TWENTY FIRST CENTURY SCIENCE

Paper 0608/01
Multiple choice (Core)

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

General Comments

In broad terms, questions testing direct recall of knowledge were well answered.

Comments on specific questions

Questions answered well

Candidates answered questions well relating to:

- sex determination (**1**),
- interpretation of tabulated data (**8**),
- rocks and tectonics (**11**),
- peer review (**18**),
- life cycle assessments (**23**),
- food chains (**31**),
- food additives (**33**),

- hazards of radioactivity (**39**).

Questions that proved difficult

Question 4

The commonest incorrect choice was that for identical twins, the egg splits into two before being fertilised (**C**).

Question 7

The answers chosen were evenly spread between all four choices, with marginally more candidates choosing option **D**, suggesting that incomplete combustion is responsible for the production of nitrogen and sulfur oxides as well as carbon monoxide.

Question 10

Most candidates thought that a catalytic converter removes carbon dioxide, and hence chose option **A**.

Question 12

This proved difficult because candidates did not choose the idea that mountains are forming all the time, but most incorrectly thought that the information suggested that all mountains are millions of years old (option **B**).

Question 17

This question was withdrawn as response **A** proved too strong a distractor. Candidates should be taught that the bacteria used in a vaccine must be dead or inactive, and that small amounts of live bacteria could pass the disease to the person vaccinated. In this case, however, distractor **A** was a very common choice, even though it did not mention that the bacteria were dead or inactive.

Question 25

Response **B** was also given credit as fully correct (in addition to the correct response, **D**). Candidates are not expected to know that ozone is a greenhouse gas, but it is nevertheless true that ozone does have greenhouse properties.

Question 35

Most candidates incorrectly thought that proteins contain calcium and iron.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/02

Multiple choice (Extended)

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

General Comments

In broad terms, questions testing direct recall of knowledge were well answered.

Comments on specific questions

Questions answered well

Candidates answered questions well relating to:

- sex determination (**1**),
- syndromes linked to genes (**5** and **7**),
- reliability of data (**11**),
- earthquakes (**16**),
- heart problems (**19**),
- peer review (**20**),
- data, correlation and cause (**21** and **31**),

- the effect of distance on photon intensity (**27**),
- carbon cycle (**29**),
- selective breeding (**30**),
- evolution (**32**),
- risk and benefit (**35** and **36**),
- hazards of radioactivity (**40**).

Questions that proved difficult

Question 10

Most candidates did not know that sulfur dioxide comes from the combustion of fuel, so incorrectly chose **D** as their answer.

Question 14

All distractors were chosen with similar frequency, suggesting that candidates did not know the age of the Earth compared to the Solar System.

Question 22

Distractor **D** was a common choice, suggesting that candidates do not fully understand the relationship between the structure of a monomer and the polymer it forms.

Question 25

Response **B** was also given credit as fully correct (in addition to the correct response, **D**). Candidates are not expected to know that ozone is a greenhouse gas, but it is nevertheless true that ozone does have greenhouse properties.

Question 28

The commonest incorrect response was that candidates thought oxygen and nitrogen were greenhouse gases.

Question 33

Many candidates chose option **A**, suggesting that they think that nitrogen is a component of carbohydrates.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/03
Paper 3 (Core Written)

Key message

In general, those questions requiring candidates to use recall skills were better answered than those requiring analysis and evaluation of the information provided. Candidates require further practise in order to develop the skills required to answer the latter and perform well on this paper.

General comments

All candidates attempted most questions on the paper and made a good attempt at each question. There was no indication that candidates were short of time. **Questions 2**, **7** and **9** proved to be more accessible to candidates, with **Questions 1**, **3**, **4** and **5** causing more difficulties. It was pleasing to see that the responses given to the 'Ideas about Science' questions were better than in previous sessions. Some errors were made as a result of not reading the question carefully enough and therefore not doing as the question asked. The standard of written English was very good.

Comments on specific questions

Question 1

(a) Most candidates were able to correctly identify the two pollutant gases as nitrogen dioxide and sulfur dioxide. Fewer were then able to correctly name a source of these gases. A large proportion of the candidates instead named an effect of the gas, e.g. acid rain. Others identified a source but were very vague in their descriptions and credit could not be awarded.

(b)

(i) It was pleasing to see that almost all candidates were able to complete the sentence to describe the correlation correctly.

(ii) This part of the question was less well answered. Candidates tended to repeat the correlation and very few made any reference to the quality of the data and how that could be improved.

(c) This question caused some difficulty. Very few candidates realised that there needed to be an additional nitrogen monoxide molecule on the left hand side of the arrow. A few of the most able correctly drew one carbon dioxide molecule on the right hand side of the arrow but this did not receive any credit as two molecules were required. Questions of this type are quite common on these exam papers and candidates would benefit from lots of practice filling in missing molecules from a range of different reactions. They need to ensure that there are the same numbers of each type of atom (circle) on each side of the arrow. It is also quite common for the stem of the question to state the names of the reactants and products and candidates should use this information to help them with the question.

Question 2

(a)

(i) The majority of candidates were able to identify the value for Sample 3 as an outlier, or to describe that it was a value far from the others. Candidates need to be careful about the spelling of these key words as 'outliner' was seen and could not be credited. Fewer candidates were able to explain how the outlier would affect the mean if it were not removed. This question was worth two marks and candidates should use this information as an indication that more than just the identification of an outlier was required.

(ii) Whilst a significant number of candidates were awarded credit here, it was disappointing to see few include their working in their answer. As in previous sessions, candidates are advised to show all of their working when carrying out calculations. This will ensure some credit is obtained even if the calculation is then carried out incorrectly or an incorrect answer given.

(iii) Almost all candidates were able to correctly identify the range of the results here.

(b) Some of the more able candidates correctly described the addition of cross-links as a way of making a polymer harder. The remaining answers were either vague, e.g. 'add something different' or just a reversal of the question, i.e. 'don't add plasticiser'. Neither of these ideas could be credited.

Question 3

There were a significant number of candidates who did not appear to fully understand what this question was asking. Many referred to the risks associated with consuming foods containing pesticides, additives and mould, but very few correctly explained how these harmful chemicals could have entered the food.

(a)

(i) Very few candidates seemed to appreciate the idea that the pesticides sprayed on crops whilst they were growing could remain in the food. Many candidates described the role of pesticides which was not relevant to the question.

(ii) Again, many candidates described what additives were but did not explicitly state that they are added to the food and would be present in the food when it is purchased.

(iii) Very few candidates seemed to know that mould can grow on food when it is stored, and hence be on the food when it is purchased. A significant number of candidates made no attempt at this question at all.

(b) The term 'risk assessment' was not seen but a number of candidates were able to correctly describe the idea of carrying out tests. More candidates understood that these tests would then be used to determine the level at which chemicals can be added to food safely.

(c) The majority of candidates correctly suggested checking food labels or purchasing organic food.

Question 4

(a) A number of candidates were able to suggest that clouds or light pollution would limit the view of the sky from the Earth's surface. The most common incorrect answer was the idea that the telescope on Earth would be further away than the telescope in space.

(b) Candidates' responses to this question varied greatly. Some candidates did not use the information given to help them answer the question. The scientists' opinions needed to be read and incorporated into the candidates' answers. Those candidates that read the instructions carefully and did as the question asked scored full credit by extracting the relevant information from the speech bubbles. Many of these candidates suggested good examples of how the money might be better spent.

(c) A large number of candidates correctly described that solar systems are made from dust and gas. A few candidates confused this with the Big Bang theory and did not gain any credit.

(d)

(i) This question was generally well answered. Most candidates were well-prepared to recall the definition of a light year. A few of the less able candidates incorrectly described a light year as the speed of light.

(ii) A surprisingly large number of candidates answered this question incorrectly. Some simply stated the stem of the question, i.e. that light years are used instead of kilometres, but did not explain why.

Question 5

(a) This question was well-answered by the majority of candidates and demonstrated that candidates were able to interpret the graph correctly. A very small number incorrectly read the scale on the *y*-axis and gave the answer as 308.

(b) Most candidates were able to correctly extract the values from the graph and add them up. However, as with previous calculations, candidates did not show their working despite being asked to. In some cases, this led to credit not being awarded.

(c) This question was poorly answered by many candidates. No credit was given for a conclusion, i.e. whether the statement was true or false, without some evidence of calculations. Therefore, those candidates who simply wrote that the statement was false received no credit. The question clearly states that candidates should use the data to support their answer and candidates need to read these instructions carefully so that they answer the question completely. A few of the more able candidates correctly halved their answer to **(b)** but then did not compare it to 800 (the radiation dose from radon gas in the ground). Some weaker candidates incorrectly halved 800.

(d) Few candidates appeared to understand what this question was asking them to do. Most answers did not describe a test that could be carried out and, despite the fact that a larger number of candidates stated that alpha radiation would be absorbed by paper, few compared this to gamma radiation to make it clear that they would know how to identify which source was giving out the alpha radiation. A significant number of candidates referred back to the graph which was not relevant to this part of the question.

Question 6

(a)

(i) Most candidates selected the correct words to complete the sentences.

(ii) Some candidates answered this correctly although it was not uncommon for candidates to incorrectly select a word from **(a)(i)** to answer this question.

(b)

(i) The majority of candidates were able to correctly identify one of the effects of ultraviolet radiation.

(ii) Equally, most candidates could suggest a reason why people choose to sunbathe despite the risks.

(iii) This question required a suggestion and an explanation to secure the credit available. This is made clear in the stem and candidates need to read the instructions carefully and note the use of bold to emphasise key things that should be included in their answers. The majority of candidates could suggest a method of protecting yourself from ultraviolet radiation but, since very few then explained how this method would protect you, few candidates received credit for this question. A small number of candidates made an attempt at an explanation stating that the sunblock or the clothes 'block ultraviolet radiation'. However, credit was only awarded for a clear statement describing how ultraviolet radiation is absorbed or reflected.

Question 7

(a) This question was well answered by the majority of candidates and they were correctly able to identify the combination of sex chromosomes found in males and females.

(b) Equally, many candidates answered this question successfully. Almost all of the candidates got at least two of the terms correct. Errors were usually due to the candidate misreading or not following the instructions, e.g. by drawing more than one line from or to each box.

(c)

(i) Most candidates answered this question correctly. Candidates should be made aware that when they are asked for a specific number of responses (ticks) such as in this example, i.e. the question asks them to suggest two reasons, they will be penalised if they tick more than two boxes.

(ii) Some candidates were well-prepared for this question and were able to provide suggestions why George might not want to be tested, with the fact it could cause stress being the most common answer. Some of the other candidates' answers suggested that there was some confusion over the term 'screening'. A large number of candidates seemed to link this to the previous radiation questions and assumed that radiation was used for the screening. Therefore, their reasons why George might not want to be screened incorrectly included the risk from the radiation.

Question 8

(a) This question was generally well answered.

(b)

(i) It was pleasing to see that candidates had a better understanding of correlations than in previous sessions. Many were able to identify the factor and the outcome with little difficulty. A few of the less able candidates simply rewrote the correlation here and did not score any credit.

(ii) In order to answer this question correctly, candidates could select any correlation in any context. Some candidates restated the correlation from the question, i.e. that between heart disease and air pollution. The question clearly asks for a different correlation so this could not be credited. A significant number of candidates were able to give an example of a correlation but the direction had to be clear, i.e. whether the factor increases or decreases and whether that then leads to an increase or decrease in the outcome. It was evident that some of the less-well prepared candidates did not properly understand the term correlation as they instead suggested how air pollution might cause heart disease.

(iii) Unfortunately very few candidates used the term 'peer review' in their answers, despite this being a term used in the 'Ideas about Science' section of the syllabus. Therefore, few candidates scored credit here.

(iv) However, most candidates could correctly identify why peer review is carried out. A small number of candidates did not receive credit here because they ticked more than one box, despite being told that they only needed to tick one.

Question 9

(a) Most candidates correctly identified the sun as the energy source for the food web.

(b) Candidates were able to interpret the food web and therefore most correctly identified the two species competing for razor clams.

(c)

(i) A large number of candidates could correctly explain the term extinct although some descriptions were rather simplified. It would be useful for candidates to practise writing definitions for the key words on the syllabus so they are prepared for this sort of question.

(ii) Most candidates correctly identified the effect that an increase in the number of horseshoe crabs would have on the food web.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/04

Paper 4 (Extended Written)

Key message

In order to perform well in this paper, candidates require a better understanding of the 'Ideas about Science' concepts, and further practise at dealing with complex data.

General comments

The entry for this paper was quite small, making it difficult to give overall comments. More able candidates showed knowledge and understanding in a number of areas of the specification, though rarely in all areas or in depth. Weaker candidates evidenced patchy knowledge and often a superficial understanding of key concepts. Many candidates clearly had difficulty in understanding what was required by the questions. Interpretation of simple data was generally good, but more complex data proved incomprehensible to many candidates. Similarly simple calculations were usually performed well, but few could cope with more complex ones. Many of the 'Ideas about Science' concepts were poorly understood. There was no evidence that candidates had insufficient time to complete the paper, and few left blank spaces.

Comments on specific questions

Question 1

Candidates' performance was hindered by poor understanding of the questions.

(a)

(i) Most candidates correctly described the trend shown by the graph. A few mentioned the correlation, which was also credited. Only the least able gave vague answers referring just to the number of cars.

(ii) Few candidates understood this question. Many simply referred to the graph or repeated their answer to **(i)**, not realising that more data was needed or that the investigation should be repeated.

(b)

(i) Most candidates drew another nitrogen monoxide molecule on the left of the equation to gain partial credit. Very few drew two correct carbon dioxide molecules on the right for further credit to be awarded. Many drew either one or two incorrect diagrams for carbon dioxide.

(ii) Few candidates had any idea of how to write a symbol equation, and those who did generally could not balance it. Many candidates wrote a word equation, which was not given credit.

(iii) The reference to 'indirectly' in the question was poorly understood. Many candidates wrote about direct harm. Few related their answer to acid rain.

Question 2

The majority of candidates showed little expertise in the manipulation of data and even less knowledge of polymer chemistry.

(a)

(i) Most candidates included the outlier in their range and so could not gain credit here. Some gave figures that were not present in the table. Only a small number of more able candidates gave the correct answer 73 to 77.

(ii) Only a few candidates excluded the outlier to calculate the mean as a best estimate. Most used all of the data to calculate the mean, which gained only partial credit. Many candidates clearly had no idea of what to do.

(b) Only the most able candidates realised that the mean of polymer A does not lie within the range of polymer B. Most gave irrelevant and often incomprehensible answers.

(c)

(i) Very few candidates had any idea that the polymer could be made harder by making the chains longer, adding cross-links or increasing crystallinity. A wide variety of incorrect answers were seen, many with no direct relation to polymer chemistry.

(ii) Only a tiny minority of candidates gave an answer related to the forces between polymer molecules.

Question 3

Most candidates were more successful in answering these questions. Some knowledge of farming methods and chemicals that may be found in food was evident.

(a) Only a few candidates mentioned risk assessments or that the safe levels of additives in food needed to be found. Most gave vague answers about the harmful nature of additives that gained no credit.

(b) More able candidates made sensible suggestions as to how pesticide residues could have been left in the soil from previous crops or blown by the wind from adjacent farms. Many candidates gave irrelevant answers suggesting for example, that organic food would be attacked by pests and spoiled if not sprayed with insecticide.

(c) Many candidates correctly suggested that fungi or bacteria could grow on the food, and produce toxic chemicals. Fewer suggested ideas of toxic chemicals produced during cooking or that some plants actually produce chemicals that can have harmful effects on humans.

Question 4

Most candidates showed some knowledge and could apply this to novel ideas.

(a) More able candidates mentioned dust and/or gas forming planets. Few mentioned a time scale. Many candidates gave vague answers related to the big bang theory which gained no credit. Some simply described the solar system.

(b)

(i) Most candidates realised that a light year is a measurement of distance but few could correctly express its meaning in words.

(ii) A wide variety of answers was seen, but rarely the correct one of 300 000.

(c)

(i) More able candidates correctly suggested that this would avoid light pollution, but did not mention problems caused by atmospheric distortion or clouds. Many candidates suggested that the telescope would be better because it is nearer the stars, which gained no credit.

(ii) Most candidates gave sensible arguments. Commonly they thought that the telescope would give mankind more knowledge but would cost too much money that could be spent on something worthwhile on Earth.

Question 5

Some candidates showed knowledge of radiation and its effects. Many candidates did not fully answer the question that had been asked e.g. suggest and explain.

(a)

(i) Only a few of the more able candidates correctly identified both X-rays and gamma radiation. Some gave one correct and one incorrect example, which did not gain credit. A wide variety of answers were seen, some of which were not examples of radiation at all.

(ii) Most candidates knew that ionising radiation damages cells and many also knew that it causes cancer.

(b)

(i) The risk and the benefit were well described by most candidates, but few went on to say that these people thought the benefit outweighs the risk.

(ii) Most candidates suggested using sunscreen products but few went on to explain how this provides protection.

Question 6

Simple calculations were carried out correctly by most candidates, but few could perform more complex manipulation.

(a)

(i) The radiation dose was correctly calculated by most candidates.

(ii) Most candidates subtracted 800 from 2360 to find the radiation not from radon to be 1560, which is more than half of 2360, showing the statement to be untrue. This gained full credit. An easier method of halving 2360 and finding the answer of 1180 to be higher than 800 was not seen.

(iii) Few candidates had any idea of how to calculate this answer.

(b) A number of candidates misread the question and thought the gamma radiation to pose a greater risk. Many gave vague and rambling answers that gained no credit. The idea that radon gas would enter and stay in the lungs was not appreciated.

Question 7

Moral issues were well understood and expressed by most candidates.

(a) Most candidates correctly identified XY and XX chromosome combinations correctly.

(b) Few candidates understood what is meant by the role of a gene. Most simply described the fusion of sperm with X or Y with an egg cell with X.

(c) Most candidates gave well-reasoned answers based on the employer not wanting to employ George or give him health insurance.

(d)

(i) Answers based on ideas of wanting to find out if he will get the disease and not wanting to pass the disease to his children were commonly seen and gained full credit.

(ii) Most candidates gave sensible answers based on the stress that could be caused by a positive result.

Question 8

Selection of the correct statements caused problems for many candidates.

(a) Two correct lifestyle factors were suggested by most candidates.

(b)

(i) More able candidates gave the correct answer **F**. Common incorrect answers were **D** and **E**.

(ii) Again only the more able chose the correct responses **C** and **D**.

(iii) Only the most able chose the correct response **E**.

(c) Few candidates realised that heart disease takes a long time to develop. Most incorrectly based their answers on ideas of accuracy of the data.

(d) This calculation was performed correctly by most candidates.

Question 9

Some candidates clearly had difficulty understanding the food web.

(a) Only the most able knew that the source of energy is the sun. The most common incorrect response was plankton.

(b) Very few candidates had difficulty in identifying the two species as diamondback terrapin and horseshoe crab.

(c) More able candidates correctly suggested that the number of striped bass would increase because they would have more horseshoe crabs to eat. A number of the less able thought the number of striped bass would decrease.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/05

Paper 5

Key message

Candidates would perform better on this paper with an improved ability to describe experimental procedure.

General comments

The presence of two shorter comprehension questions in **Section A**, in place of a single 30-mark question, meant that many candidates were able to make a fresh start after some had trouble with the first question. A few candidates did leave questions unanswered, but most made attempts at most questions.

Comments on specific questions

Section A

Question 1

(a) Fossils fuels and carbon dioxide as a greenhouse gas were known by almost all candidates.

(b) Only the more able candidates could label the block diagram for a power station, showing that many are not familiar with the names 'reactor', 'turbine' and 'generator'.

(c) Very few candidates showed awareness that the environmental load from a power station should include its building (and maintenance and decommissioning), when much carbon dioxide is released.

(d) More able candidates could calculate the energy efficiency of the power station, but less mathematical candidates often omitted this part.

(e) Good reasons for and against the use of nuclear power were seen from many candidates. Better answers were more specific: 'gives out radiation' is not enough for a disadvantage', but 'produces radioactive waste' is.

(f) Most could name a renewable energy source, but only the more able candidates could explain what 'reliable' meant.

(g) Some good descriptions of nuclear fission were seen, often helped by the use of diagrams.

Question 2

(a)(b) Most candidates knew the difference between low-level and high-level nuclear waste, with better answers referring to half-life.

(c)(d) Few candidates appreciated the difference between irradiation and contamination, although the most successful ones knew the properties of gamma radiation. Most candidates could suggest procedures to protect workers, although few knew the meaning of the ALARA principle.

Section B

Question 3

(a) More able candidates could describe how the procedure must be done, but many did not understand what the question was asking, and described instead the findings.

(b) Many candidates could suggest at least one experimental variable that had to be controlled in this experiment.

(c) Few knew that the circle soaked in distilled water was a control, but many gained credit for explaining why it was there, and could explain why it produced a different result.

(d) No candidates were able to compare the mouthwashes **A**, **C** and **D** in terms of effectiveness, although many did realise that **D** was the best.

Question 4

(a)(b) Most could select the apparatus needed for the experiment, but most (as in **3(a)**) could not describe the procedure followed. The extensions of the two polymer strips were rarely read correctly: partial credit was obtained for correct recording of their lengths.

(c)

(i) Most candidates could suggest at least one experimental variable that had to be controlled in this experiment.

(ii) Many candidates realised that a ruler graduated in finer divisions would give more accurate readings, and most were aware that repeating results improves accuracy.

Question 5

(a)(b)(c) Most could select an appropriate timer and calculate the mean time, and more able candidates could identify a variable to be kept constant during the experiment.

(d) Almost all candidates were able to plot the points accurately, but few drew a best-fit curve. Reading off their own graph was generally done well. Virtually everyone recognised that greater force produced shorter orbital times – 'negative correlation' got full credit – but further credit for identifying that the graph was not linear, proved inaccessible.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/06
Paper 6 (Case Study)

Key message

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 'Ideas about Science' to produce a balanced and informed account

General comments

Most schools provided the appropriate stimulus for their candidates so that a range of Case Studies were presented which were often adapted to reflect the local environment and so encourage ownership and interest on the part of candidates. Some encouraging and appropriate work had been performed; there has been a noticeable improvement in the quality of work submitted over the last few years and in particular the performance levels shown in Strands A and D have improved.

The purpose of the Case Study is for candidates to gather 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 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.

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.
- 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 for each of these strands and the following examples illustrate how to convert aspects of performance marks into Strand marks. The aspect marks are added together for each Strand and divided by 3 to calculate the average mark and the answer is rounded to the **nearest whole number**.

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 for 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	[(a)+(b)] / 2 = 5	= 5
	Strand C (a) = 6, (b) = 5	[(a)+(b)] / 2 = 5.5	= 6
2	Strand B (a) = 7, (b) = 6	[(a)+(b)] / 2 = 6.5	= 7
	Strand C (a) = 6, (b) = 5	[(a)+(b)] / 2 = 5.5	= 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

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 more able 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.

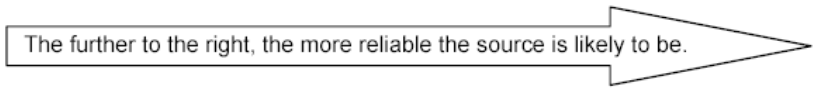
In simple terms this strand assesses candidates' ability to describe and explain the underlying relevant science and to recognise and evaluate the scientific evidence on which any claims are based (IaS 1, 2 and 3).

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 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.

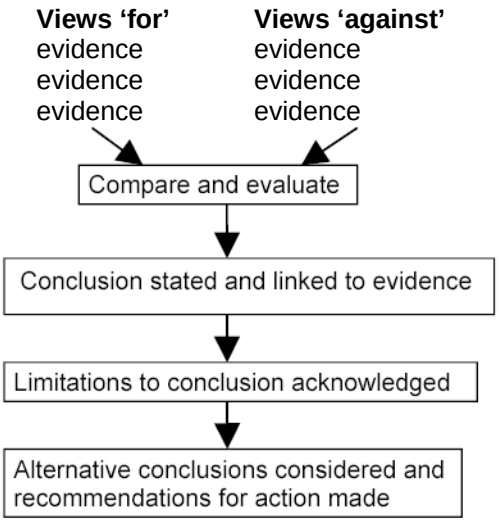


Publication	Website or newsletter of a private individual or a fringe group	Respectable pressure group website or newsletter	'Quality' media e.g. BBC, *The Times, The Independent, The Guardian, Daily Mail*	School textbook or science magazine e.g. New Scientist, Focus, Catalyst.	Peer reviewed science 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. More able candidates started to compare and balance arguments against one another in both their 'for and against' list and were awarded 6 marks. The most able 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 more able 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.