TWENTY FIRST CENTURY SCIENCE

Paper 0608/01
Multiple Choice (Core)

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

General comments

Questions testing direct recall of knowledge were generally well answered.

Questions answered well

Candidates answered questions well relating to:

- galaxies and stars (**Question 13**)
- vaccination against viruses (**Question 18**)
- lifestyle factors that cause heart disease (**Question 19**)
- life cycle assessments (**Question 20**)
- properties of plastics (**Question 21**)
- correlation and cause (**Question 24**)
- hazards of ultraviolet radiation (**Question 25**).

Questions that proved difficult

Question 5

Candidates did not know whether differences between clones were caused by environmental or genetic factors or both.

Question 9

Two correct ideas were needed for this answer (1 and 3, option **B**). Most candidates correctly identified that cycling to work would reduce the carbon dioxide produced by an individual (hence selecting **A**), however, option 3, insulating the hot water tank, is also correct but was not identified by many candidates.

Question 15

Candidates found it very difficult to identify the factor in the correlation.

Question 27

There was an even spread of choices for this question about microwave and ultraviolet radiation, suggesting that candidates misunderstood the differences between them.

Question 28

About half of the candidates answered incorrectly that intensity of radiation increases with distance (option **B**).

TWENTY FIRST CENTURY SCIENCE

Paper 0608/02
Multiple Choice (Extended)

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

General comments

The extension paper showed a range of credit awarded to candidates. Candidates who are likely to achieve low credit should be advised to enter the core paper.

Questions testing direct recall of knowledge were well answered.

Questions answered well

Candidates answered questions well relating to:

- ideas about science (**Questions 3**, **4** and **15**)
- representations of molecules (**Question 6**)
- the atmosphere (**Question 7**)
- combustion reactions (**Question 8**)
- Wegener's theory (**Question 13**)

- immunity (**Question 18**)
- interpretation of graphs (**Question 20**)
- polymer disposal (**Question 21**)
- food webs (**Question 29**)
- diet and lifestyle (**Question 37**).

In addition, almost all candidates answered some questions correctly:

- risk and benefits of vaccination (**Question 16**)
- viruses (**Question 17**).

Questions that proved difficult

Question 9

Most candidates did not realise that insulating the hot water tank would lower an individual's contribution to carbon dioxide levels.

Question 11

Candidates chose several answers with equal frequency, indicating a misunderstanding between fission and fusion and where they occur.

Question 23

Many candidates thought that hydrocarbons contained oxygen atoms.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/03

Paper 3 (Core Written)

General comments

All questions appeared accessible for the majority of candidates and there was no indication that candidates were short of time. **Questions 3**, **4** and **5** proved to be more accessible to candidates, with **Questions 1**, **2** and **7** causing more difficulties. In general, those questions requiring candidates to use recall skills were less well answered than in previous sessions. However, those questions requiring analysis and evaluation of the information provided or use of the Ideas about Science were answered better than in previous sessions. There was some credit lost owing to candidates not reading the rubric carefully enough or not showing their working in calculations. The standard of written English was excellent.

Comments on specific questions

Question 1

(a) Some candidates were able to correctly name the cells that fertilise a woman's egg cells as sperm cells. The most common incorrect responses were 'embryo' and 'ovum'. A few candidates gave the answer 'sex cells' but this could only be credited if it was clear that these were male sex cells.

(b) Most candidates were able to refer to the diagram as instructed, but fewer were able to correctly identify the idea that not all embryos will develop into a baby. A significant number of candidates thought that if the embryo had a genetic disease it might lead to the process being unsuccessful.

(c) (i) Very few candidates appreciated that Lee and Margaret's baby would have a high chance of having cystic fibrosis if they are both carriers, and that embryo selection would enable an embryo without the disease to be selected.

(ii) Candidates were confident in suggesting ethical reasons why the process should never be carried out. Most of the answers referred to the rights of the embryo as a human being or that the process is unnatural.

Question 2

(a) (i) Only a few candidates were able to label the two blood vessels correctly. It was more common to see the term 'artery' than 'vein' although not necessarily applied to the correct diagram. Candidates seemed unfamiliar with diagrams of this type. A significant number of candidates did not make any attempt at this question.

(ii) Fewer candidates were able to correctly select a feature of the artery and then relate that feature to the function of the blood vessel. Some candidates identified the narrow lumen but it was much more common to see references to the vessel carrying blood with no scientific detail about how its structure helps it to do this. Again, a significant number of candidates did not make any attempt at this question.

(b) (i) The majority of candidates were able to identify that the blockage was most likely to be fat.

(ii) Many candidates made reference to the blood not being able to flow to the heart but this was not enough to be awarded credit. Many responses were imprecise or poorly expressed. Candidates needed to be more specific and were required to identify that oxygen would not reach the heart. This would then lead to the heart tissue dying. A few candidates described how the fat deposit is likely to have got into the blood vessel which was not relevant to this question.

(c) (i) A large number of candidates were able to identify the factor and the outcome in the [illegible]t seemed that candidates were much more confident about this 'Ideas about Science' qu[illegible] in previous sessions.

(ii) The majority of candidates were able to correctly identify another lifestyle factor that would be li[illegible] to increase the risk of heart disease.

(iii) Candidates were much less confident about describing the correlation. It is important that candidates describe the direction of the correlation. The best format to use when describing a correlation is "As the factor (which should be named) increases, the outcome (which should be named) increases/decreases". Therefore, in this example, the correct answer could be expressed as "As the amount of smoking increases, the risk of heart disease increases". It is not correct to describe the correlation using the idea of cause. For example, "Smoking causes heart disease" is not a description of the correlation.

Question 3

(a) Almost all candidates were able to correctly complete the food web using the information in the question to help them.

(b) Most candidates were also able to correctly complete the table to show the effect various events would have on the population of the puffins. A few candidates made one error in the table but still managed to score partial credit here.

(c) (i) Again, most candidates recognised that a continued decline in the puffin numbers would most likely lead to them becoming extinct.

(ii) Fewer candidates were able to give an example of a species that is already extinct. The syllabus clearly states that candidates should be able to state an example of a modern extinction. Candidates need to be prepared for this type of question so that they have a few examples ready to quote in the exam.

Question 4

(a) (i) Almost every candidate correctly completed the gaps to describe the correlation here. Candidates were much more confident about completing the gaps to describe the correlation than they were describing the correlation in their own words in 2**(c)(iii)**.

(ii) Fewer candidates correctly used the term 'correlation' to describe the relationship.

(b) (i) Very few candidates could describe particulates as very small pieces of solid.

(ii) Following on from this, very few candidates could correctly describe how the particulates are produced. The best candidates identified that they are a product of incomplete combustion, when there is insufficient oxygen available.

(c) A larger number of candidates were correctly able to give examples of how particulate production could be reduced. The most popular answer was to encourage the use of public transport.

Question 5

(a) (i) This question was well answered by the majority of candidates and demonstrated that most candidates understand how to calculate a best estimate. Those candidates who did not gain full credit usually made transcription errors from the table to their calculations.

(ii) The majority of candidates correctly identified the range.

(b) This question was poorly answered by many candidates. No credit was given for simply stating HDPE (which the majority of candidates did). The credit was for giving reasons behind the choice and very few candidates could clearly explain their choice. A significant number of candidates made no reference to tensile strength despite that being the property of the material described in the question. The best candidates linked the property of tensile strength to the use of the rope, and explained how a high tensile strength would mean that the rope was less likely to break.

(c) Candidates still find it very difficult to correctly name the type of reaction that occurs wh molecules are joined together to make long chains as polymerisation.

Question 6

(a) Some candidates answered this correctly although no credit could be given to those candidates who stated that the chemicals were added to colour the food. This information was given in the question. The majority of credit was awarded to those candidates who explained that the colouring would make the food more attractive to eat.

(b) A significant number of candidates spotted the pattern and recognised that the natural colourings do not cause hyperactivity or vice versa. These responses were awarded half credit. Far fewer candidates also stated the names of a natural colouring to show that they could interpret the data in the table.

(c) The majority of candidates suggested that individuals are likely to look at the labels on the foods to identify which are the better ones to eat to reduce hyperactivity. Far fewer candidates were able to describe a way in which the government might act. It seems that very few candidates were familiar with the idea of risk assessments.

Question 7

(a) This question was quite poorly answered by candidates. The most common error was to label the darker grey area as the mantle and the pale grey as the crust. Alternatively, a few candidates labelled the crust and the mantle the wrong way round.

(b) (i) A few candidates were able to describe the jigsaw fit of the continents or the similar fossils, but only a small number of candidates scored credit here. Most candidates made reference to continental drift or tried to describe how the movement might occur.

(ii) Few candidates correctly answered this question. Most answers were imprecise with some reference to his ideas not being correct or just a repeat of the question describing how other scientists at the time did not believe him. A few of the best candidates recognised that there was no mechanism to support Wegener's ideas at the time.

(c) (i) A large number of candidates selected the correct range of magnitude from the table, or suggested a value within that range. A few incorrectly selected the magnitude 4.0 to 4.9.

(ii) A number of candidates spotted the pattern in the data. However, they then failed to explain why you would expect there to be more than 10 earthquakes. Equally a number of candidates stated that they would expect 13 earthquakes to occur, but failed to describe the pattern in the data that helped them to calculate this. Only very few candidates did both of these things and scored full credit. Candidates should be reminded to use the amount of available credit in a question to guide the level of detail in their answer.

Question 8

(a) Most candidates correctly completed the first blank space with 'electromagnetic'. However, photons were commonly confused with electrons in the second blank space and so few candidates scored full credit here.

(b) (i) The majority of answers to this question were imprecise and failed to use the correct scientific terms as requested. Most answers simply described that the microwaves heat the food without giving any details about absorption or vibration of molecules.

(ii) Few candidates referred to the metal nature of the walls or specifically to the door screen. A number of responses talked about the door closing tightly and the glass window in the door protecting the user.

(c) This question was generally well answered with candidates able to describe the ben associated with giving a child a mobile phone. More candidates were able to describe a benefit. A few candidates approached this question in the wrong context and desc benefits and risk of using a mobile phone generally. This did not necessarily gain any Candidates will only obtain full credit in these types of questions when they give a balan argument between the benefits and the risks.

Question 9

(a) A large number of candidates did not make any attempt at this question and very few candidates were able to describe how the experiment would be carried out. Very few candidates appreciated that the radiation given out would be measured by counts on a radiation detector.

(b) (i) Almost every candidate selected **B** here, showing that they are able to correctly interpret the data.

(ii) Similarly, almost every candidate correctly selected **C** here.

(c) A few candidates recognised that the 'benefit outweighs the risk' and this scored full credit. A significant number of candidates identified that her cancer could be cured (which is a huge benefit) but fewer candidates described the risk of damage to the cells as comparatively small.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/04
Paper 4 (Extended Written)

General comments

More able candidates were able to show knowledge and understanding in a number of areas of the syllabus, but less able candidates showed an incomplete knowledge of key concepts. Many candidates showed difficulty in understanding what was required by the question. Interpretation of simple data was good, but more complex data proved to be challenging for many candidates. Simple calculations were also well answered, but few candidates performed well with more complex ones. Many of the 'Ideas About Science' concepts were not well understood. Candidates had sufficient time to complete the paper, and few left blank spaces.

Comments on specific questions

Question 1

Interpretation of the information given allowed candidates to gain credit.

(a) Most candidates correctly answered that the synthetic food colourings caused hyperactivity but those from natural sources did not. Some less able candidates based their answers on the colours rather than the sources of the additives.

(b) (i) The precautionary principle was understood by only a few of the more able candidates. Most wrote about actions the government could take and did not gain credit.

(ii) Though many candidates correctly answered that tests were made on food additives, few mentioned risk assessment or that safe levels in food were determined.

Question 2

Interpretation of data was better than use of knowledge and understanding.

(a) Most candidates showed that there was a correlation and many could describe it accurately.

(b) The more able candidates wrote about the need for a causal link. Many correctly stated that the data did not include information about particulates.

(c) Most candidates gave good answers based on use of public transport, walking or cycling, car sharing, better engine design, etc. A number suggested fitting a catalytic converter which does not have any effect on the number of particulates produced.

Question 3

The more able candidates showed good knowledge and understanding of polymer chemistry.

(a) (i) Though most candidates calculated a mean as the best estimate, only the more able candidates omitted the outlier. Many did not follow the rubric to give their answer to the nearest kPa.

(ii) The most able knew that real difference is shown when the mean of one set of data lies outside the range of the other set of data.

(b) Most candidates correctly chose HDPE though fewer gave a satisfactory reason.

(c) (i) The more able knew that the difference in properties could also be caused by longer ... or more cross-linking.

(ii) In this part, candidates were asked to use ideas of force and energy. Many candidates put terms into incorrect sentences and some did not use the terms at all. The more able candida... realised that with stronger forces between molecules it would take more energy to separate them. Some candidates did not make clear that the forces in question are between molecules rather than between the atoms in molecules.

Question 4

Interpretation of data was performed well, but many candidates did not understand some of the terms used in the questions.

(a) Most candidates put the organisms in the correct boxes, but few put arrows pointing in the correct direction between each box.

(b) Few candidates presented answers to both parts sufficient to gain credit. The most common error was to transpose the correct answers for interspecific and intraspecific competition. Other candidates gave a similar answer to both parts or named the correct predator species but did not name their prey.

(c) A large majority of candidates gained full credit.

Question 5

Candidates' knowledge of blood vessels was incomplete in this question.

(a) The most able candidates were able to match the structure of the blood vessels to their function. Many could not identify which was an artery and which was a vein. A number thought the valves in the vein were blockages or designed to filter the blood.

(b) Many correctly answered that the blockage would prevent flow of blood but few related this to a lack of oxygen and subsequent death of heart muscle. Weaker candidates answered that blockages made it more difficult to pump blood around the body.

(c) (i) The more able candidates could describe this correlation, but many did not use correct wording.

(ii) The most common correct answers were the idea that not all smokers will get cancer and that other factors cause cancer. Few candidates presented both ideas.

Question 6

Few candidates seemed to have sound knowledge of PGD, but most could present a moral or ethical argument.

(a) Most candidates thought that PGD involved removing a whole embryo or some of the tissue of an embryo from a woman. Only the most able mentioned removal of egg cells and subsequent in vitro fertilisation. Though many candidates realised that embryos were tested, few knew how or what for. The idea of only implanting the healthy embryos was seen more often, but many candidates suggested that unhealthy embryos should be aborted.

(b) Many candidates realised the relatively high risk that an embryo could inherit the problem, but most incorrectly thought that the test would be carried out on a baby in the womb which could then be terminated.

(c) (i) Most candidates gave answers based on moral, ethical or religious ideas rather than the probable effect of imbalance of gender in the population.

(ii) Again, answers to this part were mostly based on moral, ethical or religious ideas.

Question 7

Only the more able candidates showed knowledge of microwave properties.

(a) (i) The more able candidates knew that food absorbs microwaves which cause molecules to vibr and so heat the food. Less able candidates simply described how to use a microwave oven.

(ii) The more able candidates identified metal wall or door mesh as preventing the escape of microwaves. Less able candidates answered that closing the door was enough or that glass stops the passage of microwaves.

(b) Many candidates could present a sound argument for young children using a mobile phone, commonly for emergencies, but fewer could say why they should not. Ideas of susceptible developing brains were infrequently given.

Question 8

Many candidates had a good knowledge and understanding of Wegener's ideas, but few understood what the magnetic stripe diagram showed.

(a) (i) A large majority of candidates gave a correct piece of evidence.

(ii) Most candidates gave a good reason why Wegener's ideas were not accepted at first.

(b) (i) The most able candidates understood what the diagram showed and could present an explanation for the pattern.

(ii) Many candidates realised that this provides a mechanism for continental drift.

(c) (i) Only a few candidates correctly chose 4.0–4.9 or any value between these to gain credit. The most common incorrect answer was 3.0–3.9.

(ii) The most able candidates answered that the data showed fluctuation from year to year and that this did not show a clear pattern of increase across the years.

Question 9

The calculation was performed well but few candidates showed sound knowledge of radiation.

(a) Very few candidates described how to carry out this experiment or how the results would show that this was beta radiation.

(b) Only a few of the most able candidates correctly labelled the **Key**. Other candidates gave labels such as oxygen, carbon and hydrogen.

(c) (i) Few candidates gave the origin of background radiation.

(ii) The majority of candidates correctly marked the half-life of helium-6 on the graph and worked out the value as 0.8 seconds.

(iii) The more able candidates calculated the activity after 4 seconds to be 400 counts per second. A small number of candidates showed that this is 5 half-lives or 100 times more than the previous example.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/05

Paper 5 (Analysis and Interpretation)

General comments

In this session, the candidates were well prepared to answer questions tackling assessment objectives 2 (in **Section A**) and 3 (in **Section B**). Less successful candidates attempted, particularly in **Section B**, to write what they could recall about the topic areas from which the questions were drawn, but responses of this type were far less frequent than in previous sessions. All questions were done well, with a slightly lower score in **Question 4** than the others, possibly as it was the last question in the paper.

To ensure continued success next year, Centres should ensure that candidates read the 'command words' in each question carefully. In this paper, many candidates answered, not the question that was asked, but one that they had anticipated. This usually meant that they **described** a situation when they were required to **explain** it.

It is important also to remember that the emphasis in **Section A** is a test of scientific comprehension of the science in the article(s) provided, while **Section B** questions concern scientific procedures and the analysis of data. In particular, in **Section B**, candidates need to read instruments and scales, and to suggest apparatus and techniques that could be used. They should be able to identify the variables which must be controlled, the factor which is being changed (the independent variable) and the way measurements are made upon the factor which changes as a consequence (the dependent variable). In analysing the results, candidates need to be able to find best estimates from repeated values (which may or may not contain outliers) and to process data graphically.

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

Comments on specific questions

Question 1

Comprehension question on the article 'Are electric cars the answer?'

(a) Most candidates could read from the graph and offer a reasonable value for extrapolation, but few could explain why they chosen their extrapolated value either in terms of the variability in the data or in terms of a possibly factor that could change the outcome.

(b) This part, requiring explanations of how the carbon monoxide and particulate carbon are produced and why they are harmful, was less well done by candidates.

(c) A large number of candidates completed both equations correctly, but a number of candidates did not know what the terms 'word equation' and 'symbol equation' meant.

(d) The nature and effect of sulfur dioxide was generally well understood, but in part **(i)** weaker candidates did not appreciate that 'direct' meant an effect upon humans, whereas 'indirect' meant an effect on the environment.

(e) Most candidates scored well in this question and showed appreciation of the reason why air pollution is particular problem in city centres and why electric cars often just move the pollution out to fossil-fuel burning power stations.

(f) A number of candidates provided suggestions why people in the countryside did n cars which were clearly applicable to their own country rather than the worldwide data i but this was acceptable.

(g) Some candidates did not realise that this question was asking for power stations which did not b carbon-based fuels, but most scored well on this part.

Question 2

Comparing antibiotics

Most candidates had no difficulty in interpreting the diagram in this question although a number failed to read the diameter of the clear circle correctly. In part **(b)**, a number thought the 24 hours was needed for the bacteria to grow, rather than for the antibiotic to kill them. Parts **(c)** and **(d)** were well answered, but in **(e)** only the strongest candidates could explain the advantages of a water control.

Question 3

Absorption of beta radiation

Candidates had no difficulty in handling the data in part **(c)**, but in part **(b)** many were unfamiliar with the type of radioactive source used in Centres and attempted answers based on industrial procedures for reducing risk. These were generally credited. To say that protective clothing should be worn was allowed, but the remaining credit could not be gained without reference to absorption of beta radiation. In part **(d)**, the interpretation of the data table was partially done by almost all candidates. Few failed to notice that an increasing number of sheets of aluminium produced a continuing reduction in the amount of radiation penetrating to the detector, but few observed the rapid fall off at the beginning and the levelling out later. Many could describe how to allow for the background radiation in the count in part **(f)**, although some suggested a further experiment rather than just subtracting two from each reading made per second.

Question 4

Measuring nitrogen dioxide

Finding the mean in part **(a)** was well done, although part **(b)** did discriminate well between candidates. Many did not label the *x*-axis of the graph with the variable and units needed (from the table), and although most could plot the points accurately, there were many instances of a best-fit straight line not being drawn correctly. Candidates could almost all use the graph to interpolate the value of nitrogen dioxide at a distance of 5 m from the road, but many lost credit at the end by not continuing the graph back to the *y*-axis to extrapolate the value representing the edge of the road.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/06

Paper 6 (Case Study)

Introduction

This session some interesting and high standard work was submitted. Most Centres provided a suitable stimulus for their candidates so that a range of Case Studies were presented and often 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 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.
- Candidates' work should be fastened in the left-hand corner.
- 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 the stra
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 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' or 'technical feasibility and values' it is easier to match the performance descriptions of the criteria and gain higher credit.

Case Studies are always best formulated in terms of a question to provide a focus in an area o For example, 'Does air pollution cause asthma?' rather than just 'Asthma'. A question will candidates to look for different opinions and views, and to consider the evidence on which they a and the reliability of sources. The Case Study is not a report on a topic but a critical analysis controversial issue. Some topics are so uncontroversial that there are no valid opposing views. The 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. It is this latter aspect which many candidates found the most difficult.

Some typical Case Study titles are

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

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 1 mark should be awarded and if no references are given then zero marks should be awarded. For 3 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 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 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 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 rele content and data in their sources. Candidates who were awarded 6 marks referred to the evide the various claims and opinions, e.g. data from research studies, a collection, survey or review o data, a computer simulation, etc. Candidates obtaining 7 or 8 marks look more critically at the quality evidence. They used terms like 'reliability' and 'accuracy' when considering data, they looked at the des 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.

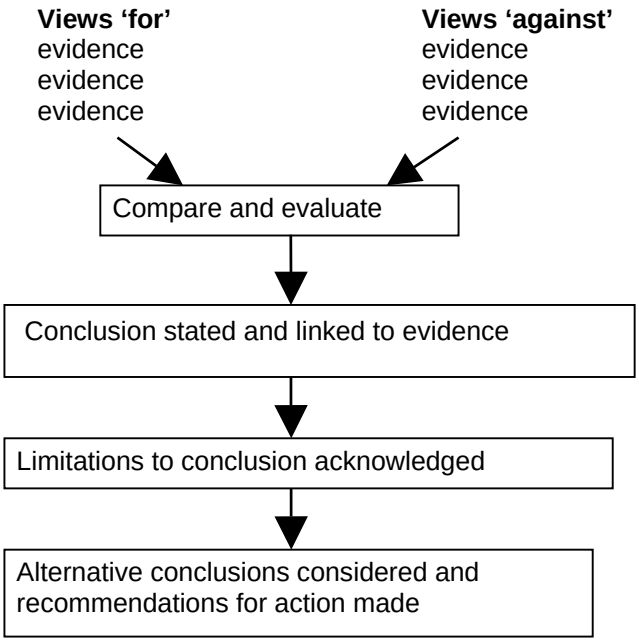
The further to the right, the more reliable the source is likely to be.

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 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.

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 1 mark is appropriate. 2 marks would be awarded for the inclusion of decorative images only or perhaps for the minimal use of informative images. 3 marks would be given for including a variety of informative illustrations, 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.