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GCSE

Science A

Twenty First Century Science Suite

General Certificate of Secondary Education **J241**

OCR Report to Centres

January 2013

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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

The units assessed this session were A141, A142 and A143. Note that this is the last time this specification will be assessed in a winter series; henceforth, assessments for this specification will be offered in the summer series only.

Principal Examiners for the GCSE Science A papers all commented on how candidates dealt with difficulties presented by the newer styles of questions: six-mark free-response questions, and developed mathematical questions.

Candidates were much better prepared for the free-response questions than last year, but many still fail to answer the question actually set. In the pressure of an examination it is easy to make mistakes of interpretation, which can severely limit the number of marks available to the candidate. Centres are recommended to train candidates in strategies such as highlighting significant words in the question to enable them to structure their answer around those points.

Centres are also reminded that the six-mark extended-writing questions often demand that the candidate considers more than one aspect of a problem, and so examiners usually reserve the highest level marks for those candidates who clearly address all the required aspects.

Extended mathematics still provides difficulties in both Foundation and Higher tiers: these questions frequently have a structure (e.g. division into parts (a)(i), (a)(ii), etc.) which is intended to indicate a developing story wherein candidates must do a calculation or analyse some data, and then go on to use this information in evaluating the situation.

Candidates should be reminded that if they wish to change their answer, the old answer should be crossed out and a new one written in its place. There were instances of alterations (e.g. from a 5 to a 6) that created a completely ambiguous response. Where a response is ambiguous, examiners have little option but to give zero credit.

Another point raised by all principal examiners for these papers – and this comment is not new – is with regard to objective tick-box questions. There were a number of examples of candidates ticking only one box when instructed to tick two. It is also always worth reminding candidates that, irrespective of whether or not the number of ticks required is stated in the question, the number of marks allocated to the question does not necessarily equal the number of ticks required. This principle also applies to the number of lines drawn in a ‘join the boxes’ type question.

Most candidates were entered for the appropriate tier of each examination. Weaker candidates who are entered for Higher Tier papers do not have a pleasant experience and are usually unable to demonstrate what they know and understand. This clearly has an adverse effect on the grade that they will receive. Centres should enter weaker candidates for the Foundation Tier where they are more able to demonstrate what they know and understand, and complete the examination feeling that they have had a positive rather than a negative experience.

A141/01 – Twenty First Century Science A (B1, C1, P1) Foundation Tier

Section 1 – General Comments

Overall, candidates appeared to find the paper accessible with most questions being attempted. Attempts at the six-mark extended-writing questions suggested that candidates were well prepared for this type of question. Despite some tailing off of responses towards the end of the paper, time restraint did not seem to have been a problem for most candidates. The quality of written communication was satisfactory in most cases.

Section 2 – Comments on Individual Questions

1 **(a)** Most candidates scored at least 1 mark here, but DNA was often given as an answer to (a)ii.

(b) **(i)** Generally answered well. Common mistakes included only one d and Dd. Occasionally Pd, Qd appeared.

(ii) Candidates at Foundation level found this difficult as although they could see the problem, they did not know how to phrase their answer. Many said the conclusion was correct because of the evidence of the Punnett square.

2 **(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.

(b) This was the first six-mark extended-writing question on the paper and was the one on which candidates scored the highest. A wide range of answers was seen; some just quoted the stem "they would want to test to find out if they had a genetic disease" or "they would want to know the sex of the child" and did not go on to state that this was an argument for the testing. Others did not achieve Level 2 as they did not produce a balanced argument. Few achieved Level 3 as the main argument for sex testing was about "choosing the colour of clothes for the child" or "spoiling the surprise". Some responses referred only to genetic testing of adults. There were however some excellent balanced arguments using the two examples.

3 **(a)** Most candidates scored the mark. The most common incorrect response was "individuals that look the same".

(b) Few candidates scored here and the ones that did used "asexual reproduction". "Bits falling off plants" was common and "strawberries" occasionally appeared without any further explanation. "Seeds" and "photosynthesis" were also mentioned. Many suggested taking cuttings.

(c) **(i)** This was well answered. Occasionally more than one range was given.

(ii) Candidates had difficulty describing correlations. The first mark was awarded more often than the second. Common mistakes included thinking that the graph was showing height plotted against time.

(iii) Many used the word "environmental" and some went on to give an example and score both marks. "Sun" and "nutrients" appeared occasionally. A number said they were not clones if they were different heights.

4 **(a)** **(i)** Candidates can read keys. Nearly all scored both marks here.

(ii) Correct answers were extremely rare. Candidates often referred to carbon and to incomplete combustion as well as to petrol and fuel. Occasionally we saw oxygen from the air, but never nitrogen. Gases "mixing" was mentioned, but never "reacting", and no mention of high temperature.

(b) Generally well answered. Most common error was to select "rain washes surfaces clean" or to tick three boxes or one box only.

5 **(a)** Most candidates scored here with many correctly ticking both boxes. No common errors.

(b) Many scored the first marking point for "going down" but were unsuccessful with the second despite attempting it. Down to 0.5 was common as was 2090.

(c) First marking point usually awarded, and a number of candidates made it clear that they had used both graphs to obtain the second one.

6 **(a)** Majority of candidates scored both marks. Some made arithmetic errors despite knowing what they were trying to accomplish.

(b) Again, candidates made good attempts at this six-mark extended-writing question. Most could identify the changes in levels and were credited for this even if the changes were implied. Some did not use the word "photosynthesis" despite appreciating the oxygen and carbon dioxide changes were due to plants evolving. Some talked about the plants "breathing" carbon dioxide in and oxygen out. Some referred to human activity, pollution and global warming as causes but a number achieved Level 3.

7 **(a)** All possible combinations were seen but many responses were correct.

(b) **(i)** There were many answers in the range 3 to 5 minutes, but some candidates quoted a specific time of day.

(ii) Many correct responses as candidates multiplied their 7(b)i answer by 420, but a very common error was 420 X 7 as candidates used the 7 m/s.

(iii) Very few obtained 2 marks. The first mark was awarded to those who stated that Simeulue was closer to Thailand, but there were a lot of confused responses including the effects of S and P waves, the time of day, and the type of buildings.

8 **(a)** Well answered with "positive correlation" often stated.

(b) Many answers in the accepted range and a number of 19,500.

(c) and **(d)** were both well answered.

9 A combination of being the last question on the paper and a six-mark extended-writing question that proved difficult to candidates, meant that this question gave the lowest average marks and the highest omission rate of the three six-mark extended-writing questions. Level 3 answers were rarely seen on this overlap question. Level 1 was usually achieved by mentioning volcanoes, mountains or moving tectonic plates as a consequence. At Level 2, candidates were able to give an incomplete mechanism for convection in the mantle and a consequence. Some candidates appeared to present a prepared answer to a question on Wegener's theory without tailoring it to this particular question.

A141/02 – Twenty First Century Science A (B1, C1, P1) Higher Tier

Section 1 – General Comments

The overall performance on the paper was similar to January 2012, but Centres have clearly prepared their candidates more successfully for the newer types of questions, in particular the six-mark free-response questions.

Objective questions were generally well done, but the shorter free-response questions, particularly the mathematical ones, were still found taxing and were often treated in a superficial way. In these papers it is important that candidates recognise that a mathematical question will often be extended in nature, needing not only a calculation (which could involve more than one stage) but also quite often evaluation of the results.

Candidates are also well advised to read the instructions in the question stems carefully; many candidates lost marks by answering a question different from the one in the paper. Candidates who underlined or highlighted key words and phrases in the question stems made that error less frequently.

Section 2 – Comments on Individual Questions

1 (Polydactyly) The objective part (a) of this question was well done by candidates who understood the technical terms being examined. In (b), more successful candidates could analyse the family tree for this new genetic condition analytically, realising that two affected individuals could have an unaffected child only if the condition was dominant, but many were distracted by misguided attempts to calculate frequencies of occurrence of the condition (with very small numbers of individuals) or by trying to justify their own assumptions that the condition had to be recessive or sex-linked.

2 (Saviour siblings) Part (a), a sequencing exercise, was generally well done. Part (b), the first six-mark extended-writing question of the paper, differentiated well between candidates who clearly understood the context of parents choosing to have another baby to treat a genetic condition in his sister and those who did not appreciate the 'story line' and discussed instead recalled aspects of gene therapy or cloning. The most successful candidates were able to recognise implications of the treatment (to the new baby, or to the elder sister, or to the family) and link those to concerns of feasibility or ethical issues.

3 (Plant clones) This question was well done throughout. In (c)(i) most candidates gained marks for correctly giving the range in which most plants occurred. Some poorly expressed responses attempted to describe an increase and then a decrease over a fixed range. In (c)(iii) the better candidates realised that environmental factors, such as light, watering and temperature, were important factors whereas weaker responses forgot the context and referred to examples such as identical twins.

4 (Catalytic converters) The difficult part of this question proved to be (as has been found before) realising that nitrogen monoxide is produced by reactants from the air combining at the high temperature of the engine: many assumed that nitrogen came from the fuel. A number of candidates were distracted by the 'monoxide' and answered their own question 'Why is nitrogen monoxide, and not nitrogen dioxide, produced?' in terms of there being insufficient oxygen present to produce nitrogen dioxide.

5 (Biofuels) Although candidates had no difficulty in describing the graphs using the true/false statements in (a)(i), most did not recognise that (a)(ii), in asking for an explanation in the difference in slopes of the two graphs, was assuming recognition that the pollutants produced by petrol and by biofuels were similar and that the small gradient of the biofuels graph was due to the way in which carbon dioxide produced is reabsorbed by the growing crops. Evaluation of the impact of biofuels in (a)(iii) was much more successfully done, although many had attempted to answer that question in (a)(ii). Part (b) was well done by most.

6 (Changes in the atmosphere of the early Earth) The straight-forward calculation of the percentage of oxygen in the early atmosphere was well done by nearly all in (a), but weaker candidates then went on to try to explain the changes in the six-mark part (b) in terms of air pollution in the modern world rather than the changes in the era shown in the data. Candidates who recognised the context mostly explained the changes very well, although many failed to reach level 3 (5 or 6 marks) by misuse or omission of the appropriate technical terms condensation, dissolving, sedimentation and photosynthesis.

7 (Earthquakes) The calculation in (a) proved difficult for many, as they had to calculate two times, subtract them and them convert from seconds to minutes to compare with the given 15 minutes. Weaker candidates did not attempt calculations but quoted the fact that the two events on the graph were 15 minutes apart (which is what the question was asking them to show).

8 (Galaxy data) In (a), most could identify the fact that further galaxies were moving faster and many explained that this showed that the Universe is expanding. Only the best were able in (b) to calculate a value for the distance to another galaxy of speed 50 000 km/s either by interpolation between two of the given points or by assuming a proportional relationship and calculating the graph gradient. The objective part (c) was well done.

9 (Seafloor spread) This final six-mark question differentiated well between the weakest responses which recognised the topic area but failed to discuss the mechanism of movements in the mantle, often answering their own question about Alfred Wegener, and the best responses which could explain clearly the foundations of modern tectonic plate theory.

A142/01 – Twenty First Century Science A (B2, C2, P2) Foundation Tier

Section 1 – General Comments

The paper seemed accessible to all with little evidence of issues with time. Candidates are now writing more in extended writing questions but are sometimes just looking to fill the space rather than identifying relevant points to answer the question.

Section 2 – Comments on Individual Questions

1 **(a)** The range of sizes for nanoparticles was not well known, with few candidates recognising that 10 nm and 50 nm were the appropriate sized particle to choose.

(b) There seemed to be very little understanding of why nanoparticles behave differently and most attempts at this question involved a comment about the size of the lump (e.g. too big to fit in cut) and the nanoparticle, but no reference to surface area or area/volume. Others simply restated the information in the question and said that the nanoparticles killed the bacteria. A few candidates did recognise the increased surface area of nanoparticles or had the idea of the particles being spread throughout the plaster.

(c) Candidates had a good understanding of why there are worries about the uses of nanoparticles, with most recognising that nanoparticles might be harmful. Many also realised that nanoparticles have not yet been fully tested.

2 **(a)** **(i)** Most candidates understood that control of the size of the piece of material was needed to ensure that the test was fair. A significant number ticked two boxes, often choosing ‘how often they repeat the test’.

(ii) Candidates were much less clear about why more than one sample of each material should be used, with many opting for “to increase accuracy” or “to make test fair”. Some thought that they were repeating with different materials rather than different pieces of the same material. Better candidates chose “an increase in reliability of results”, “identification of outliers” or “to find an average”, but only a few gained both marks.

(b) **(i)** The majority of the candidates could correctly identify the range as being from 94 to 103, but many chose the sample 1 and sample 5 results from the table (giving the range 95 to 103).

(ii) Again, many candidates thought that the tests had been made on different materials and so referred to pieces having different absorbencies; others thought that the pieces might not have finished dripping although that was excluded in the question. Better candidates realised that the size of the pieces might not be consistent and the best candidates also considered variation in environmental conditions while dripping (e.g. temperature, wind etc.).

3 **(a)** Candidates had a good knowledge of crude oil with most gaining all 3 marks. A few thought that crude oil is found in the oceans rather than the crust.

(b) Most candidates were able to make use of the data in the table to justify their choice. However, quite a few confused wrapping food with a means of carrying food (as in plastic bags or containers) thus leading to a wrong choice of plastic. Of those candidates who correctly chose A as the most suitable plastic, most justified their choice by listing the appropriate properties without explaining why these were important (e.g. by comparing with another plastic or describing the application of the property to food wrappings).

4 **(a)** Most candidates could successfully choose at least one of the scientific terms describing what was happening to the infrared radiation but only the better candidates knew all three. 'Reflected' was correctly chosen most frequently, with most common errors being to choose 'transmitted' instead of 'emitted' or 'absorbed' instead of 'transmitted'.

(b) **(i)** Most candidates could plot the points correctly on the graph, though some found the scale difficult in spite of having been given some plotted points to start them off. The quality of the curve of best fit was generally low as they were rarely smooth or through all points. Many drew straight lines or omitted a line altogether.

(ii) Very few candidates were able to use the numbers in the table to show that each sheet of paper stopped roughly a quarter of the radiation with the majority just saying 'yes' and then restating the question. Some thought it was true because the last value (i.e. after 5 sheets) was roughly a quarter of the first and others thought it should go down by a quarter of the original value each time so that none should be left after 4 sheets.

5 **(a)** The issues about mobile phones were well understood by the majority of candidates.

(i) Generally well answered.

(ii) The reduction in risk was correctly linked with Chris (only using the phone to send texts so that it was not near your ear) by most candidates but a significant number linked it with Amy (brain cancer has become more common as more people use mobile phones).

(iii) Amy's comment was identified as a correlation by most candidates, although a few chose Chris' comment.

(iv) Well answered.

(b) **(i)** Most candidates analysed the data given in the table to explain that the image has a larger number of bytes and therefore takes longer to send. Some gained 1 mark by just comparing the number of bytes in the messages, while others simply quoted the figures from the table without a comparison and so failed to score.

(ii) Better candidates understood that the new phone uses more detail/pixels or has higher resolution/greater definition and so needs more memory. Most just restated the information in the question by stating that the phone is better quality or uses more memory/bytes.

6 There were many good attempts to explain the increase in carbon dioxide levels and the possible future effects on humans. However, some failed to understand the question and explained the graph instead of how the change in carbon dioxide levels occurred. Basic answers involving more cars were common with better answers referring to the increased use of fossil fuels, but marks were limited by lack of reference to the burning of the fuels or

other causes of increased carbon dioxide such as deforestation. References to global warming or greenhouse effect were often included, with some describing the effect of global warming (causing polar ice caps to melt, sea levels rising and the flooding of countries; affecting weather, and habitats of animals), but many described breathing difficulties and death due to carbon dioxide being a toxic gas, or referred to issues with the ozone layer. Candidates need to think more carefully about the amount of detail likely to be needed in an extended-writing answer.

7 **(a)** Most candidates could identify at least two of the statements about antimicrobials as being true or false, but only the stronger candidates knew them all.

(b) **(i)** Most candidates recognized that the graph showed a decrease in the number of bacteria killed since 1940, although some thought that it was a decrease in the number of bacteria remaining so that more had been killed. The best candidates gained both marks by explaining that the percentage of bacteria killed decreased rapidly (from 1940 to 1950) and then decreased more steadily (by 10% each year).

(ii) The idea of bacterial resistance was not well known, with many just describing a decrease in the numbers of bacteria present or stating that people were becoming immune.

(iii)(iv) Few candidates knew that viruses are not killed by penicillin and so most chose graph C instead of graph B. This also meant that few were able to explain their chosen graph.

8 **(a)** Most candidates could complete the sentences to show a positive correlation between amount of stress and risk of heart disease. Some just tried to find words that would complete the sentences but with no indication of a correlation.

(b) The vast majority of candidates identified someone with highest/lowest risk of heart disease and gave appropriate reasons from the table, but answers were often just a list of factors without any evaluation. Better candidates were able to make more detailed comparisons between individuals, explaining why they had chosen one rather than another (e.g. Olive has higher risk than Norman because she is an office worker and so has less exercise than the builder), while others offered some relevant/correct science to justify their choice (e.g. that fatty food would block the arteries giving a higher risk of heart disease).

9 **(a)** Candidates showed a good understanding of the need for testing new drugs before they are given to patients with almost all identifying a safety consideration such as not harming the patient. Many also gained the second mark for realizing that it should be shown to be effective before being used.

(b) Many candidates were able to identify a benefit of taking part in the trial of a new drug, with “potential cure” or “helping others” being the most popular. Most could also identify a risk, with “making them feel worse” or “shortening life span” appearing most frequently.

(c) Placebos remain poorly understood by the majority of candidates. Some thought that there may be side effects from the placebo or that it might make their cancer worse, while others thought that the point of placebos was to improve health by ‘mind over matter’. A few had the idea that a placebo was an alternative type of life form to be experimented on. Most marks were gained by the idea that placebos do not work (e.g. fake drugs), while better answers understood the ethical issues of withholding a potential benefit from seriously ill patients by giving a placebo instead.

A142/02 – Twenty First Century Science A (B2, C2, P2) Higher Tier

Section 1 – General Comments

This paper was well attempted by the majority of candidates. The questions differentiated effectively and there was a wide range of total marks on the paper. Almost all questions had responses and there was no evidence of candidates being short of time.

Many answers to the free-response questions lacked 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. Candidates do need plenty of practice in this new style of question, with suggestions on how to include their scientific knowledge and understanding in their answers.

Numerical questions are still found to be challenging. Again, plenty of practice on a wide variety of mathematical questions within science should improve candidates' responses. They should include calculations when asked, be encouraged to show working and to lay out calculations logically and neatly.

Candidates find it difficult to apply their knowledge and understanding of science to different contexts. There is a tendency for candidates to write down pieces of scientific knowledge, without thinking whether they fit into the context and answer the question.

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

Section 2 – Comments on Individual Questions

1 **(a)** This question on nanoparticles was expected to be a straightforward start to the paper. However, in this part few knew the size range of a nanoparticle. Often, illogically, candidates would choose two non-consecutive numbers for their answer.

(b) Very few candidates knew that nanoparticles work because they have a very high surface area. Fewer could apply this knowledge to the context and say that more bacteria were in contact with silver and would be killed because the silver was more spread out. A popular misconception was that silver nanoparticles were synthetic whilst a lump of silver was natural.

(c) This question differentiated well, with more candidates able to say why some scientists think there should be restrictions on nanoparticles.

2 **(a)** This was a well attempted question on data collection and analysis. Most candidates were able to suggest a factor that had to be controlled, but some lost a mark because they were unable to say how the results would be affected if this factor was not controlled.

(b) Most candidates correctly calculated the best estimate of the true value, but few were able to use this, and the data provided, to decide whether the absorbencies of the two materials were different. Candidates should know that, when asked if there is a difference in two sets of data, they must refer to both the difference in means and to the variation within each set of measurements.

3 **(a)** A well answered question. Candidates could recognise molecules from diagrams and could relate the size of molecule to intermolecular forces and to boiling points.

(b) This question asking candidates to name polymerisation was surprisingly differentiating.

(c) This was the first of the six-mark extended-writing questions on this paper. Candidates were expected to link modifications in the arrangement of polymer molecules to the properties of that polymer. They were then expected to explain how this happened by describing the change in intermolecular forces and saying why this affected the properties. Many were able to link modifications to properties, but few developed this in terms of intermolecular forces, which limited the majority to Level 1 on this question. Crystallinity in polymers was not understood well, with many writing that 'crystalline' or 'crystallinity' was an additive. Weak candidates often failed to read the question correctly. They used information given in the question to link properties to uses or to make links between different properties and failed to score any marks on the question.

4 **(a)** This was a well answered question. Almost all candidates were able to plot the final three points on the graph, and there were many excellently drawn curves of best fit passing through all six points. Some of those who lost marks on this question had drawn the curve in ink so could not erase any mistakes, and there were still a few who drew a straight line across the graph even thought they had been specifically asked, in this case, for a curve.

(b) Few scored marks on this part of the question. Candidates needed to use data from the table or graph to calculate that each sheet of paper stopped a quarter of the radiation. Many made general answers such as 'you can see from the graph that it drops by a quarter each time' which did not score. There were others who did not understand the cumulative effect of the paper and thought that the detector reading should drop by 20 every time another sheet of paper was added.

(c) In part (i) many were able to tick the correct boxes when asked why the intensity of infra red radiation was different in the two diagrams. However, in part (ii) few could explain why replacing an IR source with a source of visible light increased the intensity. Answers lacked detail with many just rewriting the question.

5 **(a)** This was a talking heads question looking at risk & benefit and cause & correlation. Candidates could confidently identify who was talking about risk and benefit in part (i), and also name the two people who suggest that mobile phones do not cause brain cancer in part (ii). However, a minority of candidates only ticked one box in part (ii) when they were asked to tick two. As this was a single-mark question this meant that they did not score even if they had ticked one of the correct boxes. In part (iii) Chris was a common wrong answer. Chris is talking about data, but not using it to discuss risk. In part (iv) there was little understanding of causal mechanism. All wrong answers were equally selected showing that guesswork and luck played a part in scoring on this question.

(b) This was another question requiring calculated answers, but a common response was that a text message is quicker than an image, which did not score. Candidates need practice in recognising mathematical questions and completing the calculations for these. The second, non mathematical part of this question differentiated well. Weaker candidates often suggested that the images were bigger.

6 This six-mark extended-writing question required candidates to relate increasing amounts of carbon dioxide in the atmosphere to the burning of fossil fuels or the cutting down of rain forests. Many could do this, but were unable to link this to global warming, which restricted the score to Level 1. A few candidates showed knowledge of global warming and its effects, but hardly anyone made any reference to the debate. This seemed surprising when so much has been in the news recently.

7 **(a)** Good candidates were able to define antimicrobial drugs, but weaker candidates were unclear in their answers. Comments on the drugs "stopping disease and illness" or "fighting bacteria" did not score.

(b) Candidates found this question difficult. In part (i) graphs of all possible shapes were seen, most of them incorrect. Those who realised the graph had a downward slope failed to see the relevance of the 10% of bacteria being resistant. There were few graphs starting at 90%. This possibly linked with the fact that although many could name mutation as being a likely mechanism for bacteria becoming resistant hardly anyone realised that the resistant bacteria become a greater proportion of the population as time progresses. There is still confusion between antibiotics and vaccination. Incorrect ideas about bacteria becoming immune or antimicrobials making antibodies were common throughout this whole question. Candidates were confident in their response to why antibiotics should be used carefully, with most scoring in part (iii) of this question. Part (iv) differentiated well.

8 **(a)** The whole of question 8 differentiated candidates. Most could give reasons why terminal cancer patients would take part in drug trials. Some are still limiting their score by listing only one or two points for a three-mark question.

(b) There were some good answers to the reason for the length of time taken by a drug trial.

(c) Many were confident in answering this question on the different type of drug trials that use placebos, with most scoring the mark.

9 **(a)** A straightforward question on the correlation between stress and heart disease. Unfortunately, many wrote about the effect stress may have on the body (such as high blood pressure and lack of sleep), so failed to score.

(b) This was the last six-mark extended-writing question on the paper, and responses were better than on the other two. There was a variety of acceptable answers for the person at lowest and the person at highest risk. Most candidates used data from the table to explain why their choices were the highest and lowest risk. They expressed their answers well, gaining 4 marks. Some explained in more detail so accessed Level 3.

A143/01 – Twenty First Century Science A (B3, C3, P3) Foundation Tier

Section 1 – General Comments

Most candidates followed the rubric but there were a few who ticked too many boxes or circled too many answers. The omission rate was generally low, but it is difficult to understand why candidates did not give a response to the objective questions where this occurred. The writing of some candidates is still an issue; illegible writing cannot score marks. Examiners do their best to work out what the candidate has written but it is not always possible.

Section 2 – Comments on Individual Questions

1 (a) (i) This question required candidates to know the type of power station that produced radioactive waste. Nearly all the candidates scored the mark for nuclear.

(ii) This followed on from the previous question. It wanted to know why the waste is dangerous for living things. Vague references to “kills living things” were not enough; details of the dangers were needed (e.g. “emits ionising radiation which damages or mutates cells or DNA”). A reference to it causing cancer also scored a mark.

(b) This question was looking at the different components used in power stations. It asked candidates to identify which of the listed components were found in which type of power station. This section scored poorly. Few scored all three marks and most candidates scored 0 or 1 mark only. There was no pattern to the wrong answers.

2 (a) A simple subtraction calculation was needed here to work out the number of kilowatt hours used between Monday and Friday. The answer was 64 kWh.

(b) Another follow-on question. How much would this cost? The candidates were given the cost per unit. Error carried forward was allowed here, so a wrong answer in (a) was not penalised twice. However, the marks were relatively low. No units were given and therefore to score a mark, correct units had to be included.

(c) Electricity companies sell their electricity cheaper at night. Candidates were asked to select two reasons why. Most candidates scored 1 mark for encouraging people to use electricity at night or the fact that electricity production is a 24-hour process.

(d) (i) After reading some data about power and time for one use for three different appliances, candidates had to select which one was the best one to use at night and explain why. The answer was the washing machine because it uses most energy (and therefore would be best to use when energy was cheaper).

(ii) More data about a kettle. This time the question wanted to know why it should not be used at night. The idea that it was only in use for 5 minutes was a correct answer, as was the idea that most people do not use kettles at night because they are sleeping.

3 This was the first of the six-mark extended-writing questions. Candidates were given data about two different lamps used in the home. The question wanted to know the advantages and disadvantages of using each type of lamp to light their bedroom using the information given in the question. In order to score all the marks candidates needed to write about advantages and disadvantages of both lamps. In order to score 1 or 2 marks they had to state an advantage or a disadvantage of one lamp. This question scored well with many candidates scoring 5 or 6 marks. References to power input, heat loss, lifetime and price were needed in the answer.

4 **(a)** This question was about biodiversity and required candidates to select answers to complete sentences. Most scored 1 or 2 marks.

(b) Candidates were told that replacing natural woodland with conifer trees decreases biodiversity. They were asked to select two reasons which, when taken together, explained this. Both reasons were needed for 1 mark.

(c) **(i)** The definition of sustainability was known to very few candidates.

(ii) Using the information given about the decline of natural woodlands to write down two ways in which the national trust are promoting sustainability was answered much better. Many candidates scored both marks.

(d) **(i)** The calculation was completed correctly by most candidates. The answer was 11.8%.

(ii) The national trust is encouraging tree planting because there is a lower percentage of trees/forests in GB compared to the rest of the world. Few appreciated this from the data.

(e) In this question candidates had to read some data and then they were given four statements and had to say which supported Stu and which supported Bob. The most common mark was one for three correct ticks. To get both marks all four ticks had to be correct.

5 This was the question which candidates found most difficult.

(a) In this question, candidates were given some information about Darwin and Owen. What the question wanted to know was, why, using the same evidence, did they come up with different theories. The idea needed was that Darwin and Owen interpreted the evidence differently. Few referred to the evidence. The idea that scored marks was that Darwin looked at living things as well as fossils.

(b) This question asked how fossil evidence supported Darwin's theory. Few candidates realised that these groups were related or that this might be a link. Many thought that birds had evolved into reptiles.

6 This was the second of the six-mark extended-writing questions. Candidates were given a diagram representing part of the nitrogen cycle. They were asked about the recycling of nitrogen and how labelled processes and microorganisms were involved. A full answer must include reference to all four labelled stages and the role of the microorganisms. Many candidates scored only 1 or 2 marks because they did not mention the microorganisms at all. Another problem was that the answers talked about nitrogen instead of nitrogen compounds or nitrates.

7 **(a)** Nearly all candidates knew that chlorine kills bacteria.

(b) **(i)** This question was based on 'Ideas about Science', in particular benefit and risk. Many correctly identified Julian as the person who though that the benefit outweighed the risk.

(ii) Kate was the person who was giving the correct explanation about risk.

(iii) Many candidates did not correctly identify Lee as the person who made the untrue statement. Nothing is risk free. The common incorrect answer was Hannah.

8 **(a)** **(i)** This question about purity of salt and its use was answered correctly by most candidates.

(ii) Candidates were asked how salt mining damaged the environment. The answers wanted were along three themes: making the land unstable, damaging habitats and pollution (qualified). Vague answers like "kills animals" or "causes pollution" were not given credit. Most candidates scored at least one mark.

(b) **(i)** A pie chart showing the uses of salt was given. Candidates were then given some statements and using the pie chart had to decide whether they were true or false. Two marks were awarded if all statements were correctly identified and one mark for 3 correctly identified.

(ii) Nearly all candidates knew that salt is a preservative.

(c) The uses of sodium hydroxide and hydrogen were only known by a few candidates. This question was very poorly answered.

9 **(a)** Candidates did not know that chlorine was the other element in PVC.

(b) This was the third and last of the six-mark extended-writing questions. Candidates were given data about using PVC and wood for making window frames. The question was about Life Cycle Assessment and wanted some conclusions from the data given and what else would be needed for the LCA. Those who did not write about what else was needed only scored the lower marks. Further data might include reference to sourcing the raw material, sustainability, environmental impact, carbon footprint, biodegradability and lifespan. Conclusions from the energy data should have included an overall statement as well as some detail about the various individual data.

A143/02 – Twenty First Century Science A (B3, C3, P3) Higher Tier

Section 1 – General Comments

This is only the second time these units of the new specification have been examined.

As in June 2012, candidates found the increase in the number of free-response questions, compared to the number in the old specification, a challenge. The increased amount of quantitative work also proved demanding. The paper was appropriate for the ability range of the expected entry but it is possible that many candidates may have been better suited to the Foundation paper. However, there was no evidence that students ran short of time and even the weakest candidates left very few questions un-attempted. Despite this is was clear that many candidates did not really appreciate how to approach the longer answer questions, often they simply repeated the information provided in the stem of the question without really answering the set question, e.g. Q4(c), Q5(b) and Q7(a)(ii).

Candidates remain well prepared for the objective questions and with practice will improve their answering of the free response questions.

The six-mark extended-writing questions allowed nearly all students to gain some marks, and there were some excellent detailed answers, especially to Q9(a). In general, however, the nitrogen cycle details were not well known, and in Q3 high level mathematical comparisons of the lamps were rare. Greater familiarity and practice should allow candidates to make better use of all the information provided.

Section 2 – Comments on Individual Questions

1 **(a)** This proved to be a demanding question which revealed a lack of knowledge of the common features of electricity generating power stations.

(b) Most candidates understood the concept of renewable energy sources. Many could also suggest a possible disadvantage of wave power, although some clearly confused wave with either tidal or wind power, or lost marks due to general references to “pollution”.

(c) Candidates found this question very difficult. Some picked up marks for the idea of damage to cells, usually knowing that risks of cancer increased and the idea of consuming contaminated sea food. However, many were not clear about what is meant by contamination and described irradiation e.g. the danger of swimming in the sea or even breathing radioactivity in.

2 **(a)** **(i)** This question was well answered, with most candidates knowing that 1 W is Joule/s, and correctly identifying the microwave oven.

(ii) By contrast, few candidates used the relationship *power = current x voltage* to correctly identify the vacuum cleaner, or perhaps did not know that the domestic voltage is 230 V. Common wrong answers were kettle and hair drier.

(b) The maths required here proved beyond many candidates. Many candidates showed no working at all; those that did show working could often be given some credit. Where working was shown it was common for power not to have been converted to kW.

(c) Most candidates that gained marks here did so for suggesting the lower power kettle would have to be used for longer; few of these candidates showed real understanding that the energy needed to heat the water to boiling is independent of the type of heating device used.

3 Candidates usually made a choice and supported this with data from the table, for a Level 1 answer. However, few mathematically compared costs and lifetimes (required for Level 2), and very few calculated lifetime costs or actual power converted to light (for Level 3).

4 **(a)** Weaker candidates showed a variety of misconceptions, e.g. that members of the same species do not compete or are genetically identical.

(b) This question discriminated well. Most candidates got one tick in a correct box, but only better candidates got both ticks in the correct boxes.

(c) Three marks were rare. Many candidates repeated statements from the question regarding light and soils pH. Marks were gained for an appreciation of habitat protection and maintaining biodiversity. Some candidates gave good definitions for sustainability but it was rare for them to be able to link all these ideas together.

(d) **(i)** Correct percentage calculations were surprisingly rare.

(ii) Perhaps due to the difficulty with Q4(d)(i), few candidates recognised that the UK had a lower percentage of forested land than Europe or the rest of the world and so comparisons were rare.

(e) Most candidates gained some marks here. Few candidates commented on the general trend present in the data, and there was often a lack of precision in identifying when increases occurred or vague references to “not enough data”.

5 **(a)** This proved to be difficult. Some candidates suggested religious differences, or pointed out Darwin had looked at living specimens as well as fossils. A few candidates did refer to creative thought but most simply repeated Owen’s and Darwin’s explanations from the stem of the question.

(b) This was another difficult question, with few candidates being able to go beyond the information supplied. Few were able to say that Archaeopteryx suggested a link between reptiles and birds, and that change had occurred over a long period of time. A surprising number of those candidates that did make these suggestions thought reptiles had therefore evolved from birds.

6 Weaker candidates simply described the diagram, picking up some marks for descriptions of animals “eating” plants or “excretion/decomposition”. Better candidates described the role of bacteria, and there were a few very good detailed answers showing knowledge of the roles of nitrogen-fixing and denitrifying bacteria.

7 **(a)** **(i)** Often candidates just calculated 8% and then failed to multiply by 6 000 0000 tonnes.

(ii) A significant number of candidates did not score any marks simply because they didn’t answer the question and failed to state how the salt was obtained e.g. failed to mention mining. The other common error was to refer to “clean”/”dirty” rather than “pure”.

(b) Many candidates knew that there was a chemical change and the process is called electrolysis; fewer could identify the products.

8 **(a)** Candidates mostly failed to address attitudes towards risk in their answers, making it hard for them to gain marks. Most simply restated the relative risks in developed and developing countries or referred to cost.

(b) Better candidates correctly identified that organic material could be filtered out before chlorination to lower risk from THMs in drinking water.

9 **(a)** Candidates compared the LCA well, but a surprising number failed to suggest further information needed or incorrectly referred to cost. Only the best candidates calculated the overall LCA energy requirements.

(b) Most candidates gained at least one mark. The commonest distracter was that PVC contains an element that is poisonous.

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