TWENTY FIRST CENTURY SCIENCE

Paper 0608/01

Multiple choice

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

General comments on whole papers

This June exam session was the third 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 62% which is relatively high and shows that generally candidates appeared to be well prepared.

The items that candidates found easiest (facility > 67 %) were 1, 4, 5, 9, 11, 12, 13, 14, 15 16, 17, 19, 20, 22, 24, 25, 30, 32, 33, 38, 39 and 40. Items where the facility showed that candidates found the topic particularly challenging were 7, 18, 21, 26 and 37.

In item 7, candidates should have been able to indicate that hydra is multi cellular from the labels provided.

Item 18 was on photosynthesis. Some candidates indicated that carbon dioxide is the gas added to the atmosphere by photosynthesis. The correct Key is C.

Item 21 was on renewable energy sources. Some candidates indicated that uranium was renewable. The correct Key is D.

Item 26 was on genetics. The correct answer was Key B but many candidates selected Key D probably expecting to find only one carrier.

Item 37 was based on the correct labelling of parts in a block diagram for a nuclear power station. Some candidates selected Key A but the correct Key is C.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/02

Multiple choice

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

General comments on whole papers

This June exam session was the third 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 65% which is relatively high and shows that generally candidates appeared to be well prepared. The maximum mark achieved was 32 and the minimum mark achieved 21.

The items that candidates found easiest (facility > 63 %) were 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18, 24, 25, 28, 29, 30, 32, 33, 34, 36, 38, 39 and 40. Items where the facility showed that candidates found the topic particularly challenging were 22, 23, 26, 27, 31, 35 and 37.

Item 22 was based on the correct labelling of parts in a block diagram for a nuclear power station. Although most candidates selected the correct Key, the other Keys were selected by a good many candidates.

In item 23, Sue is also referring to the safety of the treatment and using trained doctors so the correct Key is C.

Item 26 was about gender determination of a human baby. The correct Key is C. There were some candidates who selected Key D.

For item 27 it is the random mutation of bacteria that bring about the resistance to the antibiotic. This is Key A.

The most popular Keys for item 31 were C and D. More of the higher ability candidates selected the correct Key.

Item 35 was about the precautionary principle and applying it to a specific situation. The more able candidates selected the correct Key B whereas more of the weaker candidates selected Key A.

Item 37 was about what happens when the Sun's ultra violet radiation energy is absorbed by gases. Key A and C were equally selected. Key A was selected by most candidates.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/03
Paper 3 (Core Written)

General comments

The entry for this paper was relatively small, making it difficult to give overall comments. More able candidates were able to show some knowledge and understanding in a number of areas of the specification, though rarely in all areas and rarely to any depth. Weaker candidates showed very patchy knowledge and often very little understanding of key concepts. Interpretation of simple data was generally good, but more complex data proved difficult for most candidates. Many of the 'ideas about science' concepts were poorly understood. There was no evidence that candidates had insufficient time to complete the paper, and only one left a significant number of blank spaces.

Comments on specific questions

Section A

Question 1

Candidates could identify outliers and calculate a mean from a set of results, but had little idea of how excluding outliers before calculating a mean made this a more reliable best estimate.

(a) (i) Almost all candidate correctly identified the outlier.

(ii) Few candidates realised that inclusion of this value would make the mean a poor best estimate. Most simply said it was not included because it was an outlier or a mistake.

(iii) Most candidate incorrectly based answers on ideas of accuracy rather than reliability.

(b) (i) All candidates correctly identified the range.

(ii) Most candidates correctly calculated the average for metal **B** as 66.

Question 2

Candidates had some success in interpretation of the diagram, but had limited knowledge of the fate of carbon dioxide in the air.

(a) All candidates correctly matched the names and formula to score both marks.

(b) (i) No candidate gave the correct answer 5. The most common incorrect answer was 4.

(ii) The majority of candidates gave the correct answer 4. Common incorrect answers were 2 and 8.

(c) More able candidates gained one mark for photosynthesis but did not realise that carbon dioxide also dissolves in rain or sea water.

Question 3

Candidates showed only a weak appreciation of the ideas about different methods of agriculture covered in these questions.

(a) More able candidates realised that crops remove nitrogen from the soil, leaving insufficient for subsequent crops, but few went on to say that in this type of agriculture the nitrogen is not returned.

(b) Some candidates realised that abandoned areas could not be used for growing again, but few developed their answer further to ideas of all forest eventually being used. A few candidate incorrectly attempted answers based on global warming.

(c) Most candidates knew that manure can be used as a fertiliser.

(d) Most candidates ignored the reference to pest control in the stem and incorrectly wrote about other factors such as fertilisers.

Question 4

Candidates gained some marks in this question, but few scored well.

(a) (i) Almost all candidates gave the correct sequence.

(ii) No candidate knew that the solar system was made from both dust and gas.

(b) Candidates had no idea of the mechanism by which an asteroid collision could results in the death of the dinosaurs. Most thought the dinosaurs lived close to Mexico.

(c) More able candidates correctly wrote that the asteroid crashed long before the death of the dinosaurs.

Question 5

Candidates had only a little knowledge of the properties of uv radiation.

(a) Some candidates knew that uv can cause cancer but none could relate this to the fact that uv is ionising.

(b) More able candidates knew that this has something to do with the ozone layer, but none realised that ozone absorbs uv.

(c) (i) Most candidates correctly identified Abby and Barry to gain one mark, but missed out Carl.

(ii) Few candidates identified both Abby and Barry for this mark.

Question 6

Some marks were scored by interpretation of the data provided, but few candidates scored well.

(a) More able candidates gave all three energy sources to gain both marks, but most gave only two to gain one mark. Weaker candidates gave incorrect answers such as nuclear and hydroelectric.

(b) More able candidates correctly identified oil. The most common incorrect answer was hydroelectric.

(c) Whilst some candidates gave the correct answer 475, many gave 180.

(d) Most candidates identified two of the energy sources, but few gave all three.

(e) Most candidates correctly identified a renewable energy source. Nuclear was a common incorrect answer.

Question 7

Demonstration of candidates' knowledge of genetics was generally poor in answers to these questions.

(a) Candidates had little idea of which statements are true and which are false.

(b) Most candidates completed the diagram correctly. The most common error was to have the father as XX and the mother as XY.

(c) (i) Most candidates chose either Badr or Amir to gain this mark.

(ii) A majority of candidates correctly chose Dao.

(iii) Only a few candidates correctly chose Ellen.

Question 8

Candidates showed some knowledge of antibiotics and could interpret the data quite well.

(a) All but the weakest candidates gained both marks for this question.

(b) Most candidates know that antibiotics kill bacteria, though some thought that they kill viruses.

(c) No candidates could relate their answers to the idea that bacteria can develop resistance.

(d) (i) Almost all candidates correctly read off the percentage as 60.

(ii) Most candidates realised that this percentage had increased.

Question 9

Candidates showed a lack of knowledge in this question.

(a) Candidates had little idea of the differences between nervous and hormonal communication.

(b) Most candidates gained one or two marks. The fact that 'human apes have a common ancestor' does not affect the prediction. This was rarely entered correctly.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/04

Paper 4 (Extended Written)

General comments

Although the entry remains small for this examination, there was an increase this June over last year's entry. Most candidates showed a good understanding of the science content of the syllabus, and also of the application of Ideas about Science. The more successful candidates showed clear understanding of exactly what each question was trying to assess, while less successful candidates did not read the instructions clearly and consequently tended to answer their own version of the questions. Overall, candidates were slightly more successful in the Biology questions than in the Chemistry or Physics ones.

Comments on specific questions

Question 1

Hardness of metals.

(a) Most candidates could calculate a mean, but only few discounted the outlier before doing so.

(b) The idea of a real difference between data sets relating to their ranges not overlapping was understood by few, although most could explain which metal was harder.

Question 2

Pollutant gases.

(a) Most candidates had a good understanding of the correct representation of molecules, but few were able to balance the equation. Most knew that photosynthesis removed carbon dioxide from the atmosphere, but the removal by dissolving was rarely seen.

(b) The symbol equation, as distinct from the pictorial one in part **(a)**, was more difficult. In part **(ii)**, the reaction of sulfur dioxide with oxygen, and then with water was not understood.

Question 3

'Slash and burn' agriculture.

(a) Soil depletion was well understood, but many did not refer explicitly to the removal of nitrogen products.

(b) Most candidates realised that 'slash and burn' is not sustainable, but only the better could relate it to rate of removal and rate of replacement.

(c) Most candidates realised that many developing countries could not afford pesticides in this part.

Question 4

Human chromosomes.

This proved to be most successfully answered question in the paper, slightly ahead of **Questions 9** and **1**.

(a) and (b) Most candidates were able to relate the chromosome pairs to contributions from each parent, and understood the role of the Y chromosome in determining sex.

(c) Most could complete the Punnett square correctly, but not all realised that the probability of having a boy was 50% (1 in 2) even if the family already had three boys.

(d) Better candidates were able to identify the 'talking heads' associated with different ethical standpoints from Idea about Science 6 (Making Decisions about Science and Technology), but most found this part harder than **(a)**, **(b)** or **(c)**.

Question 5

Antibiotics.

(a) Most candidates understood that antibiotics kill bacteria; some also correctly added fungi.

(b) The reason for completing a course of antibiotics (preventing bacteria from developing resistance) was not known.

(c) Nearly all candidates mentioned the continual increase shown by the graph, but few went on to comment that the initial steep rise was followed by a gradual levelling off. The mechanism for the process – mutation in the bacterial genes and passing on to the next generation – was explained well by better candidates.

Question 6

Nervous and hormonal communication systems.

(a) Most could quote at least one difference between these two systems.

(b) Most were able to identify the statement which is an explanation, but finding the ones to increase or decrease confidence in that explanation proved harder.

Question 7

Asteroid impact and dinosaur extinction.

This proved to be the most difficult question in this paper.

(a) Few could identify the climatic consequences of a large asteroid impact.

(b) Identifying the three statements containing data proved difficult: this was probably because candidates were not told how many statements they had to select.

(c) The reasons for scientists disagreeing over rival theories – a significant aspect of Idea about Science 4 (Scientific Community) – were not successfully suggested by many.

Question 8

Fair skin and the Sun's ultraviolet radiation.

(a) The possible effects of ionising radiation on the skin were clearly known.

(b) The mechanism by which the ozone layer absorbs ultraviolet radiation – the production of reversible chemical changes to the ozone – proved difficult for all. There was much confusion with the greenhouse effect.

(c) Recognition of the 'talking heads' associated with analysis of risk and benefit proved variable: almost all could recognise the two who were doing something to reduce risk (even though there was no indication how many answers were required there) while identifying those who identified a risk, or both a risk and a benefit, was harder.

Question 9

Energy sources and electricity generation.

(a) Recognition of the major primary sources from the bar chart was done well by all.

(b) A correct total of the energy produced from carbon fuels was given by relatively few candidates: the problem may have been in recognising the fuel rather than doing the addition although, because candidates rarely show their working, this is only a hypothesis.

(c) Many candidates could show, by a number of routes, that the data did not support the claim that nuclear power produced a quarter of all electricity world-wide.

(d) Calculation of efficiency from the Sankey (energy flow) diagram was not done well by most, who obtained partial credit for using the diagram to obtain the amount of electrical energy produced, but then clearly could not take the calculation further.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/05

Paper 5 (Comprehension, Practical Procedures, Data Handling and Analysis)

General comments

Most candidates attempted all questions on the paper. There was no indication that candidates were short of time. **Questions 1(a), 1(b)(i), 1(c), 3(b) and 4(b)** proved to be more accessible to candidates, with **Questions 1(d), 1(f), 1(g)(ii), 1(h)(ii), 1(h)(iii), 1(h)v(), 2(c)(ii) and 3(c)(i)** causing the most difficulty. Questions requiring knowledge of the Ideas about Science were less well answered than the other recall questions. The standard of written English was very good.

Comments on specific questions

Question 1

(a) This question proved to be a gentle start to the paper with the vast majority of candidates answering it correctly. Candidates are reminded that, on this paper, some of the questions can be answered by quoting information from the article – as was the case here.

(b) (i) This was also well answered by the majority of candidates.

(ii) A large number of candidates were able to correctly identify an environmental change that may cause a species to become extinct. Those not gaining the mark usually gave an example of how human activity may lead to the extinction instead, which was the answer to part **(c)**. Candidates should carefully read each question before answering as this may help to prevent them writing their answers in the wrong section or repeating answers in two sections.

(c) Most candidates answered this question very well and gave good examples of the direct and indirect influence of humans on species becoming extinct.

(d) Few candidates were able to answer this question correctly. The very strongest candidates gave a definition of sustainable but hardly any were able to link that to the context of this question. Candidates needed to recognise that if biodiversity is maintained and extinctions reduced, people will be able to use the different species, e.g. for food and medicines, and this will enable us to meet the needs of people today and also provide for the people of the future.

(e) (i) Surprisingly few candidates were able to define 'clone' correctly. Candidates needed to refer to the identical nature of the DNA or the genes. Many just stated that a clone was a copy without making it clear that it is the genetic information that is copied.

(ii) Most candidates were able to explain that identical twins are a result of one embryo splitting into two. Fewer were able to describe how that original embryo was formed. There were a significant number of candidates who described the involvement of two sperm cells fertilising one egg and, in a very few cases, two egg cells being fertilised. Candidates need to be clear that identical twins have identical DNA and so can only arise from the fertilisation of one egg with one sperm.

(iii) This question was well answered by the majority of candidates. Most chose to go back to the article and select answers from the examples that were given there. Once again candidates are reminded of the importance of reading the article carefully and using the information in their answers whenever they are able to.

(f) Few candidates answered this question correctly and a large number of candidates made no attempt. The data required for the calculation was given in the article. 439 embryos were created in total but only one was born. Therefore the correct calculation is:

1/439 x 100 = **0.22%**

It seemed that candidates lacked confidence in even attempting this question. Candidates are allowed to use calculators to help with these questions. Centres should ensure that candidates have calculators that can be used in these examinations.

(g) (i) Few candidates were able to correctly describe the correlation in the article. In fact, part **(g)** was generally very poorly answered. A correlation describes more than just a link between two things. It links a factor and an outcome, but it also gives an idea of the relationship between those two things and the direction in which the relationship exists. For example, in this question, candidates are asked to describe the correlation between the number of sailors (factor) and the population of Dodos (outcome) so both of these (the factor and the outcome) must be included in the answer. i.e. 'as the *number of sailors* increased, the *population of Dodos* decreased'. Responses such as 'if there are more sailors, more Dodos die' did not gain credit even though the candidate has the right idea about what is happening.

(ii) This was poorly answered by all candidates. Many gave a reason why the Dodos became extinct and so did not answer the question that was being asked.

(iii) This should have been an easy question for all candidates as the specification states that candidates should be able to describe a correlation of their own choice. Any correct correlation was credited here and it did not have to be related to the article. However, as in part **(g)(i)**, candidates did not describe the direction of the correlation and therefore answers such as 'smoking and cancer' did not gain credit. However, there were a few good answers seen here. These included 'the more people smoke, the greater the risk of getting heart disease' and 'as the concentration of CO_2 in the atmosphere rises, the temperature increases'.

(h) (i) This question was well answered by some candidates who realised that they needed to use the process described in the article as the basis of their answer. They then needed to apply it to the new context. Some candidates did not describe where the original DNA came from or incorrectly stated skin cells in place of DNA, e.g. 'extract skin cells from the remains'.

(ii) Few candidates answered this correctly. Some of the more able candidates realised that the dodo is much larger than a pigeon and is a bird and lay eggs which would complicate the process. No candidates identified that it would probably be very difficult to obtain undamaged DNA.

(iii) A surprisingly large number of candidates did not seem to be familiar with the term 'peer review' and some candidates did not make an attempt at this question.

(iv) Some candidates were awarded a mark for identifying that improvements can be made in light of other scientists looking at the study. There were lots of vague descriptions of how it would enable the results to be checked but candidates need to talk about how it improves the validity of the results.

(v) A few candidates appreciated that scientists repeat measurements but very few were able to link this to improving reliability.

Question 2

(a) This question caused some difficulties for the candidates. They were required to explain how each piece of equipment could be used to obtain the results in the table. Most candidates were able to describe how masses could be added to the end of the polymer. Few described using the ruler to measure the bend or that the polymer sample should be clamped down. The mass holder confused some candidates – this is the piece of equipment on which the masses are hung. None of the candidates were able to identify that only the 50 g and 100 g masses were used. A few candidates made no attempt at this question.

(b) This was generally well answered and most candidates were able to identify that A is more flexible than B. Far fewer used the results to identify the difference in the rate of bend.

(c) (i) Most candidates recognised that more repeats would lead to greater reliability of results.

(ii) Only the most able candidates were able to identify that the bend would be bigger with a longer polymer sample.

Question 3

(a) Most candidates correctly identified that light entering the room could be blocked by drawing the curtains or pulling the blinds down.

(b) This question was answered correctly by the majority of candidates.

(c) (i) Most candidates suggested using coloured paper and were obviously confused by the initial investigation described in the question. A few correctly selected a beaker to hold the liquid, but few were able to identify that you would also need equipment to measure the depth of the solution.

(ii) Most candidates found this question difficult. Few were able to describe how they would carry out the investigation. In most cases, this followed on from incorrectly selecting equipment in part **(c)(i)**.

Question 4

(a) (i) Most candidates were able to identify the odd nature of this value but fewer were able to use the term 'outlier' to describe it correctly.

(ii) Most candidates attempted the calculation but very few realised that they needed to remove the outlier before calculating the mean. The correct calculation was:

12 + 11 = 23/2 = **11.5**

(b) The majority of candidates successfully identified the range.

(c) A large number of candidates were able to recognise that repeating an experiment is necessary to ensure reliable results.

(d) Most candidates were able to consider the variables involved in the experiment but some incorrectly selected the independent variable (distance from the light source) as a variable that should be kept the same.

(e) There were three marks available for this question. Most candidates were able to correctly draw the axes with appropriate scales. Fewer candidates were able to label the scales and very few included units. The majority of candidates were able to plot the bars correctly although candidates should be reminded to keep their presentation clear and to use only single lines (ideally drawn with a ruler). Sketchy lines should be avoided.

(f) (i) Some candidates provided a correct conclusion and successfully described the relationship between the distance from the light source and the location of the woodlice. Others gave vague statements, e.g. 'woodlice are affected by light' which was not worthy of credit.

(ii) Few candidates were able to suggest an advantage to the woodlice of this behaviour.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/06
Paper 6 (Case Study)

Introduction

Although the number of Centres is relatively small, it was clear that some encouraging and appropriate work had been performed by those candidates who have been entered for this syllabus.

Administrative aspects

As a reminder the following key points regarding the administration of coursework samples are described below

- The coursework assessment summary form should be completed showing the individual Strand and total marks awarded for each candidate.
- Candidates' work should be fastened in the left-hand corner with the appropriate CIE candidate Record card.
- Details should be included about 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.
- Details of internal standardisation procedures should be described if appropriate.

Marking procedures.

The award of marks is based on the professional judgement of the science teacher, working within a framework of performance descriptions which are divided into strands and aspects of performance.

- Each aspect of performance within each Strand should be considered in turn, comparing the piece of work against the lowest performance description first, then each subsequent higher one in a **hierarchical** manner until the work no longer matches the performance description.
- For Strands B or C, where candidate performance exceeds that required by one performance description, but does not sufficiently match the next higher one, the intermediate whole number mark should be given. Thus, the level of performance in each aspect is decided.
- The single, overall, mark for the whole strand is determined by taking the average of the aspect marks and rounding to a whole number as 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.

Strands A and D:

There are three aspects to each of these strands and the following examples illustrate how to convert aspects of performance marks into Strand marks.

Example	Marks for the three aspects in a strand	Formula to be applied	Mark to be awarded for the strand	
1	(a) = 4, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.66 round up	= 4
2	(a) = 3, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.33 round down	= 3
3	(a) = 4, (b) = 3, (c) = 1	[(a)+(b)+(c)] / 3	= 2.66 round up	= 3
4	(a) = 3, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	= 2.0	= 2
5	(a) = 2, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	=1.66 round up	= 2

Strands B and C:

There are only two aspects of performance to each of these strands.
The average of the aspect marks may come to a whole number (N) or to N + ½.

- 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. For example,

Example	Marks for the two aspects in a strand	Formula to be applied	Mark to be awarded for the strand
1	Strand B (a) = 6, (b) = 4 Strand C (a) = 6, (b) = 5	[(a)+(b)] / 2 = 5 [(a)+(b)] / 2 = 5.5	= 5 = 6
2	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. Comparison of teacher and moderator judgements in each aspect allows easy identification of where a Centre marks too severely, too leniently or where marking is inconsistent. This allows moderators to make far more constructive reports back to Centres.

Case Studies

General comments

The purpose of the Case Study is for candidates to gather together claims, opinions and evidence about a controversial issue in science. Candidates should use their scientific knowledge and understanding of the Ideas about Science (IaS) to compare and evaluate the evidence that they have collected so that they can form their own conclusions and make appropriate recommendations for future action. Where candidates use the language and concepts related to IaS, such as 'peer review', 'replication of evidence', 'correlation and cause' 'reasons why scientists disagree', 'precautionary principle', 'ALARA', 'risks and benefits', 'technical feasibility and values' it is easier to match the performance descriptions of the criteria and gain higher marks.

Case Studies are always best formulated in terms of a question to provide a focus in an area of controversy. For example, 'does air pollution cause asthma?' rather than just 'asthma'. 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. Some topics are so uncontroversial that there are no valid opposing views. 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 and informed account.

Assessment

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 identified by the candidate then a maximum of 1 mark will be allowed, unless annotation confirms that a suitable range of sources were used. To meet the 3 mark performance description, candidates must select sources which represent a variety of different views or opinions. It does not matter if all the sources are from the Internet although a balanced use of websites, textbooks and journals is to be encouraged. Whatever sources are used by candidates they must assess their sources in terms of reliability in a meaningful and appropriate way if 4 marks are to be awarded.

A(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 3 marks candidates must include complete references to the exact URL 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. Candidates awarded 4 marks included the date that the site was visited and also some information about the nature or sponsorship of the site.

A(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 including details of the author as well as the institution. Some candidates gathered information from self-constructed questionnaires which also added to the pool of material for their Case Study, but occasionally this caused distraction from the underlying science and scientific evidence.

Strand B: quality of understanding of the Case.

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

B(a): Candidates often describe 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 link 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 C21 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.

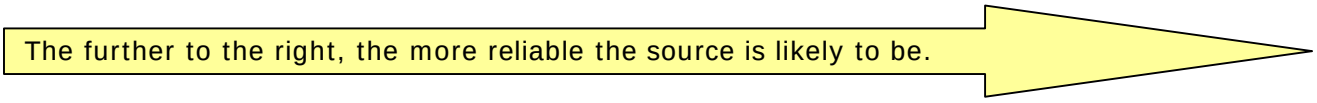
For example, in the Higher Tier Science C21 Textbook

B1 You and Your Genes: 'genetic engineering' etc. Pages 34/5
C1 Air Quality: any pollution related Case Study. Pages 62 and 63
P1 The earth in the Universe: 'What killed the dinosaurs?' etc. Pages 90 and 91
B2: Keeping Healthy: 'diets'; 'MMR' etc. Pages 118 and 119
C2 Material Choices: 'sustainability related' Pages 146 and 147
P2: Radiation and Life: 'mobile phones'; 'sunbathing' Pages 174 and 175
B3: Life on earth: 'evolution'; 'extinction' Pages 202 and 203
C3: Food Matters: 'organic farming'; 'diet' Pages 230 and 231
P3: Radioactive materials: 'radiation'; 'future energy needs' Pages 258 and 259

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 come either for applying this correctly to the case, or for finding and explaining some more specialised knowledge.

B(b): Candidates were awarded 4 marks if they were able to recognise and extract relevant scientific content and data in their sources. Candidates who were awarded 6 marks referred to the evidence base of the various claims and opinions e.g. data from research studies, a collection, survey or review of existing data, a computer simulation etc. Candidates obtaining 7 or 8 marks look more critically at the quality of the evidence. They used terms like 'reliability' and 'accuracy' when considering data, they looked at the design of experiments and the issue of sample size and they also compared the reliability of data between sources.

The following table gives guidance as to the sort of aspects to consider when considering reliability of sources and data.

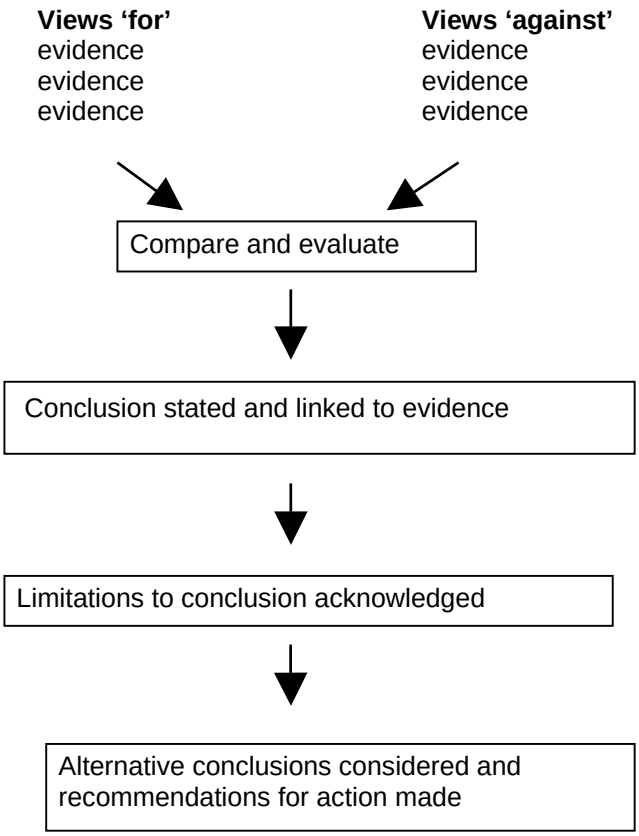


Publication	website or newsletter of a private individual or a fringe group	respectable pressure group website or newsletter	'Quality' media e.g. BBC, *The Times, The Independent, The Guardian, Daily Mail*	Sschool textbook or science magazine e.g. New Scientist, Focus, Catalyst.	peer reviewed science journal or government report
Nature of the data	based on little or no data	Based on some data, but of questionable validity or reliability, e.g. small sample, not representative of population.	Based on just one study (or several small studies). Little information about sample, or procedures followed.	valid and reliable method e.g. health study with large sample size, carried out over many years	results repeated by different scientific studies, each using a valid and reliable method,
Science explanation	no support within the science community	new explanation, but with basis in accepted scientific ideas	One among several explanations discussed with the science community.	agreed by most, but not all, within the science community	agreed by everyone within the science community
Status of the author	Someone who knows little or no science. Someone known to have a particular point of view.	an inexperienced scientist or science candidate	A professional scientist whose expertise is in a different field.	a professional scientist working in the area – though not regarded as a top expert by his/her peers	a recognised expert in this field of science
Author's affiliation or institution	a non-science institute	a scientific institute or company that represents particular views only	a scientific institute with a doubtful reputation	a recognised university or scientific institute	a leading university or scientific institute, or the research lab of a major company

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.

The aspects for Strand C can be summarised in the following simple flowchart.



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 4 marks. Better candidates started to compare and balance arguments against one another in both their 'for and against' list and were awarded 6 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 future action should also be included.

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 and this matched the 3 mark performance description. 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.

D(b): Suitable diagrams and graphics should be incorporated as appropriate to clarify difficult ideas and encourage effective communication but the visual impact was often variable. If there are no decorative or informative images included then zero marks is awarded. If one image is included, a decorative front cover or other low level attempt to add interest then 1 mark is appropriate. Two marks would be awarded for the inclusion of decorative images only or perhaps for the minimal use of informative images. Three marks would be given for including a variety of informative illustration e.g. charts, tables, graphs, or schematic diagrams and 4 marks if this is fully integrated into the text, referred to and used. Too often downloaded images from the Internet were not clear, too small and not referred to in the text.