candidates to complete sentences about how vaccinations work. It was well answered, with most candidates scoring at least two marks out of three. Part (b) was a Level of Response question, asking for reasons why people might be against universal vaccination for influenza. Here a significant number of candidates failed to score, only giving vague statements. Some candidates seemed to think that the vaccine is used to treat influenza rather than prevent it. Others gave some reasons in favour of vaccination, which were not asked for in the question. Surprisingly few clearly expressed the idea of freedom of choice. The most common credit-worthy ideas were cost, side effects and fear of needles, with a few well-articulated descriptions of influenza being particularly dangerous to the at-risk groups. Few answers were awarded Level 3 where a range of reasons, including both ethical and practical, was needed.

11 This question concerned pulse rate and exercise. Part (a)(i) required candidates to plot results onto a graph and to draw a line of best fit. A majority of candidates scored at least one mark, but some poor, irregular lines were seen. Part (a)(ii) asked candidates to complete sentences regarding comparative pulse rates. This was generally well answered. In part (a)(iii), candidates were required to use this information to evaluate relative fitness of two individuals, but only a minority were successful in identifying the link between fitness and recovery rate.
Part (b) called for two other lifestyle changes which would reduce the risk of heart disease. Most candidates scored at least one mark, but many mentioned exercise, despite the question stating that changes other than exercise were required. Some candidates lost marks as they simply stated “alcohol” or “diet”, without indicating a change.

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

General Comments

This paper was well attempted with many very good answers and the questions discriminated effectively. Almost all questions had responses and there was no evidence of candidates being short of time.

Candidates wrote well on the longer questions though they need more practice on writing balanced arguments or discussions on scientific topics. It was not uncommon to see detailed knowledge and understanding of science on one side of an argument followed by a single superficial sentence on the other side.

Many find the numerical questions challenging. Again, plenty of practice on a wide variety of mathematical questions within science should improve candidates' responses. They should be encouraged to show working and to lay out calculations logically and neatly.

Questions that ask for candidates' knowledge and understanding of science to be applied to other contexts are still proving very challenging. Candidates must think about the context of the question then recall the knowledge required and apply it to the context.

There were a small minority of candidates entered for this paper who would have been better suited to the foundation paper.

Comments on Individual Questions

1 (a) This was expected to be a straightforward start to the paper, with candidates asked to interpret data given in a table. Whilst most scored in part (i), few thought about the context of the question for part (ii). Many candidates used the idea that the **best estimate** was only an estimate but the **range** gave actual values which showed a misunderstanding of how data is used. Candidates need practice in using data in different contexts, interpreting the implications of the range of data given and using this data to calculate the best estimate of the true value.

1 (b) The calculation of the best estimate of the tensile strength of nylon in part (i) discriminated well. Weaker candidates possibly lost marks because they showed no working. With an increase in the number of calculations on the new papers it is especially important that candidates show working at all times. Few scored in part (ii) as candidates failed to refer to either the difference in means or to the variation in the range of measurements for tensile strength. Many wrongly thought that increased stretch meant that the rope was stronger and some that density and moisture absorbency were also measures of strength. Many more scored marks in part (iii). Some weaker candidates gave general answers such as 'all the properties of nylon are better' which failed to score.

2 (a) Most candidates used their knowledge of crude oil as a source of new materials in this question and scored marks.

2 (b) This discriminated well though some good candidates failed to score because they misread the question and gave the answer for the number of additional molecules that had been added to the original one.

2 **(c)** This was another question that discriminated well. All the wrong answers were seen amongst those who failed to score. Candidates should be able to recognise diagrammatic representations of the polymer modifications listed in the specification.

2 **(d)** This was an excellent discriminator that gave able candidates a chance to express their knowledge whilst weaker candidates could gain marks without having to express ideas on a molecular scale.

3 There were many good and confident answers to this question, giving full descriptions of consequences, benefits and reasons for taking risks and excellent descriptions of the causes of skin cancer on a molecular level from able candidates. Some candidates lost marks because they gave one sided arguments, writing fully on the consequences, but just mentioning a tan or feeling good for the benefits. Candidates should have the opportunity to practice writing balanced responses to questions such as this.

4 Many candidates found the diagram difficult to interpret and scoring was low in all parts of this question. Whilst a few candidates answered part (a) succinctly and correctly many struggled to set out their calculations logically. A few wrote a paragraph of explanation rather than show any calculations.

5 **(a)** Most scored on this question. The most common way to lose one of the marks was to add a 0 at the end, misinterpreting the horizontal axis as part of the digital code. A few candidates gave each code twice.

5 **(b)** Able candidates scored all the marks on this question, whilst weaker ones picked up marks for ‘noise’ and/or the received signal being weaker. Candidates should be reminded that when they are asked to compare two things, as in this question, they should be sure to specify which they are writing about rather than just using ‘they’ or ‘it’. A small, but significant number of candidates wrongly stated that the second wave was analogue.

6 Answers to this question on photons were not well known. No candidates were able to identify all three true statements in part (a). Few knew that if a red light and a blue light emitted the same energy the red light emits more photons. In part (b) the common wrong answers were B and C.

7 Many candidates were able to give a reason for the range of values for resting pulse rate in part (a). Those that didn’t score just repeated part of the stem of the question writing that there was variation in resting pulse rate. It should be stressed that candidates do not gain marks by copying or rewording the stem, but by answering the question. There were some excellent graphs drawn in part (b), but a considerable number attempted a straight line as the best fit through the points which was incorrect. In science, lines of best fit are often curved lines. Few candidates extended the curve to find when Ryan’s pulse returned to its resting value though many were able to give the correct answer. Most concluded that Liam was fitter than Ryan as his recovery rate was quicker. Incorrect responses included those that gave no reason for Liam being fitter, those that stated Ryan was fittest as his pulse rate was higher or that they were equally fit because their recovery was similar.

8 **(a)** Few knew where in the body ADH was secreted from with many wrongly responding with the kidneys. Equally few knew that ADH was a hormone. Acids, alkalis and urine were common wrong answers.

8 **(b)** Only able candidates could choose the words to make correct sentences about how taking Ecstasy can affect ADH secretion.

8 **(c)** This question gave problems to many candidates. A number misinterpreted the question and, although they showed good knowledge and understanding of the affect of alcohol on ADH production, gained no marks. Others believed the study was a good one because it kept gender and age constant, thereby making the test fair. Those that answered correctly usually wrote about the limited sample, the fact that urine was not measured and the affect of other drinks/diet on urine production.

9 **(a)** Most candidates scored at least one mark on this and there were many very good answers. Amongst weaker candidates there were still references to 'small' amounts of micro-organisms in vaccinations.

9 **(b)** There were some excellent and well balanced arguments for and against compulsory vaccinations. Many candidates referred to mutation because influenza is a virus with some good, but irrelevant knowledge and understanding about the race to eradicate the disease faster than it can mutate.

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

General Comments

This paper was the first time these units of the new specification have been assessed Although candidates had encountered Level of Response questions in January, many still struggled to include enough science to achieve the marks at Level 2 or Level 3.

Comments on Individual Questions

1 (a) (i) Some candidates failed to appreciate that the word **other** was in bold text and gave answers in terms of gas having the highest percentage. Many candidates failed to understand what the question was asking and gave the answer as "coal". Many better candidates failed to score the mark because they did not include any element of comparison in their answers. Typically the answer was "the size of the line", or similar.

1 (a) (ii) Many candidates gave a general description of the use of renewable energy sources without referring to the diagram at all and some thought nuclear was a renewable source. Some candidates that did use the diagram only scored one mark for either not quoting 2% as the percentage for renewable or failing to equate the usage of renewable to that of oil.

1 (b) (i) Many candidates talked about leaving lights on or leaving appliances on standby. For candidates gaining the mark, heat was by far the most common response following an idea of the energy being lost to the atmosphere.

1 (b) (ii) Many candidates were able to correctly calculate the efficiency of electricity production as 0.36 using the percentage figures for electricity used both in homes and in industry. The most common errors were to use the percentage energy lost to give an answer of 0.64 or to use the industry figure alone to give 0.23.

1 (b) (iii) Some candidates answered this question in terms of how a generator is used within the stages of electricity generation in a power station and failed to appreciate that they were required to talk about the details of how a generator itself works. Many answers that scored both marks clearly related to class room demonstrations with candidates talking about the magnet being pushed in and out of the coil.

2 (a) Most candidates were able to recognise which statements about nuclear power stations were advantages and which disadvantages. The most common error was that candidates considered that nuclear fuel lasting for many years was a disadvantage, presumably confusing this with ideas of nuclear waste.

2 (b) Most candidates knew the potential consequences of ionising radiation. The most common scoring response was about cancer. Responses in terms of burns were quite common as were those in terms of cell damage.

3 This question was certainly accessible to candidates and almost all were able to attempt it. Nearly all candidates made a decision about which source they would advise the islanders to choose, with the large wind farm being the most popular with about two thirds of responses. Weaker candidates tended to focus on the environmental issues and suggested a large wind farm, using vague ideas of being environmentally friendly as justification. However, there were some very good descriptions which balanced the advantages of lower emissions with the disadvantages of noise and land loss. Many candidates failed to realise the difference in building and running costs and others failed to justify how the wind farm could meet the steady supply requirements.

4 (a) Very few candidates were able to correctly calculate the power of the kettle as 2 kilowatts. The most common error was for candidates to select "2000" showing a failure to appreciate that the answer was required in kW rather than W.

4 (b) (i) Almost all candidates failed to convert minutes to hours and so obtained an answer of 54 instead of the correct answer of 0.9 kilowatt hours.

4 (b) (ii) Many candidates were unable to attempt the calculation of the energy used by the kettle although a small minority did it successfully. Some candidates simply converted the kilowatts to watts without converting minutes to seconds to get an answer of 1200 while a few did the conversion to seconds but did not convert the kilowatts to watts.

5 (a) Most candidates realised that river C had experienced a major environmental change which they justified by correct interpretation of the mayfly data. However some candidates failed to realise that the question was asking about change and gave river A as it had 0 mayfly over the whole time period.

5 (b) There were some good descriptions of environmental changes which might cause the reduction in mayfly. These included ideas of increased pollution, physical changes such as changes in temperature or water level and biological changes such as change in predators. Most candidates who failed to score did so because they answered in terms of the weather or seasonal change. Some weaker answers just suggested that the habitat was harmed or that the nymphs moved elsewhere.

6 (a) (i) Very few candidates understood that the source of energy for most food webs is the Sun. Most thought that it was krill or phytoplankton.

6 (a) (ii) Most candidates could successfully use the food web to identify herring or humpback whales as the organisms that compete with jellyfish for food. Some showed confusion over the significance of the direction of the arrows by choosing krill or sea turtles.

6 (a) (iiii) Again many answers showed a lack of understanding of food webs and described cod numbers as increasing because there would be less herring to eat them.

6 (b) (i) Few candidates were able to use the relationship given at the beginning of the paper to correctly calculate the percentage efficiency of energy transfer as 2%, even with an example having been given in the stem of the question. 5% and 50% were common errors.

6 (b) (ii) Only the better candidates understood the ways that energy leaves a food chain with 'heat' being the most frequently seen correct response. Many candidates thought that 'death' or 'being eaten' would lead to energy loss from the food chain.

7 (a) Responses showed that candidates find it difficult to distinguish between statements describing data and statements describing explanations. Although most candidates could correctly connect at least four of the six statements, there was no clear pattern for which statements caused the greatest problem.

7 (b) Candidates struggled with the concept of natural selection and there were many simplistic answers containing little science, for example, just repeating information given in the question about sailing around the world collecting samples. Many candidates who scored well did so because they included specific examples such as long necked giraffes. Many weak responses talked about evolution and in particular talked about how mankind evolved from apes. Some responses, including those that scored some marks, showed that the candidate was using Lamarck's ideas. Suggestions that species made a conscious effort to adapt to their environment were frequently seen, with ideas of them selecting mates with favourable characteristics. There were many responses that talked about fertile offspring showing that candidates knew the definition of a species, but these responses also often talked about different species breeding together.

8 (a) Most candidates could identify bacon as the food which should be labelled as 'high salt' for part (i) although cereal appeared occasionally. "Bread" and "cereals" both being selected was the most common error for 'low salt' foods in part (ii), possibly because candidates were trying to recall the information rather than using the information given in the stem of the question.

8 (b) Many candidates were able to use the figures given to correctly calculate the salt content of the food eaten but others struggled completely. There were some arithmetic mistakes and some candidates failed to halve the values for bacon and bread.

8 (c) (i) There was a common misconception that the Government puts salt in food and could therefore put less in. Food labels were commonly identified. Most answers were phrased in terms of salt content.

8 (c) (ii) Many candidates named or implied that preserving food and taste were areas of benefits. Some candidates just talked about small amounts of salt being necessary. Most candidates could name and often describe a risk but did not explain that the Government did not ban the salt because the benefits outweighed the risks.

9 (a) There were some good descriptions of the formation of rock salt from the evaporation of sea water but too many were confused with the extraction of salt from rock salt. Others showed a lack of understanding of rock salt and answered in terms of rock and salt mixing in some way.

9 (b) Most candidates were able to give a simple description of at least rock A although they found the picture of rock B difficult to interpret. Some showed better understanding of the formation of sedimentary rocks by recognising that rock A contained a fossil and/or that water was involved in the formation of rock B. Some candidates gave more general descriptions of information that can be obtained from sedimentary rocks without linking it to the two examples given. Many thought that the marks were formed by events after the rock was formed such as erosion.

10 (a) Most candidates could recall at least one use for an alkali. 'Changing fats to soap' was a common error in place of 'making glass'.

10 (b) Most candidates understood that alkali neutralises acid but a lot added that alkalis are harmless. Some thought that the production of salt was important as it is used to stop roads being slippery.

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

General Comments

This paper was the first time these units of the new specification have been assessed. As with the other new specification units, it contained considerably more free response questions than in previous sessions and there were more marks available for quantitative work. It was clear that the candidates found these longer questions and the quantitative work more challenging and there were significant numbers of candidates that made no attempt at some of the questions, namely 1bii, 9a and 10a.

This paper was appropriate for the ability range of the expected entry but there appeared to be poor understanding of some concepts, especially those that were new to this specification and have not previously been assessed in the old specification. There was some evidence to suggest that a few candidates may have run out of time. Overall, it seemed that a significant number of candidates struggled with the demand of the questions on this paper and may well have been better suited to a Foundation Tier paper.

As in previous sessions, candidates were well prepared for the objective style of questioning. Occasionally candidates put the incorrect number of ticks in the boxes. If candidates are asked for two ticks, only two ticks should be given. Otherwise candidates are likely to lose marks.

There were more issues for those questions requiring extended answers. Many answers to the free response questions lacked appropriate scientific detail and clarity in their answers. For some questions it was clear that a few candidates did not know where to start. It was often felt that they had not read the question carefully enough or used the information given to help them.

The new Level of Response questions (six marks) were attempted by most candidates. Candidates' responses are marked as a whole, including the quality of their written communication, rather than obtaining marks for individual mark points. This can provide the greatest challenge for candidates on these new specification exam papers. It is worth noting that Level of Response questions often ask candidates to give at least two strands of an argument. A candidate who only deals with one strand will be restricted to the lower levels. Centres might find it useful to encourage candidates to read a range of Level of Response questions and get them to identify the different strands they might be expected to talk about.

Comments on Individual Questions

1 (a) This proved to be a more difficult start to the paper than expected. Candidates should be reminded that the equations needed to perform these calculations are given at the beginning of the exam paper. Candidates are not expected to recall the equations. Too many candidates correctly multiplied voltage by current, but then failed to divide their answer by 1000 so that it was given in kilowatts. Hence, they incorrectly circled 2000 as the correct answer.

1 (b) (i) This calculation also caused the majority of candidates some difficulties. The equation required is given at the beginning of the paper. Candidates were required to multiply power by time. However, many candidates were unable to select the correct equation to use. Those that used the correct equation failed to convert 45 minutes into hours (0.75 hours) and so 54 was commonly seen as an incorrect answer.

1 (b) (ii) This calculation also caused problems for many candidates. The equation required is the same as that used in (b)(i) but the answer needed to be given in joules. This required the candidates to convert minutes into seconds and kilowatts into watts. Hence the correct calculation was 60 x 1200. The correct answer (72 000) was only seen on a small number of scripts. However it was pleasing to see some candidates show working and a small number of candidates were awarded one mark for their working even though their final answer was incorrect.

2 (a) This question proved to be a very good discriminator with only the best candidates achieving all three marks. A common error was to write 'furnace' for A and fail to note that it was a nuclear power station and that fuel would not be burned. A significant number of candidates labelled parts B, C and D turbine, generator and transformer but far fewer had them in the correct order. A large percentage of candidates were unable to label even one of the parts correctly.

2 (b) Most candidates attempted to define contamination and irradiation here but few noted that the question was asking for a comparison of risk between them. As a result a significant number of candidates scored one mark for a correct definition of contamination or irradiation but very few scored the second mark for a discussion of risk. Occasionally candidates described how contamination is having the source closer to you (on or in you) and that this would be more dangerous, and this was awarded the second mark for the idea that risk is dependent on distance. A number of candidates described contamination in completely the wrong context and this was not credited.

3 (a) This question proved to be a good discriminator with the most able candidates scoring two marks whilst the majority either failed to perform any correct calculations, or did not make any attempt at the question. Those who were able to either calculate that nuclear power was 190/900 = 21% or that 20% of 900 = 180 usually went on to score a second mark for their conclusion. A rather large number of candidates seemed unable to correctly total all of the energy inputs (or indeed outputs) to equal 900. This then prevented them from scoring any marks. It is possible that candidates did not have a calculator with them and this may have limited their ability to answer the quantitative questions on this paper. A small number of candidates wrote a conclusion without any calculations but this could not be credited as there needed to be evidence of the processes candidates had used to reach their conclusion.

3 (b) The majority of candidates did not score a mark here. Of those that did, they were equally spread across candidates of all abilities. This suggests that there was a lot of guesswork involved in many of the candidates' responses and that a correct answer was perhaps due to luck. There was a lot to read and some calculations to perform. Candidates needed to half the electricity used in power stations (13) and calculate 10% of the energy losses (55). These values could then be added together to give the correct answer of 68.

3 (c) The majority of candidates were able to identify that the use of renewable energy or nuclear power is likely to increase. Occasionally candidates contradicted themselves by writing that renewable energy usage would increase, e.g. coal. Responses like this were not credited. A few candidates used the stem to identify that the total energy input would increase. Far fewer candidates were able to describe how non-renewable energy sources would become a much smaller proportion of the total energy input.

4 This was the first Level of Response question on this paper and it proved to be accessible to all but a very small number of candidates. As with many of these Level of Response questions, there were two strands to talk about. Candidates needed to discuss ways to meet energy demand in the future and ways that energy use should be managed. Few candidates picked up on the latter idea and it was rare to see any comment regarding the management of energy use on the island. A few candidates made reference to it needing to be sustainable but the lack of discussion of this strand limited most responses to Level 2. The vast majority of candidates were able to suggest a suitable method of producing energy, with wind and tidal energy being most commonly seen. However, in order to score some marks, there also had to be a suitable justification as to why this choice had been made. Some justifications were very brief or rather obvious – 'use wind because it's windy' – and these did not score above one mark. Where candidates explored a wider range of justifications they were able to score at Level 2. No credit was given for the simple mention of renewable energy. A few candidates suggested nuclear power or fossil fuels and no credit was given for this either.
It is worth pointing out that a significant number of candidates incorrectly believe that hydro-electric power relies on the sea, and a large number of candidates also seemed unable to use the information in the stem to help them, i.e. the information about the distance of the islands from the mainland and the low population.

5 (a) Candidates found this question difficult and the majority got it incorrect. Only those candidates performing well across the whole paper were able to define an indicator species correctly and so this question was a good discriminator. There were lots of vague answers about how scientists use the mayfly nymphs 'to get information' or 'to do experiments'. A significant number thought that the species would give clues about evolution and a few candidates confused the idea of indicator species with the indicators used to measure pH.

5 (b) Candidates also found this question difficult with the majority scoring zero marks. Only the most able candidates made the link between the presence of the mayfly nymph and the lack of pollution. The majority of candidates assumed that the nature reserve would be developed to conserve the population of the nymphs. There were lots of answers that related to how suitable the environment was for the nymphs and how easy or difficult it would be to conserve the nymphs in that environment. Some candidates just quoted comparative figures and made no attempt to give any scientific support to their suggestions.

6 (a) (i) Candidates were confident about adding the information correctly to the food web and the majority of candidates achieved a mark here. The most common error was to point the arrow heads in the wrong direction.

6 (a) (ii) Very few candidates scored a mark here. A significant number of candidates correctly ticked that detritivores feed on dead organisms and waste products, but few could correctly tick that they release carbon dioxide back into the air.

6 (a) (iii) This question proved to be a very good discriminator with only those candidates achieving the highest marks across the whole paper able to get all four boxes correct here for the mark.

6 (b) (i) A large number of candidates could not correctly calculate the percentage efficiency between the phytoplankton and the whale. A significant number tried to calculate the efficiency of the two stages in the food chain and then add them together. Others incorrectly divided 100 000 by 140. However, the candidates that knew how to approach this question answered it correctly and showed their working out clearly, scoring two marks. A few candidates scored one mark for their working. It was common for the efficiency to be calculated

correctly as 0.14 but for candidates to then multiply it by 100 before writing it on the answer line. This is probably because candidates saw the % sign on the answer line but failed to realise that they had already calculated a percentage. It might also be that candidates didn't think that 0.14 was a large enough number to be correct. It is worth noting that some candidates calculated the percentage efficiency to be greater than 100% which is clearly incorrect. It was surprising that candidates did not realise this to be wrong.

6 (b) (ii) Generally the answers given to this question were good. Those candidates that had some understanding of the ideas were able to achieve at least one mark here. However, there were also a large number of candidates scoring zero and not attempting the question or not understanding the idea of energy transfer. The most common mark awarded was for describing the energy loss at each stage. Many candidates also gave an example of how that energy can be lost for a second mark. Candidates found it much harder to obtain the third mark by comparing the lengths of the shark and the whale food chain. In some cases, it was clear that candidates had the right idea, but the language used and the ability to express the ideas was not good enough to score the mark.

7 (a) This second Level of Response question proved to be accessible to most candidates and showed a better spread of marks across the three levels than the other two Level of Response questions on the paper. There were still relatively few candidates achieving Level 3 but many were able to obtain three or four marks at Level 2.
It was pleasing to see a good understanding of the theory of natural selection. Many candidates correctly described the idea that some organisms are more successful than others due to a particular feature or adaptation. Most candidates also explained how these organisms will survive to pass on that feature to their offspring. It was less common to see a mention of genes or alleles and few candidates talked about variation explicitly in their answers. The best candidates were able to describe all the stages of the process in the correct order. Some candidates chose to illustrate the idea by describing particular examples, e.g. Darwin's finches. This was worthy of credit.
Some candidates did not score any marks for this question as they were either describing selective breeding or describing Lamarck's ideas (possibly with help from the stem to part (b)).

7 (b) This question was answered very well by the majority of candidates. Almost every candidate scored one mark and most scored at least two.

8 (a) This question was answered well by many of the candidates and it was certainly the best answered quantitative question on the paper. Candidates seemed confident about calculating the amount of salt in the foods although a significant number failed to halve the values given for bread and bacon (since the values given are per 100g). This meant that the most common error was to calculate the total salt as 4.56g. Those that calculated the amount of salt correctly as 2.78g were then also able to correctly identify that this value is less than the GDA.

8 (b) This question was a good discriminator and was generally very well answered. Most candidates scored at least one mark and a significant number scored all three. The most common answers were a reference to the use of salt to improve taste and preserve food, and to the health risk of salt, e.g. high blood pressure. No credit was given for vague comments regarding how salt is bad for our health. Some candidates scored a mark for discussing the potential loss of income to the food manufacturers.

9 (a) It was surprising to see how many candidates found this question difficult. There was lots of confusion and many candidates either described the extraction of rock salt rather than the formation, or incorrectly talked about the formation of rocks. It was not uncommon to see descriptions of layering and compression and the formation of sedimentary rocks. Candidates that tackled the question in the correct manner usually scored both marks. The most common mark was for the idea that salty water is required.

9 (b) This question was a reasonable discriminator with most candidates ticking at least one of the correct boxes. A few candidates were not awarded the marks because they ticked more than two boxes.

9 (c) This appeared to be the most inaccessible Level of Response question on the paper. A significant number of candidates did not make any attempt at it and a large number of candidates that did attempt the question scored zero marks. Very few candidates scored above three marks for this question. It seemed that candidates were unsure how to tackle the question and the understanding of this area of the specification was very poor.
The question again asked for a discussion of two strands. Candidates needed to give a reason why there is variation in the magnetism in the rocks, and how that variation can be used as evidence for continental drift. Very few candidates were able to talk about both of these things in detail. The most common responses referred to the reversal of magnetism but it was clear that many candidates did not really understand what the significance of this is. Some thought that the magnetism was responsible for repelling the continents away from each other or pulling them back together.
The responses that scored marks were usually for recognising that the magnetism in South America and Africa runs in the same direction which suggests that the rocks were formed at the same time in the same place.
A few candidates did not refer to magnetism at all and instead talked about the 'jigsaw fit' of the continents and Wegener's ideas.

10 (a) The vast majority of candidates either made no attempt at this question or scored zero marks. A significant number of candidates realised that one value had to be taken from the other but few were able to convert these values from percentages into tonnes. Hence, there were a reasonable number of responses that gave the answer as 22 or 220. As with all the quantitative questions on the paper, it is always worth writing down the methods so that these can be credited even when the answer is incorrect. This occurred on a number of scripts for this question.
Whilst there was an error on the paper, only a very small number of scripts were seen to have used 53% instead of 46% and these scripts were credited as appropriate.

10 (b) Again, candidates found this question difficult and the vast majority scored zero marks. The main reason for this was due to a lack of scientific ideas and terminology. There were a huge number of responses that talked about the 2010 method being 'more efficient', 'cleaner', 'cheaper', 'better for us' or a result of 'better technology' or 'better science'. Very few candidates really looked at the graphs and picked out the specific differences between them and then explained why the differences were there.

A144 Principal Moderator's Report

In this session, most Centres are to be commended for the way in which this new Controlled Assessment unit has been implemented, assessed and administered. A number of arithmetical errors and clerical errors were, however, noted and Centres must also be careful in their calculation of final marks, especially in Strand E of the Practical Data Analysis. The application of marking criteria was generally good across Centres, but 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) warrants caution. This session has seen a significant lowering of instances where there is an exact correspondence of Centre and Moderator marks.

There was some confusion over entries: please note that A144/01 pertains to submissions on the OCR Repository, whereas A144/02 is for postal moderation.

Many Centres provided their Moderator with detailed accounts of how the tasks and levels of control were administered, which aided the moderation process. Documentary evidence of internal standardisation was also supplied in a large number of instances, but for many Centres, this was not provided. Some inconsistent marking was seen which suggested, on some occasions, that internal standardisation procedures had not been applied, 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.

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'.

In some instances, there was clearly some confusion as to guidance and collaboration permissible in phases of limited and high control, and these issues are highlighted in respective sections of this report. Times for the respective phases of the assessment are recommended times, but Centres are reminded that these should not be exceeded markedly. Many Centres had, by and large, applied the Controlled Assessment marking criteria successfully, but 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). On a presentation note, Centres should also take particular note of the submission of candidates' scripts. It would greatly assist the moderation process if candidates' portfolios 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 Case Study is designed to enable candidates to demonstrate their skills in evaluating science-related information that they might find in the media.

The choice of three topics for the Case Study for 2012 was:

Stem Cells

Plasticizers

Global Warming.

The Global Warming Case Study was the most popular, with Plasticizers the least commonly seen. Overall, the quality of science tended to be a little better in the Stem Cells than the Global Warming Case Study.

The 'News Sheet' provides students with a starting point for their study, and its introduction is under limited control; candidates choose a question for investigation based on the material provided. Candidates should be encouraged to state clearly their question for investigation. This would have helped candidates to focus their response; the content of reports sometimes moved from one question to another, and in many instances, the title quoted for investigation did not truly represent a question. Some candidates had chosen areas of the topic that did not lend itself 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).

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.

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 and book sources, authors, titles of articles and dates of publication should be cited (where these are given). Internet sources should also cite full URLs. Book references were rarely fully-detailed, although in most instances, there was sufficient information to lead the Moderator to the source material.

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, i.e.

- the origin, types and location of different types of stem cells
- how plasticizers affect the properties of plastics
- the proposed mechanism of global warming, i.e. the (enhanced) greenhouse effect.

It is suggested that diagrams should be used to support the communication of these concepts; in general, these were rather limited, surprisingly often from the most able candidates. A good deal of erroneous science was seen in these introductory sections. In particular, in the Global Warming Case Study, although ozone is a 'greenhouse gas', it was the ozone layer that was frequently discussed in connection with global warming. In the Stem Cells Case Study, the use of stem cell technologies in the treatment of degenerative diseases was often referred to as being in the present, rather than, in the main, being under research.

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 Stem Cells 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 lower, 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 similar opposing points. 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). Centres rarely appreciated the level of critical comparison required here, and 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. Some candidates, having drawn a conclusion on one side of the argument, made recommendations that were more conducive to affecting the other. The recommendations made were often vague. 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, particularly in the Stem Cells and Plasticizers Case Studies.

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.

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 Information for Candidates and Information for Teachers documents.

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

For 2012, these were:

Antimicrobials and concentration
Why are rubber bands stretchy?
Light intensity and distance.

Centres are reminded that while some flexibility of approach is possible, owing largely to differences in the availability of equipment, Centres should not prescribe their own scenarios to the experiments or modify hypotheses. The latter was more often seen in the 'Why are rubber bands stretchy?' In this Practical Data Analysis, the inclusion of a Hooke's Law practical sometimes confused candidates.

Strand D: Choice of methods, techniques and equipment

In general, this Strand was well-carried out and was one of the more accurately-marked. Candidates often discussed variables and other aspects in detail, but should be reminded that a coherent method is also required. 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, but on others, Centre marks were significantly lowered.

Many candidates working on 'Antimicrobials and concentration' often did not indicate clearly how measurements of zones of inhibition (diameters or areas) were made. It is usual, at this level, to include the disc in an overall measurement of diameter/area. Diameters of zones were sometimes recorded as 0 mm, but these are valid only if the plate has been inverted and no growth is observed beneath the disc, or this is the value obtained if the diameter of the disc is deducted from the overall diameter of the zone. If either of these were the case, it would be expected to be recorded in the method.

In the 'Why are rubber bands stretchy?' experiment, there was often confusion with 'length' and 'extension', and a significant number of candidates recorded an 'extension' when no load had been applied.

For light intensity and distance, a number of methods for measuring incident radiation were used, including the use of photocells, light meters and LDRs. For the last of these, it was clear that candidates did not always appreciate the relationship between their measurements and light intensity.

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. These were often weak. Although preliminary work is not an absolute requirement, two of the tasks did lend themselves to it. Where there was evidence of trial runs being carried out, it was easier for the candidate to justify the choices made.

In this Strand, candidates should also 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. 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. Centres should be reminded that Risk Assessment proformas can be used.

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 on the lower row), and the higher mark achieved across the two rows carried forward to the unit total. Some Centres averaged the two marks or even added these to produce inappropriate marks.

Nevertheless, it was usually in this Strand of the Practical Data Analysis where candidates scored the highest marks, though there were some discrepancies between Centre and Moderator marks, where some graphs seen were of poor quality. There was clear evidence that some Centres had not checked these carefully before awarding marks.

Graphs drawn without appropriate scales (with unequal divisions) or without one or more labelled axes, and poorly-drawn lines of best fit were often, incorrectly, awarded high marks. In the rubber bands experiment, candidates often missed that a slight S-shaped curve could be fitted to the points. 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.

In some instances, candidates awarded very low marks for poorly-drawn graphs should have been awarded three or four marks owing to their calculations of means.

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.

Strand F: Evaluation of data

In this Strand, some of the largest discrepancies between Centre and Moderator marks were frequently seen, often because of Centres' misinterpretation of the marking criteria and candidates' failure to fulfil them. Candidates' evaluations were often lengthy, but many covered the pertinent points in the first few sentences.

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.

Candidates should be encouraged to use the terms 'outliers' and 'repeatability'. Although there were some often good discussions of spread of data, 'repeatability' was not always discussed. Candidates should discuss the spread of data qualitatively and quantitatively to obtain the highest marks. Many candidates had often made an attempt to account for outliers, 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.

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 to the hypothesis once, 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 one 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. Candidates working in the 3–4 mark band upwards should make reference to some science when explaining their results. On many occasions, very little science was evident. The relevant science should include:

- Antimicrobials and concentration
  Reference to the microorganisms being killed, or their growth being inhibited.

- Why are rubber bands stretchy?
  Reference to the stretch resulting from alignment of polymer chains, as the load is increased, the stretch is limited owing to the cross-linking in the rubber. Some candidates referred to hysteresis. As the masses are removed from the rubber band, each mass that produced a specific extension/length as it was loaded onto the band now produces a slightly longer length in unloading. This is because polymer chains that had undergone changes in conformation during stretching do not fully revert back to their original form straightaway.

- Light intensity and distance
  Candidates working at the 3–4 mark level should have referred to the spread of light over a wider area as the distance from the light source increases. Those working at higher levels should appreciate that the intensity of light as a function of the distance from the light source follows an inverse square relationship. Many candidates used a diagram to illustrate this spread of light.

Candidates working at the 5–6 mark level explained the extent to which the hypothesis had been supported, recognising differences in the trend across the range and many suggested how the hypothesis could be modified. In the 7–8 mark band, many candidates suggested extra data that could be collected to increase confidence in the hypothesis, but there was rarely sufficient detail in the account to support the award of seven or eight marks.

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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