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TWENTY FIRST CENTURY SCIENCE

Paper 0608/01

Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**C**	21	**B**
2	**C**	22	**C**
3	**B**	23	**C**
4	**A**	24	**A**
5	**D**	25	**C**
6	**C**	26	**D**
7	**B**	27	**A**
8	**D**	28	**A**
9	**B**	29	**D**
10	**B**	30	**A**
11	**D**	31	**C**
12	**C**	32	**D**
13	**C**	33	**D**
14	**B**	34	**B**
15	**A**	35	**B**
16	**A**	36	**D**
17	**A**	37	**C**
18	**C**	38	**D**
19	**B**	39	**C**
20	**D**	40	**C**

General comments on whole papers

This November exam session was only the second time that the syllabus has been examined. The number of Centres taking part in the pilot scheme is relatively very small which makes it difficult to draw any firm conclusions based on statistical analysis.

Comments on specific questions Paper 1 (core)

The mean on Paper 1 was 69% which is relatively high and shows that candidates appeared to be well prepared. The maximum mark achieved was 35 and the minimum mark achieved 18.

The items that candidates found easiest (facility > 67 %) were 1, 3, 5, 6, 7, 10, 11,12, 13, 16, 17, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 34, 35, 36, 38 and 39. Items where the facility showed that candidates found the topic particularly challenging were 2, 9 and 14.

In item 2, some candidates correctly answered with key C but the majority answered with key B. The syllabus requires candidates to compare the relative ages of the Earth, the Sun and the Universe. This

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knowledge together with an awareness of the major events, such as the extinction of dinosaurs, of the earth would have helped candidates.

In item 9, candidates should be aware that human cells contain 23 pairs of chromosomes for a total There are 22 pairs of autosomes and one pair of sex chromosomes. The male gametes or sperm cells humans are heterogametic and contain one of two types of sex chromosomes. They are either X or Y. Most candidates selected key A but the correct key was B.

Question 14 was about the densities of water and ice. Ice floats because it is less dense than water which most candidates appreciated by selecting either key A or B. The correct key was B.

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TWENTY FIRST CENTURY SCIENCE

Paper 0608/02
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**B**	21	**D**
2	**D**	22	**A**
3	**B**	23	**C**
4	**A**	24	**A**
5	**D**	25	**C**
6	**C**	26	**D**
7	**D**	27	**A**
8	**D**	28	**A**
9	**B**	29	**B**
10	**A**	30	**A**
11	**D**	31	**C**
12	**C**	32	**B**
13	**C**	33	**D**
14	**A**	34	**C**
15	**A**	35	**B**
16	**A**	36	**D**
17	**A**	37	**C**
18	**C**	38	**D**
19	**C**	39	**C**
20	**B**	40	**C**

General comments on whole papers

This November exam session was only the second time that the syllabus has been examined. The number of Centres taking part in the pilot scheme is relatively very small which makes it difficult to draw any firm conclusions based on statistical analysis.

Comments on specific questions Paper 2 (extended)

The mean on Paper 2 was 85% which is relatively very high and shows that candidates appeared to be very well prepared. The maximum mark achieved was 36 and the minimum mark achieved 31.

The items that candidates found easiest (facility > 63 %) were 1, 2, 3, 4, 5, 7, 8, 9, 11,12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39 and 40. Items where the facility showed that candidates found the topic particularly challenging were 6, 10, 16 and 37.

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Item 6 was about the colour of old and young rocks based on the idea that rocks made in a with no oxygen, are dark grey, whereas, rocks made in an atmosphere with oxygen are red. were required to select the key which contained statements that were consistent with the view tha organisms did not need oxygen to live and that the oxygen in the atmosphere was released by organisms. The weaker candidates all selected the correct key C. A few of the more able candida selected key B.

Item 10 was based on a genetic diagram, where candidates were required to determine the percentage chance of the *second* child being a carrier of cystic fibrosis. The correct key was A. Candidates selected key B.

Item 16 was about what is needed in the diet of a person working hard in a hot climate. The question was not particularly successful in that the question did not fully convey that the work carried out was over a prolonged period of time. The protein in the diet is required to help muscle development, increases strength, and improves athletic performance.

Item 37 was testing an understanding of the time taken (ten/thousand/million/billion – years) for light to travel from a galaxy to a person on earth as well as how far (close or distant) a galaxy is from Earth. Most candidates selected key A but the correct key was C.

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TWENTY FIRST CENTURY SCIENCE

Paper 0608/03
Written

General comments

Most candidates attempted all questions on the paper. There was no indication that candidates were short of time. **Questions 3**, **7** and **9** proved to be the most accessible to candidates, with **Questions 1**, **6** and **8** causing the most difficulty. However, the most able were equally prepared for all questions and performed consistently across them. Questions requiring knowledge of the Ideas about Science were less well answered than the other questions. The standard of written English was very good.

Comments on specific questions

Question 1

This question was well answered by the strongest candidates but caused some difficulty for the less able.

(a) A large number of candidates did not get this question right and were unable to match the percentages to the correct gas. This question was intended to be a relatively easy introduction to the paper requiring straight recall from the syllabus.

(b) (i) This was well-answered with the majority of candidates scoring two marks for correctly calculating the mean.

Candidates need to remember that, for calculations, there is often a mark available for showing the method of working. Some candidates lost a mark because they did not show their working.

(ii) This was well answered with most candidates giving the correct answer.

(iii) This was less well answered with many candidates failing to use the data to explain why the best estimate from the highway is the more reliable. Some candidates were unclear about the meaning of 'reliable' and instead described practical reasons why the results by the highway were higher in value than the country road.

(c) This question was well attempted with only the weakest candidates failing to score any marks. However, a large number of candidates did not balance the equation and only showed one molecule of nitrogen dioxide.

Question 2

This question was well answered by most candidates.

(a) The majority of candidates identified that poly(ethene) is more flexible than ceramic material but then failed to link this to the fact that it would be less likely to break.

(b) This was well answered by most candidates.

(c) Very few of the candidates were able to recall that plasticizers can make materials more flexible.

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(d) (i) This question was generally well answered with candidates giving examples such as d car bodies. Some candidates were confused and described the idea of new fuels for than new materials, e.g. suggesting that the old material was petrol and the new ma hydrogen.

(ii) Most candidates correctly linked part **(d)(i)** and **(d)(ii)** together. No credit was given for a correct advantage here if it did not refer to the materials stated in part **(d)(i)**.

Question 3

This question was one of the best answered on the whole paper.

(a) Most candidates correctly labelled the three compounds.

(b) Most candidates successfully identified the sugar as glucose.

(c) Most candidates scored full marks for this part question as well, although a few confused where the processes occurred, swapping the 'liver' and 'kidneys'.

Question 4

This question was well answered.

(a) Most candidates correctly labelled the diagram of the section through the Earth.

(b) Most candidates identified the two correct statements.

(c) (i) This question caused some problems for the weakest candidates with a few making no attempt at it. Of those who did answer, most were able to suggest at least one idea of there being a 'fit' between the shape of the continents and the fossils found there. The strongest candidates identified two clear observations.

(ii) Very few candidates answered this correctly. Few were able to clearly explain why new theories are not easily accepted.

Question 5

This question was well answered.

(a) (i) Most candidates correctly identified this as **A**.

(ii) Most candidates correctly identified this as **C**.

(b) (i) This was also correctly answered by the majority of candidates. A few weaker candidates thought that microwaves are an ionising radiation.

(ii) This was generally well answered by those candidates who read the question carefully. It was surprising how many did not use the term 'intensity' in their answer despite being told to do so. Inevitably, they could not be credited.

(c) (i) This part caused the most problems on this question. There was no real pattern in the answers given – all boxes seemed to be ticked in a rather random way. Candidates need to read the speech bubbles very carefully to be able to answer this style of question.

(ii) Most candidates got this question incorrect. Candidates need to realise that, just because an answer has been used for a previous part question, it does not necessarily make it less likely to be used again. It seemed that candidates did not tick David because they had already ticked David in part **(c)(i)**.

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Question 6

This was one of the weakest questions on the whole paper.

(a) A surprisingly small number of candidates were able to correctly link the boxes together. W questions of this style, candidates should follow the instructions and only draw one line from each box on the left to one box on the right.

(b) (i) Most candidates identified a decrease in activity but very few went on to give more detail about the decrease, i.e. that it gets slower as time passes. The number of marks allocated for this question should have helped candidates to realise that more is required here than just a simple statement identifying the decrease.

(ii) The weakest candidates made no attempt at this question. However, most candidates calculated the correct answer and clearly showed their working out on the graph. An indication of working was required for credit to be given.

Question 7

This question was one of the best answered on the whole paper.

(a) Most candidates correctly identified this as the nucleus.

(b) Most candidates correctly identified the definition of embryonic stem cells.

(c) (i) This was answered correctly by the majority of candidates.

(ii) Most candidates gave the correct answer here. The most common wrong answer was **D**.

(d) Many candidates demonstrated a good understanding of asexual reproduction and were awarded full marks here.

Question 8

This question was well answered by the strongest candidates but caused some difficulty for the less able.

(a) Most candidates correctly identified skin as a natural barrier but less were able to correctly identify the second barrier, sweat. A large number of candidates incorrectly chose the teeth.

(b) This question was poorly answered with very few candidates making any reference to antibodies and even fewer describing how the presence of antibodies prior to infection helps to protect the body. Many candidates just repeated the stem of the question.

(c) (i) Most candidates gave the correct answer here.

(ii) The majority of candidates correctly identified that fewer people are having the MMR jab.

(iii) This was less well answered as candidates needed to write more for an advantage than just 'it protects the child from the disease'. This idea was clearly stated in the stem. Candidates needed to think about other advantages, e.g. the idea that having the vaccination reduces the number of people in the population with the disease. Most candidates could state a disadvantage but they needed both to be awarded credit.

(iv) The most able candidates correctly ringed 'autism'. Other candidates seemed to guess at the answer without really having a clear understanding of the term.

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Question 9

This question was well answered by most candidates.

(a) Almost all candidates achieved full marks for this question, correctly selecting the three words to the gaps.

(b) This was less well answered with only the strongest candidates having a clear understanding of data and explanation and how they may be applied to real situations.

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TWENTY FIRST CENTURY SCIENCE

Paper 0608/04
Extended Written

General comments

The entry for this paper was quite small, making it difficult to give overall comments. More able candidates were able to show knowledge and understanding in a number of areas of the specification, though rarely in all areas. Weaker candidates evidenced patchy knowledge and often a superficial understanding of key concepts. Interpretation of simple data was generally good, but more complex data proved incomprehensible to many candidates. Some of the ideas about science concepts, particularly those relating to data analysis, were better understood than others, for example those related to social and economic factors. There was no evidence that candidates had insufficient time to complete the paper, and few left blank spaces.

Comments on specific questions

Section A

Question 1

All candidates scored some marks in this question, but even the more able showed weak areas.

(a) Few candidates could recall the correct percentage figures. A wide variety of incorrect answers were seen.

(b) (i) Most candidates realised that the best estimate is more reliable because the results in this set have a small range.

(ii) More able candidates knew that a real difference between two sets of data is indicated when the mean of one does not lie within the range of the other. Weaker candidates gave vague answers about the collection of data or compared mean values.

(c) Most candidates drew correct diagrams for two carbon dioxide molecules.

Question 2

Most candidates showed a poor appreciation of the essential relevance of energy use and environmental impact to Life Cycle Assessments.

(a) Almost all candidates realised that poly(ethene) pipes are more flexible and therefore less likely to crack.

(b) Few candidates related their answer to the energy requirement or environmental impact of any part of the Life Cycle Assessments. The majority made vague statements about usage or disposal of sewage pipes made from the two materials, which gained no credit.

(c) Again the majority of candidates made no mention of energy requirement or environmental impact of the LCD. Answers frequently described differences in the way that the products were made or used, but did not include the essential detail needed to score marks.

(d) Few of even the more able candidates understood that plasticizer molecules get between polymer chains, reducing the forces that hold them together.

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Question 3

Many candidates were let down by poor knowledge and understanding.

(a) Almost all candidates correctly identified the formulae.

(b) (i) Though good answers were seen from some of the more able candidates, most did not link ideas about who would use or not use synthetic fertilisers and why.

(ii) Most candidates showed only a vague understanding of the nitrogen cycle. Though thunderstorms were often mentioned, most candidates did not appreciate that lightning results in the formation of nitrogen oxides. Few candidates could correctly use the terms nitrogen fixing and nitrifying. Legumes were rarely mentioned.

Question 4

Most candidates gained marks from questions about Wegener's theory, but sea-floor spreading was poorly understood.

(a) Most candidates gave one correct observation, and the majority of the more able gave two.

(b) Fewer candidates gave a valid reason for other scientists' disagreement with Wegener's theory. Many simply said that they did not support it.

(c) Most candidates gave the correct answer of 10 cm. Common incorrect answers were 2 cm and 'a few centimetres'.

(d) (i) Few candidates described the eruption and solidification of magma or that newly formed rock became magnetised. Most answers were vague and irrelevant.

(ii) No candidates could relate the symmetrical pattern of light and dark bands on either side of the mid-ocean ridge with sea-floor spreading.

Question 5

This questions was answered well by all candidates, with most gaining four or five marks.

(a) Most candidates gave both correct answers.

(b) Only the more able correctly chose David.

(c) Most candidates chose the correct person.

(d) Most candidates chose the correct person.

Question 6

Interpretation of the graph and calculation of half life gained marks for most candidates.

(a) (i) Whilst the majority of candidates realised that the activity was decreasing, few indicated that this decrease slowed down as time increased. Weaker candidates did not refer to activity in their answers.

(ii) Most candidates correctly calculated the half life as 30 years.

(b) Only the more able correctly calculated the time taken as 600 000 years. A wide variety of incorrect answers were seen.

(c) Most candidates simply gave an advantage and a disadvantage of each method. Only the more able gave a reasoned conclusion.

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Question 7

Most candidates scored quite well, though the mechanics of cloning were poorly appreciated.

(a) Nearly all candidates knew that stem cells are unspecialised and can develop into any type of ce

(b) (i) Almost all candidates made the correct choice of answer **B**.

(ii) Almost all candidates made the correct choice of answer **A**.

(c) Only the more able candidates could correctly describe the removal of a nucleus from an egg cell and its replacement by the nucleus from an adult body cell.

Question 8

The majority of candidate gained marks here and there in this question, but few gave consistently good answers.

(a) (i) Most candidates mentioned antibodies, but few realised that they are produced by white blood cells in response to the safe form of the microorganism. Even fewer went on to say that the white blood cells could then produce more antibodies quickly in response to the actual disease microorganisms. A number of candidates thought that the antibodies remained to fight the disease in the future whilst others gave vague answers about immunity that gained no credit.

(b) (i) Many candidates gave as the 'for' reason simply that it would prevent your child having measles, rather than the consequences of disability or death of the child. The idea that vaccination reduces the incidence of the disease in the population was never seen. The 'against' reason more often scored a mark, usually for the idea of risk of autism.

(ii) Only the more able gave the correct idea of not enough of the population being vaccinated. Many gave vague references to the number of people getting measles, which gained no credit.

(iii) A number of sensible ideas were seen, the most common based on the concepts of personal choice. Many of the less able candidates gave vague answers based on the risk of autism, gaining no credit.

(c) Most candidates realised that there was no correlation, and correctly reasoned that whilst cases of autism rose in number the percentage of children vaccinated remained almost constant. Few went on to say what would have been an indication of a correlation.

(d) Most candidates knew that the HIV virus has a high mutation rate, but few could explain why this makes the development of a vaccine for HIV so difficult.

Question 9

This question discriminated well across the ability range.

(a) The majority of candidates managed to identify two or three of the statements correctly to gain one mark, but few managed all four for both marks. The most common incorrectly identified statement was 'Individuals of the same species are all different' followed closely by 'Some species become extinct'.

(b) Whilst more able candidates gave clear, logical answers, most of the weaker candidates gave vague and rambling answers. Many mentioned competition for reproduction rather than for resources. Few included the idea that individuals that survive are able to reproduce.

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TWENTY FIRST CENTURY SCIENCE

Paper 0608/05
Comprehension, Practical Procedures,
Data Handling and Analysis

General comments

This is the second time that this syllabus has been examined. Although there was a small candidature for this examination, they seemed well-prepared and understood the nature of the examination and what the questions were demanding.

Comments on specific questions

Section A

Unlike the previous session (Summer 2009), the comprehension section had two small articles rather than one longer one. These were based on modules P1 and P2 from the physics sections of the syllabus; the physics question in ***section B*** was based on module P3.

Question 1

This question was based on the article 'Disappearing Glaciers'

(a) Candidates found no trouble in explaining why glaciers are found in high mountains, and almost all could find the date of maximum melting from the article.

(b) This was a longer, free-response question worth 3 marks, asking for an explanation of the greenhouse effect. There was great confusion with the absorption of ultraviolet by atmospheric ozone. Few realised that the incoming solar radiation is absorbed by the earth, which then re-radiates longer less energetic infrared radiation, which is absorbed by atmospheric carbon dioxide.

(c) This part also required candidates to obtain information from the article to find the likely dates by which 80% of the Himalayan glaciers would be gone, and to explain why scientists are concerned about the loss of these glaciers. This part was well done.

(d) Candidates were asked to state and explain one serious consequence of sea-level rise. Most could state one – flooding was the choice of all – but the extra detail to explain why this was a serious consequence was given by few. The best answers here related the flooding to regions that would be seriously affected, such as New York, the Arctic or the Netherlands. Bangladesh would also have been a good choice.

(e) Two cartoons of scientists with different opinions about global warming were used here to elicit ideas about correlation and cause. Clear distinctions between these were not common, although most seemed to realise that Dr Arnold was convinced carbon dioxide was the cause of global warming while Dr Gupta was not convinced. No-one suggested that what Dr Gupta needed to convince her of the causal link was a convincing mechanism for the effect.

Question 2

This question was based on the article 'Life beyond Earth'

(a) Nearly all realised that Mercury and Pluto are respectively far too hot and far too cold for life.

(b) Every candidate appreciated why Mars has been a popular destination for space missions.

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(c) In this part, also, virtually every candidate was able to find the two named chemicals which indicate the possibility of life.

(d) Stating the meaning of extra-solar planets – that is, finding the definition in the article – was well, but very few realised that telescopes in Earth orbit are better for making difficult observat because they are not affected by atmospheric conditions and light pollution. A very large proportion thought that they were (significantly) closer to the observed planets.

(e) It was encouraging here to see that most knew that the light-year is a unit of distance, although some were unclear as to what it was.

(f) Most candidates were able to suggest a project on Earth on which they might prefer to spend money on (rather than space research), but only the better candidates gave a reason for this, as required by the question. Most could also suggest at least one reason in favour of spending money on space research.

Section B

This section has three questions testing practical procedures, data handing and analysis.

Question 3

This question was based on comparing the effect of different antibiotics on a bacterial culture.

(a) Most candidates were able to suggest at least one, and usually two, safety precautions Martha should take when setting up the experiment. Some gave safety precautions to take *after* the experiment, which was not what was asked, and which did not get credit. An automatic 'wear goggles' was also not appropriate here.

(b) Most understood the nature of a control and could explain why one was used, although many did not seem to know the name. A clear explanation gained the mark even if the word 'control' was not used.

(c) Analysis of the effect of the different antibiotics was done accurately and explained clearly.

(d) The reason for repeating an experiment was generally well-known, and sensible factors that needed to be kept the same were usually quoted.

(e) Almost everyone realised that bacteria become resistant to antibiotics, and gained one mark; the question did state, 'Suggest and explain a reason...', and only the better candidates could explain in terms of mutations.

Question 4

This question examined the use of titration to determine the acidity of rainwater. It proved difficult for most candidates.

(a) No-one seemed to be familiar with a pipette, and all seemed to think that 25.0 cm^3 could be measured with a measuring cylinder; they did not realise that writing it as 25.0 rather than 25 implies ability to measure to the nearest 0.1 cm^3.

(b) Almost all could read the burette scale correctly, but ranking the rain samples in order on increasing concentration of acid, i.e. in terms of increasing volume of alkali needed to neutralise it, was achieved only by the better candidates.

(c) The reason for adding the alkali slowly was not appreciated by many, although the role of the indicator in the titration generally was, with only the weakest candidates thinking that the indicator was actually measuring the strength of the acid.

(d) Many candidates realised why the apparatus used to measure the rainwater needed to be clean each time, but only the very best explained why the alkali did not need a fresh burette for each titration.

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Question 5

This question examined the measurement of the activity of a radioactive material of short half-life.

(a) Almost everyone could find the mean background count accurately.

(b) Explaining why the background count had to be subtracted from the experimental measurements was appreciated by only a few. The majority realised why it was sensible, in this experiment, to take readings less frequently once the activity had ceased to change so rapidly. Most were able to make a sensible suggestion about obtaining data which was less variable.

(c) Almost all candidates could plot the required points into the graph correctly, although some of the best-fit curves were poor, varying from thick, sketchy ink lines, through wiggly lines which tried to touch every plotted point, to straight lines joining the first and last point. Those with reasonable curves – and even many with unreasonable ones – were able to find the half-life from their data and compare it with the 'book' value of 70 seconds. If their graph was such that their half-life was not close to 70 seconds, then the mark was given for stating that conclusion, as an 'error carried forward' mark – they were not penalised a second time for poor graph drawing.

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TWENTY FIRST CENTURY SCIENCE

Paper 0608/06

Case Study

Introduction

The number of Centres involved was small, however, it was most encouraging to see that the work presented for moderation clearly indicated that Centres and candidates had embraced the philosophy of the course. The coursework demonstrated that candidates had interest and enthusiasm in the work that they were doing.

Administrative aspects

The following key points regarding the administration of coursework samples are described below as a reminder for Centres.

- The MS1 sheet or other CIE approved method should be completed showing the final total coursework marks awarded.
- Candidates' work should be fastened in the left-hand corner with the appropriate CIE candidate Record card.
- Details should be included of how each of the tasks used for assessment had been introduced and presented to candidates.
- Candidates' work in the sample should be annotated showing where and why the marks were awarded.

Marking procedures

Centres clearly understood the foundations and principles involved in the marking of the coursework, but the key elements are repeated here for reference purposes. Within each Strand each aspect of performance is considered in turn, comparing the piece of work first against the lowest performance description, then each subsequent higher one in a hierarchical manner until the work no longer matches the performance description. Where performance significantly exceeds that required by one description, but does not sufficiently match the next higher one, the intermediate whole number mark should be given in Strands B and C. Thus, the level of performance in each aspect is decided. The procedure for calculating the single, overall, mark for the whole strand is shown in more detail below. If there is no evidence of achievement for an aspect, a mark of zero should be recorded and included in the calculation of the overall strand mark.

In Strands A and D there are three aspects for each of these strands and the Strand mark is determined by averaging the aspect marks and rounding to the nearest integer, so for example,

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

In Strands B and C, there are only two aspects for each of these strands and a slightly different approach is needed and it is better to consider both these Strands together when arriving at a final mark. If the average aspect marks of **either** B or C is a whole number and the other one is N + ½, then the ½ should be rounded up. If the average aspect marks of **both** B and C average to N + ½, then one should be rounded up and the other rounded down. This gives a "best fit" for the achievement overall for the two strands. So for example,

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Marks for the two aspects in a strand	Formula to be applied	Mark to be awarded for the strand
Strand B (a) = 6, (b) = 4 Strand C (a) = 6, (b) = 5	[(a)+(b)] / 2 = 5 [(a)+(b)] / 2 = 5.5	= 5 = 6
Strand B (a) = 7, (b) = 6 Strand C (a) = 6, (b) = 5	[(a)+(b)] / 2 = 6.5 [(a)+(b)] / 2 = 5.5	= 7 = 5

This general approach provides a balanced consideration of each aspect of performance involved in each strand and allows the marker to build up a profile of strengths and weaknesses in the work.

Case Studies
General comments

The purpose of the Case Study is to encourage candidates to use their scientific knowledge and understanding of the Ideas about Science (IaS) to make judgements when presented with controversial issues in science which have claims and opinions for both sides of the case. Better candidates used the language and concepts related to IaS, such as 'peer review', 'replication of evidence', 'correlation and cause' 'reasons why scientists disagree', 'precautionary principle', 'ALARA', 'risks and benefits', 'technical feasibility and values' to match the criteria within the performance descriptions and so gain higher marks.

Case Studies are always best formulated in terms of a question to provide a focus in an area of controversy. A question will encourage candidates to look for different opinions and views, and to consider the evidence base on which they are based and the reliability of sources. The Case Study is not a report on a topic but a critical analysis of a controversial issue. The key point is that the Case Study question must invite debate and discussion of both sides of the case and be firmly embedded in a scientific context so that candidates can use their scientific knowledge and understanding and their understanding of IaS to produce a balanced account.

It was most encouraging that all Centres had clearly understood the essential elements of the Case Study and their candidates had responded accordingly.

Assessment

Marking was generally of a fair, consistent and appropriate standard. The following comments are included to provide further illustration of what is required within each of the Strands.

Strand A: Quality of selection and use of information

A (a) The key aspect here is for candidates to use sources of information to provide evidence for both sides of their Case Study. If no sources are specifically listed then a maximum of one mark will be allowed because it can be assumed that the information has been extracted from at least one source. However two marks can be awarded if annotation by the teacher from observation of the candidate confirms that a suitable range of sources were used. Higher marks require that sources represent a variety of different views or opinions (three marks). In addition to the requirements of three marks candidates must assess their sources in terms of reliability in a meaningful and appropriate way, e.g. ideas about peer review, the nature of the source or the status of the author.

(b) If only one or two incomplete references, e.g. website homepages, are given then one mark should be awarded and of, course, if no references are given then zero marks. For three marks candidates must include complete references to the exact address of the webpage which would allow direct access to the source of information, and when referencing books, title, author and page references would be required. For four marks it is expected that candidates include some information about the nature, purpose or sponsorship of the site to provide more detailed background.

(c) Candidates may copy some, but reasonably short, material from their sources. However, it is essential that they make this completely clear with the use of quotation marks, use of a different font or colour highlighting etc. The better candidates included references or specific links within the text to show the source of particular information or opinions. Some candidates gathered information from self-constructed questionnaires which also added to the pool of material for their Case Study. However, a number of candidates made deductions from this evidence without recognising its limitations.

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Strand B: Quality of understanding of the Case

This strand assesses candidates' ability to describe and explain the underlying relevant science a recognise and evaluate the scientific evidence on which any claims are based (IaS 1, 2 and 3).

B (a) Candidates often described the relevant background science in the introduction to their case studies, with the more able candidates going to a greater depth and detail. However, only the most able linked their scientific knowledge and understanding to the claims and opinions that they had found from their sources. It is useful to look at the appropriate pages in the UK twenty First Century Science textbook about Science Explanations and the Ideas about Science that are appropriate for each Case Study to give an indication as to what to expect before marking candidates' work. For example, in the Higher Tier Science C21 Textbook C1 Air Quality: any pollution related Case Study (pages 62 and 63).

For topics which are related to course modules, it can be taken as a general guide that 6 marks requires all that is available in the candidate book. The 7th or 8th mark will be awarded either for applying this correctly to the case, or for finding and explaining some more specialised knowledge.

(b) Candidates were awarded four marks if they were able to recognise and extract relevant scientific content and data in their sources. Candidates who were awarded six marks referred to the evidence base of the various claims and opinions, e.g. an experiment, a collection and review of existing data or a computer simulation. Very few candidates obtained seven or eight marks in this aspect. There is a need at this top level to look more critically at the quality of the evidence, using terms like 'reliability' and 'accuracy' when considering the data between different sources, the design of experiments and the issue of sample size.

Strand C Quality of conclusions

In this strand candidates should consider aspects of IaS 5 about actual and perceived risks and the ALARA principle and in IaS 6 about how society should respond.

Most candidates could sort the information that they had gathered into views 'for and against', sometimes in a tabular form if appropriate. Those who just listed it in this way were awarded four marks. Better candidates started to compare and balance arguments against one another in both their 'for and against' list and were awarded six marks. The best candidates began to analyse, compare and evaluate the claims and opinions, describing their own viewpoint or position in relation to the original question and justifying this by reference to the sources. Alternative conclusions should be considered where appropriate and recommendations for the future should also be included. Some candidates scored less marks than they were probably capable of because they simply chose to report information about their topic, without any real analysis of the scientific evidence on which it was based.

Strand D Quality of presentation

D (a) Most reports included headings and/or sub-headings to provide the necessary structure. The better candidates included a table of contents and numbered the pages in their report to help guide readers quickly to particular sections. Those reports which were presented simply as PowerPoint printouts achieved good marks in this aspect but often lacked sufficient detail for high marks in the other strands. However, those which had notes to accompany each slide were much more successful in obtaining higher marks.

(b) If there are no decorative or informative images included then zero marks should be awarded. If one image is included, a decorative front cover or other low level attempt to add interest then one mark is appropriate. Two marks would be awarded for the inclusion of decorative images only or perhaps for the minimal use of informative images. Three marks would be given for including a variety of informative illustration, e.g. charts, tables, graphs, or schematic diagrams, and four marks if this is fully integrated into the text, referred to and used. Downloaded images from the Internet were sometimes not clear, too small or not referred to in the text.