TWENTY FIRST CENTURY SCIENCE

Paper 0608/01
Multiple Choice (Core)

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

General comments

The candidates made good use of time during the examination. No questions were left blank. There were no ambiguous responses made.

Questions answered well

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

Candidates answered questions well relating to:

- using genetic diagrams to predict a simple genotype (**Question 2**)
- interpretation of percentages in pie chart form (**Question 18**)
- polymer structure relating to properties (**Question 22**)
- transmission of light (**Question 26**)
- natural selection and selective breeding (**Question 33**)
- choices in diet relating to food intake (**Question 36**)
- disposal of nuclear waste (**Question 40**)

Questions that proved difficult

Question 7

None of the candidates knew that sulfur dioxide reacts with water vapour and oxygen to form acid rain. Most chose the option **C** which included a mention of nitrogen.

Question 9

Candidates found the negative 'not' in this question difficult to interpret. Most chose answers that gave processes that **do** remove carbon dioxide from the air. Hence **B** and **D** were popular, incorrect choices.

Question 24

Candidates typically chose answers that included other aspects of the life cycle assessment rather than only about the making of the packaging. Hence **B** and **D** were common, incorrect choices.

Question 38

Candidates found the graph difficult to interpret. Incorrect answers **A** and **D** were both chosen more frequently than the correct answer, **C**.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/02

Multiple Choice (Extended)

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

General comments

The candidates made good use of time during the examination. No questions were left blank and there were no ambiguous responses made.

Questions answered well

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

Candidates answered questions well relating to:

- The use of genetic diagrams to determine a simple genotype (**Question 1**)
- Natural selection and selective breeding (**Question 30**)
- The effect of energy input versus energy output on weight (**Question 33**)
- Making dietary choices based on energy. (**Question 34**)

Questions that proved difficult

Question 22

Most candidates did not identify hemp and sisal as having no real difference due to the range of t strengths overlapping.

Question 24

Most candidates chose answers which did not relate only to making packaging, hence **B** was a popular incorrect choice.

Question 27

Some candidates thought that intensity was related to the energy or speed of the photons rather than the number hitting the surface per second.

Question 37

Many candidates incorrectly chose option **C**.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/03

Core Written

General comments

All questions appeared to be accessible to candidates and attempts were made to answer most questions. There was no indication that candidates were short of time. **Questions 2**, **3** and **4** proved to be more accessible to candidates, with **Questions 5** and **6** causing more difficulties. Significant credit was lost due to candidates not reading the rubric carefully enough and not doing what the question asked. However, calculations were well answered and candidates showed their working clearly where required. This is an improvement compared to previous sessions. The standard of written English continues to be very good. Candidates also demonstrated a good understanding of the Ideas about Science concepts assessed on this paper.

Comments on specific questions

Question 1

(a) Most candidates recognised that female body cells contain two X chromosomes and that the two chromosomes in a pair do not always have the same alleles. However, the statements describing the number of chromosomes caused more confusion. Only the best candidates scored full credit here.

(b) (i) The majority of candidates scored credit here, with most recognising that Jack could inherit the disease from his father and that he may want to find out if he has the disease.

(ii) Very few candidates were able to give a reason why Jill might not want to be tested. There were lots of vague answers. Centres are advised to use the mark scheme for this question to help candidates to practise listing specific reasons why people may not want to be tested.

Question 2

(a) Very few candidates correctly selected all three words to score full credit here. The most common incorrect choice for the first word was ‘blood’ instead of ‘muscle’. Most candidates correctly selected ‘oxygen’ as the second word and a significant number were familiar with coronary ‘arteries’. However, it did appear that candidates were quite confused about these ideas.

(b) (i) Candidates who looked carefully at the graph scored full credit here. The most common error was to look at the wrong vertical line and hence read off the wrong figures. However, the majority of candidates gave at least one correct answer.

(ii) This question was very well answered and it was pleasing to see that the majority of candidates could describe the pattern shown on the graph.

(iii) This question was reasonably well answered. It was clear from the answers that candidates are confident with the idea of a correlation but many are still not specific enough in their description. A statement that says ‘if they are heavier, they are more likely to have heart disease’ is correct but does not describe the correlation. The trend needs to be included in the description, i.e. ‘as the mean body mass increases, the cases of heart disease also increases’. Candidates can use the axes labels on the graph to ensure they are describing the factor and the outcome correctly.

(iv) Most candidates were able to correctly identify a lifestyle factor that could lead to an increase in the risk of heart disease. No credit was given to answers that referred to obesity or body mass as this was given in the earlier parts of the question.

Question 3

(a) Some candidates identified one reason why Darwin's ideas were not accepted, with the common answer being that which described the established views of creation. Very candidates were able to describe two reasons. This question links to the 'Developing Explanations' in the Ideas About Science appendix and this is a good place in the specification to discuss these ideas with the candidates.

(b) (i) Relatively few candidates were able to describe the process as natural selection despite it being a significant part of the specification.

(ii) Many candidates clearly understood the process and were able to correctly sequence the stages in the context of the earthworms. All candidates scored at some credit here, with many scoring full credit.

(c) There was significant confusion about selective breeding. A large number of candidates referred to manipulating genes. Very few described the idea of selecting individuals with desirable characteristics, although some candidates recognised that humans breed two animals with such characteristics together.

Question 4

(a) (i) This question ideally required candidates to use the term 'outlier' in their answer. However, this was rarely seen which was surprising as candidates have used the term well in previous sessions. Ideas such as 'it does not match the others' or that it is 'different from the others' were not enough; it needs to be described as **very** different, i.e. significantly lower than the other results.

(ii) It was very pleasing to see that all candidates correctly calculated the mean (best estimate) and most showed their working as well.

(b) (i) The majority of answers referred to a 'gas' mixing with the clouds, or pollution in general. Very few candidates mentioned sulfur dioxide, although a few recognised that the gas reacts with water. A description of the reaction was required. It was not enough to just describe a 'mixing' of the sulfur dioxide gas with the water.

(ii) Some candidates chose carbon dioxide as the gas, with only a few correctly selecting nitrogen dioxide. However, in many cases candidates correctly thought the gases were produced from car engines. It is evident that there is still a great deal of confusion about the different pollutant gases and how they are produced.

Question 5

(a) (i) Very few candidates demonstrated evidence that they knew what a mixture was and that a mixture, e.g. crude oil, can be separated into fractions.

(ii) In addition, very few candidates realised that the molecules in crude oil are all different lengths. There was evidence from candidates' answers to suggest they feel very unconfident about this area of the specification.

(iii) A few candidates looked closely at the diagram and spotted that there were some chlorine atoms present in the molecule of PVC, but it was evident that some candidates were not familiar with the term 'hydrocarbon' and were therefore unable to realise that the presence of chlorine meant the molecule could not be a hydrocarbon.

(b) (i) More candidates seemed familiar with the term 'plasticiser', and a significant number correctly state that the polymer would become more flexible.

(ii) A few of the most able candidates correctly selected the three words to explain how the plas changes the properties of PVC. It was noticeable that, in many answers, candidates did not ca their ideas through, or got them muddled. For example, they correctly stated that the plasticise reduces the forces between chains, but then went on to say, incorrectly, that this makes the chains harder to separate.

Question 6

(a) Many candidates correctly identified that the soil would lose its fertility due to nitrogen being removed by the plants. Far fewer candidates were then able to explain that the nutrients are not returned to the soil and so it was rare to award full credit here. A few candidates seemed to think that the soil itself would be removed.

(b) (i) Candidates gave a range of answers describing the problems with synthetic fertilisers in terms of the potential pollution they might cause and the cost. No candidate was able to relate this to sustainability and recall that the fertilisers are made from crude oil, a non-renewable source.

(ii) Many candidates were familiar with methods that are used to maintain soil fertility with the most common ideas being the use of animal waste or crop rotation.

(iii) A few candidates were able to correctly identify pests and disease as a significant factor that may cause a decrease in crop yield.

Question 7

(a) Many candidates recognised that galaxies contain stars, and the more able candidates realised that there has to be a large number of stars for it to be called a galaxy.

(b) (i) A significant number of candidates were able to correctly describe the pattern shown in the graph, with most stating that speed increases with distance. Fewer made reference to the proportional increase that appears to exist and so few were awarded full credit.

(ii) Very few candidates seemed to understand what this question was asking and there were lots of vague references to inaccurate results rather than specifically describing the idea that the points are scattered around the line.

(iii) This was a simple recall question which asked candidates to write down a figure that they should have learnt. A large number of candidates were unable to answer this correctly. Centres must ensure that candidates are familiar with the specification statements which rely on recall of facts. Candidates should be encouraged to learn these facts as they often provide an easy opportunity to gain credit in the examination.

Question 8

(a) Most candidates correctly completed the first blank space with 'absorbed'. A significant number also correctly selected 'emitted' as the second word. However, far fewer correctly chose 'absorbed' as the third word. This is possibly an example of where candidates did not read the rubric properly. They are perhaps familiar with selecting a different word for each space but, in this case, they are told that they can use the same word more than once. For this reason, few candidates scored full credit here.

(b) (i) Few candidates were able to clearly give one reason why global warming has increased. Pollution and the idea that there are more factories did not gain credit as a specific reference to the burning of fossil fuels was required. A few candidates gained credit for deforestation.

(ii) Almost all candidates were able to describe a consequence of continued global warming. Flooding was the most common response, but many made reference to climate change.

(c) (i) Most candidates scored credit here for the idea that the ozone layer protects us from
This is a good example of where candidates need to look at the credit allocation for eac
This is a clue to the length and level of detail required in the answer. Whilst the idea that th
protects us was worthy of some credit, most candidates did not write any more. The
available for recognising the damage that the UV radiation can do was rarely awarded.

(ii) A significant number of candidates correctly identified that those who trade in items that use CFCs would suffer from the ban. Other candidates suggested 'scientists' in general or made no attempt at the question.

Question 9

(a) The majority of candidates scored some credit here for correctly identifying the nuclear reactor or the generator in the diagram.

(b) A significant number of candidates were able to identify environmental disadvantages of the two power stations. The most common suggestions were the risk of nuclear waste from a nuclear power station and the pollution, i.e. CO_2 / SO_2, released by burning coal.

(c) (i) Very few candidates used the data here and most failed to spot that much more coal is needed to produce the same amount of energy as the nuclear fuel and that this would have significant implications to the cost and ease of transporting it.

(ii) As with the earlier calculation on this paper, it was pleasing to see many candidates complete this correctly and show suitable working.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/04
Extended Written

Key Message

The major problem encountered by candidates was a lack of knowledge and understanding of large areas of the syllabus. A thorough grounding in all aspects, including the 'ideas about science', would lead to a much improved performance for most. To perform well candidates also need to understand and follow the wording of the questions carefully. Candidates are expected to be able to interpret data presented in a variety of formats and draw conclusions from these data. Practice at this type of exercise is essential.

General comments

The entry for this paper was low, making it difficult to give meaningful comments. Some of the more able candidates were able to show knowledge and understanding of parts of the specification, though rarely in breadth or in depth. Weaker candidates showed patchy knowledge and often a lack of understanding of key concepts. Many candidates clearly had difficulty in understanding what was required by the question and in expressing their answers. 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 not well understood. There was no firm evidence that candidates had insufficient time to complete the paper.

Comments on specific questions

Question 1

Most candidates could calculate an average but few showed knowledge of the pollution caused by burning coal.

(a) (i) More able candidates omitted the outlier and correctly calculated the average as the best estimate. Weaker candidates included the outlier in their calculation. Only the weakest candidates did not calculate an average value.

(ii) Very few candidates realised that a real differences was shown by the mean of one set of data not being included in the other set of data. Many candidates simply referred to a difference between the two best estimates.

(b) (i) Only the more able knew that burning coal releases sulfur dioxide to gain the first mark. Very few of these knew that this sulfur dioxide reacts with both water and oxygen to produce acid rain. Many weaker candidates wrote about smoke or fumes which gained no credit.

(ii) Few candidates wrote about indirect harm. Many thought that the pollution causes breathing difficulties. A small number of the most able candidates correctly wrote about crop damage etc.

Question 2

Only the most able candidates showed knowledge and understanding of polymer chemistry.

(a) Only a small number of the most able candidates could correctly give the structural formula of the monomer propene. Some gave the repeating unit rather than the monomer. Many candidates did not attempt the question.

(b) (i) Some very able candidates knew that a polymer with shorter chain length would have ... of attraction between molecules. Few of these could then explain how this changed t... properties. Most candidates simply inserted the word forces into an irrelevant sentence.

(ii) Very few candidates showed any knowledge of polymer crystallisation. Many candidates did ... attempt the question.

Question 3

More able candidates were able to give relevant and coherent answers.

(a) More able candidates realised that the crop removed nutrients such as nitrates from the soil. Some also suggested that these were not returned when the crop was harvested to gain the second mark. Weaker candidates gave vague answers often related to supply of water or the growing of other crops.

(b) (i) More able candidates based correct answers on the idea that these fertilisers would be too expensive for the farmers in many countries to purchase. Others gave vague answers based on ideas of pollution that gained no credit.

(ii) A significant minority of candidates knew that manure could be used. Others correctly suggested crop rotation. Some weaker candidates mixed up ideas about fertilisers and pesticides.

Question 4

Interpretation of this data was beyond the abilities of most candidates.

(a) Most candidates attempted an answer but only a few of the most able realised that the velocity of galaxies increased with their increasing distance from the Earth.

(b) A few candidates correctly calculated the gradient of the line on the graph, but even fewer showed that this is about 7 x 22. Many candidates did not attempt the question.

(c) Many candidates guessed an answer but this did not gain credit without a supporting argument. Very few realised that the gradient being too big meant that the distance values were too small.

Question 5

More able candidates showed some knowledge of the greenhouse effect.

(a) Some candidates correctly named gases which cause the greenhouse effect but very few could correctly describe what these gases do to electromagnetic radiation.

(b) (i) A number of the more able candidates suggested the burning of fossil fuels as the cause of increased global warming to gain this mark.

(ii) Many candidates correctly suggested ice melting or flooding to gain this mark.

(c) Very few candidates showed any knowledge or understanding of the effect of UV on the ozone layer.

Question 6

More able candidates gained some of the marks in this question.

(a) More able candidates could correctly label the diagram.

(b) Very few candidates showed any knowledge or understanding of nuclear fission. Many did not attempt the question.

(c) (i) Only a few of the more able candidates based sensible answers on the idea that mo d have to be supplied. Many did not answer the question.

(ii) Many candidates could correctly calculate the efficiency.

100 x 12/36 = 33.3 %

(d) Whilst most candidates could suggest measures to reduce risk, such as protective clothing, few explained how these reduced the risk.

Question 7

More able candidates could interpret the data well.

(a) More able candidates realised that the heart muscle needs to be supplied with oxygen and nutrients.

(b) (i) More able candidates realised that as the mean body mass increased the cases of heart disease increased. Some gave suggestions based on the risk of getting heart disease, which did not receive credit. Weaker candidates became confused by the axis labels on the graph.

(ii) A number of candidates gave sensible suggestions based either on agreement or disagreement with the doctor. Few gave more than one explanation. Many weaker candidates wrote that overweight people will have a heart attack, which did not receive credit.

(iii) More able candidates wrote sensible answers based on the lifestyle of many people in industrialised countries.

Question 8

Few candidates managed to frame sensible answers to all of these questions.

(a) Most candidates gained at least one mark. A variety of correct reasons were seen.

(b) Only the most able could put together a coherent and sensible answer. Many realised that mutation changes a gene, but few could explain how resistant worms survived to breed and thereby pass resistance on to their offspring. Many candidates made no attempt at this question.

(c) Very few candidates showed knowledge or understanding of selective breeding.

Question 9

Most candidates could gain some marks with sensible suggestions.

(a) More able candidates made sensible suggestions to gain some of the marks. Few made more than two suggestions. Ideas that colleagues would be unfriendly to Jill were common and received no credit. Many weaker candidates became confused and thought that the insurance company employed Jill.

(b) A majority of candidates gave a sensible reason based on the idea that Jack could have the disease or is a carrier and would like to know if this was true.

(c) Very few candidates could put together a logical answer. Many did not attempt the question.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/05

Analysis and Interpretation

General comments

Nearly all candidates attempted each question. Most candidates were well prepared for aspects of the examination specific to syllabus, particularly the central nature of 'Ideas about Science'. The quality of English was good, although there were a number of instances where words had clearly been misunderstood. This often led candidates to answer their own interpretation of the question, rather than the one that had been set.

In this paper, the more successful candidates were well prepared to answer questions tackling assessment objectives 2, in **Questions 1** and **2**, and 3 in **Questions 3 – 5**. Less successful candidates often repeated information given in the paragraphs or the questions, and frequently answered 'describe' questions with explanations and 'explain' questions with descriptions.

In the three experimentation and data analysis questions, most candidates correctly focused on issues related to scientific procedures and the analysis of data, but again they frequently did not pay attention to the command words 'describe', 'suggest', 'explain' and 'calculate'.

In preparing for the examinations, candidates would be well advised to underline or highlight these words on the question paper to make sure that that is exactly who they do, that is:

- describe – write down what has happened, or what would happen, without any explanation
- explain – use scientific knowledge to give the reasons for something
- suggest – there may be more than one answer to the question, or it may not be required knowledge in the syllabus. In this case, candidates should use their intelligence to put forward an idea which could possibly explain what's going on.
- calculate – use the data to do a calculation

Centres should read the following detailed comments together with the question paper and the published mark scheme.

Comments on specific questions

Question 1

(a) In this question, only a minority of candidates realised that planets were the largest of the objects listed, but most realised that moons orbit planets.

(b) Even though the syllabus requires candidates to discuss the probability and possible consequences of an asteroid colliding with the Earth, many thought the asteroid would smash the Earth into pieces, or create earthquakes and tsunamis.

(c) Only the better candidates were able suggest a reason why intercepting asteroids would be difficult. Most just repeated their answer to part **(b)(ii)**

(d) Most candidates were able to gain credit for suggesting useful materials from asteroids that might be worth returning to Earth and for use in space exploration, although some did not distinguish the two cases.

(e) This last part of the question was testing the Idea about Science 'Making decisions about science and technology'; most did not address it in those terms, but just repeated part **(d)**.

Question 2

This question was the more successfully answered of the two comprehension questions.

(a) Most candidates knew what a food preservative is, and realised that salt also affects the taste food.

(b) This part required candidates to extract the required health conditions from the article, and most did this.

(c) A number of candidates did not realise that it was about 'hidden salt' in processed foods, as they clearly did not register the fact that they had to find a source of salt other than that added to food at the table and in cooking.

(d) Most could suggest at least one reason why people did not attempt to reduce their total salt intake, with 'like the taste' being the most popular.

(e) Many correctly calculated the amount of salt in Sam's food. Most could suggest and alternative to reduce the salt, the most popular being to replace the pizza with baked potato, or reduce the amount of hamburger or chips eaten.

(f) A minority of candidates were able to calculate the amount of salt in the peanuts.

Question 3

(a) Many candidates did not realise the question was asking them to describe how the experiment would have been done, and tried instead to explain what the results implied.

(b) Many candidates could identify one of the variables from the list provided which needed to be controlled.

(c) Most candidates were able to calculate the percentage of seedlings that die in the last pot.

(d) A significant number of candidates omitted one or both of parts **(i)** and **(ii)** of this question. Some tried to answer the two parts in reverse order, explaining where they should have described and describing where they should have explained – see the general comments about these terms.

(e) Only the best candidates realised that measurement of the height of surviving seedlings would provide extra scientific evidence for the conclusion reached earlier, namely that you would expect taller plants in the pots where they were less crowded.

Question 4

This question was the least well answered of the three experimentation and data analysis questions.

(a) Most candidates were able to read the scales on the graduated tubes, but only a minority could calculate the percentage of oxygen in the air from the data provided.

(b) Many did not read the instructions here: part **(i)** asked for a change to the apparatus used, not to the procedure. It was clear that many could not interpret the traditional sectional diagrams used and could not visualise a 50 cm^3 tube with graduations marked, even when they had no trouble reading the scales in **(a)**. Good answers referred to needing a finer scale, i.e. more graduations per cm^3.

(c) Most candidates did not understand what was being asked, but the best did realise that repeating readings, eliminating outliers and obtaining the mean would give a better estimate.

Question 5

This question was the most successfully answered of the three experimentation and data analysis qu

(a) Most candidates found this part very straightforward.

(b) The plotting and drawing of a best-fit curve in this part was done well by the majority of candidates. For those few who had the wrong value in **(a)**, plotting their own results was acceptable, with the proviso that the best-fit curve should be smooth.

(c) Almost all candidates could obtain the answer to the depth of water for an intensity of 25 from their graph by interpolation.

(d) This part was also very straightforward.

(e) Many were able to describe the graph in simple terms, although again quite a number tried to explain the behaviour, which was not what was asked, but almost all stopped after stating that the 'intensity drops as the depth goes up', with very few then attempting to describe the non-linear way in which it dropped, e.g. 'it drops sharply to start with, but then starts to level out'.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/06

Case Study

Introduction

The majority of Centres provided a suitable stimulus for their candidates so that a range of Case Studies were presented and in many cases adapted to reflect the local environment and so encourage ownership and interest on the part of candidates. 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, B and D have improved.

Strand C is still generally the weakest area of the assessment. Candidates often gather and report suitable information from a variety of sources but do not generally analyse, compare and evaluate the claims, opinions and scientific evidence. More individual input is required if the highest marks are to be awarded for Strand C.

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.
- Details should be included about how each of the tasks used for assessment have been introduced and presented to candidates.
- Candidates' work in the sample should be annotated showing where and why the marks were awarded.
- If appropriate, details of internal standardisation procedures should be described.

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 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 t 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 and Strands B and C should be considered together when awarding the final marks for each.

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.

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. 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 und f IaS to produce a balanced and informed account. It is this latter aspect which many candidates most difficult.

Some typical Case Study titles are

Are mobile phones a risk to health?
What killed the dinosaurs?
Is global warming due to human or natural causes?
Is nuclear power the answer for our future energy needs?
Should genetic modification be allowed?
Is sunbathing good for your health?
Is organic food healthier for us?

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 one mark will be allowed, unless annotation confirms that a suitable range of sources were used. To meet the three 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 four 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 if no references are given then zero marks should be awarded. For three marks candidates must include a number of 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 four 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 quotations including details of the author as well as the institution.

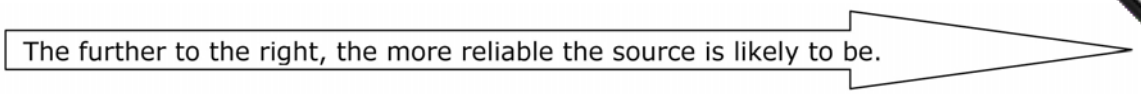
Strand B: quality of understanding of the Case.

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 six marks requires all that is available in the candidate book. The seventh or eighth 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 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. data from research studies, a collection, survey or review of existing data, a computer simulation, etc. Candidates obtaining seven or eight 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 f sources and data.

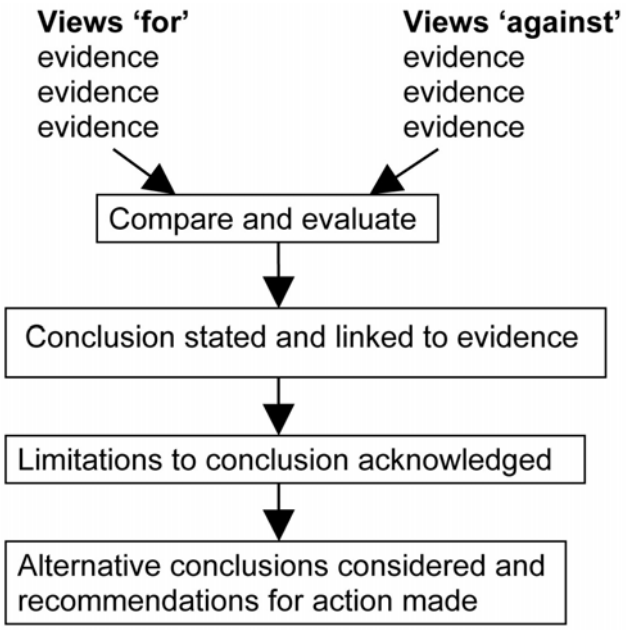


Publication	Website or newsletter of a private individual or a fringe group	Respectable pressure group website or newsletter	'Quality' media e.g. BBC, *The Times, The Independent, The Guardian, Daily Mail*	School textbook or science magazine e.g. New Scientist, Focus, Catalyst.	Peer reviewed science 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	An scientific institute or company that represents particular views only	An 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 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 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 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 three 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.

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 are 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 illustrations, e.g. charts, tables, graphs, or schematic diagrams and four 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.