TWENTY FIRST CENTURY SCIENCE

Paper 0608/01

Multiple Choice

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

The answers given by the candidates showed a spread of ability. The paper gave a spread of marks, with a lowest score of 18 and a highest of 24. There was a relatively small entry for the core paper.

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

- bacteria (1 and 2)
- photosynthesis (17)
- interpretation of information about radioactivity (18)
- species competition (22)
- two dimensional representations of molecules (29)

In addition, all candidates answered some questions correctly. Specifically

- food chains (4)
- plasticisers (12)
- chemicals from crude oil (28)

Questions that proved difficult

Question 8

Most of the candidates thought that carbon particles were a gas and opted for key **(D)**. Carbon particles settle on buildings.

Question 9

Most candidates did not know that carbon monoxide forms due to incomplete combustion. Many thought it originated from fuel impurities.

Question 11

Many candidates forgot to exclude the outlier when calculating the best estimate and so chose the incorrect distracter **(D)** as the correct answer.

Question 20

Many candidates did not know that light is electromagnetic radiation. Most chose the distracters saying either that it was ionising or that it was a type of microwave.

Question 26

Some candidates thought that effectors were the ears, implying confusion between receptors and effectors.

Question 27

Many candidates did not recognise sweat as a natural chemical on the skin responsible for destroying bacteria.

Question 32

The key idea here was that Eve was assessing the risk of eating Krunchy Crisps. Some chose the distracter that suggested other factors in Eve's life – while these may have an effect on Eve's health, they do not help her assess the direct risk of eating the crisps.

Question 37

Most chose **(D)** which is a correct statement about microwaves. The question asked candidates to identify an **incorrect** statement.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/02

Multiple Choice

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

The answers given by the candidates showed a spread of ability. The paper differentiated well, with a lowest score of 16 and a highest of 36. There was a relatively small entry for the extended paper.

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

- natural selection (1 and 2).
- defence against infection (5)
- crude oil products (6)
- molecular two dimensional representations (7 and 8)
- interpretation of data (9)
- factual knowledge about microwaves (14)

- cloning (17)
- linked ideas about drugs trials (23 and 24).
- correlations in data (25)
- continental drift (38 and 39).

In addition, all candidates answered some questions correctly. Specifically

- cell structure (18)
- double blind tests (20)
- the precautionary principle (32)

Questions that proved difficult

Question 10

The key idea here was that Eve was assessing the risk of eating Krunchy Crisps. Some chose the distracter that suggested other factors in Eve's life – while these may have an effect on Eve's health, they do not help her assess the direct risk of eating the crisps.

Question 11

Many candidates chose the incorrect response B. The correct answer was D, which explains that individuals do not always behave according to a correlation which applies to many people.

Question 19

Most candidates thought genetic material was made from protein. The correct response to the question was DNA.

Question 37

This question had a very low facility. Candidates needed to interpret the graph to work out background radiation. This proved difficult for many candidates.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/03
Written

General comments

The entry remains small for this examination. The total raw marks this year covered a very narrow range. Most candidates showed a good understanding of the science content of the syllabus and also of the application of Ideas about Science. The more successful candidates showed clear understanding of exactly what each question was trying to assess, while less successful candidates did not read the instructions clearly. Overall, candidates were more successful in the Biology questions than in the Chemistry or Physics questions.

Comments on Specific Questions

Question 1

This question was reasonably well answered.

(a) Few candidates knew, or could explain, the symptoms of sickle cell anaemia.

(b) Some candidates knew that a person with a condition caused by a recessive allele must have both recessive alleles, but most could interpret the family tree and complete the Punnett square (genetic diagram).

(c) Most candidates successfully suggested why people might want to be tested for a genetic condition in **(i)**, but few could suggest a reason for not wanting to be tested in **(ii)** (e.g. possible difficulty in obtaining a job, or insurance cover, or just simply not wanting to know about a worrying possibility).

Question 2

This was the best answered question on the paper.

(a) Most candidates correctly gave antibiotics as the answer.

(b) Most candidates also gave suitable reasons for testing new drugs.

(c) Most candidates were awarded at least partial credit for the sequencing exercise.

Question 3

This proved the most difficult question on the paper.

(a) Few candidates recognised that hydrocarbons cannot contain chlorine atoms.

(b) The explanation of polymerisation was confused or left blank for most.

(c) Most candidates could identify one but not two of the materials that are not made from living things.

(d) Plasticisers were not known in **(i)** although some did recognise that PVC window frames did need to be rigid in **(ii)**.

Question 4

This question was well answered.

(a)

(i) About half the candidates realised that the simple molecules which were the precursors of life must have been able to reproduce.

(ii) A similar number could also identify at least one of the sources of evidence for evolution.

(iii) The meaning of 'extinct' was clearly explained.

(b)

(i) All could identify Lamarck's explanation of the giraffe's long neck.

(ii) Nearly all could identify a statement containing data.

(iii) Very few candidates could pick out the statement in Lamarck's theory which was also applicable to Darwin's theory.

Question 5

Most candidates found this question difficult.

(a) Most candidates could identify the outlier.

(b)

(i) Most candidates could not explain why repeating readings gave a more reliable best estimate.

(ii) Most candidates did not realise that this question was asking why the readings at one particular location varied (i.e. conditions there were varying with time).

(iii) The best estimate calculation was successfully attempted by most candidates.

(c) The eventual fate of particulates in the air (they settle out) was not known.

Question 6

This was well tackled by most, with most aware of the nature of a balanced diet and able to suggest features of the faulty diet contributing to obesity in **(a)**. Diseases linked to adult obesity in **(b)** were known by most.

Question 7

This question was reasonably well tacked.

(a)

(i) Most candidates knew what was meant by *continental drift.*

(ii) The evidence supporting Wegener's theory was not well known.

(iii) Few candidates could suggest the reluctance of contemporary geologists to accept Wegener's theory.

(b)

(i) Most candidates knew where earthquakes were most likely to occur.

(ii) Most candidates understood the need for stronger buildings in an earthquake zone.

Question 8

This question was found difficult by all but the most successful.

(a) Identifying photosynthesis **(i)** and respiration **(ii)** in the simplified carbon cycle proved to be difficult.

(b) Candidates also had difficulty with using the cycle to explain the constant level of carbon dioxide in the atmosphere prior to recent global increases.

(c) Most candidates could explain *correlation*.

(d) Most candidates gave an example of a human activity that was not detailed enough, e.g. 'use of cars'. For credit to be awarded, 'burning petrol/gasoline/diesel in cars' was needed.

Question 9

This question was well tackled.

(a) Nearly all candidates could interpret the bar chart correctly, but could not suggest reasons for the increased dose received by the heart compared with the lung in a scan in **(iv)**.

(b) The advantage of having a scan (accurate diagnosis of a potentially fatal condition) was recognised by nearly all, but few weighed the irradiation risk against this: an ideal answer would have been, 'The benefit of accurate diagnosis for this serious condition outweighs the slight risk from radiation.'.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/04
Extended Written

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 4** and **8** proved to be more accessible to candidates with **Questions 2** and **5** causing more difficulties. However, the most able candidates appeared to be equally well prepared for all questions. In general, it is still the case that those questions requiring candidates to use recall skills were better answered than those requiring analysis and evaluation of information provided. However, there was a significant improvement in the quality of responses given to Ideas About Science questions compared to previous sessions. The standard of written English was very good.

Comments on specific questions

Question 1

(a)

(i) Most candidates were able to recognise that it is possible to calculate a mean value if several measurements are taken and that this leads to a more reliable best estimate. Some candidates were also able to recognise that outliers can be identified and removed before the mean is calculated. It was pleasing to see the use of the term 'outlier' and candidates should be encouraged to use that term rather than talking about 'odd' or anomalous results.

(ii) Equally most candidates were able to correctly calculate the mean value. Some candidates did not remove the outlier and so instead calculated a mean value of 5.7 and were awarded partial credit for the correct method. Candidates need to be taught to look carefully at data given so they can check if there are outliers that need to be ignored before carrying out any calculations. It is also advised that candidates show all of their working when carrying out calculations.

(b)

(i) Some of the most able candidates were aware of the term 'real difference' but fewer were able to clearly explain why there was a real difference between the two data sets in this example. Candidates need to look at whether the mean of one set of data lies within the range of the second set of data. In this case, the mean of the city centre road is 5 which lies outside of the range of the country road (1-3). Therefore there is a real difference between the two sets of data. Equally candidates could have looked at the mean of the country road (2) and recognised that it lies outside of the range of the city centre (4-9).

(ii) Very few candidates were able to identify that it is important to obtain similar results in order to increase the reliability of results and conclusions.

(c) This was a difficult question and, although many candidates made an attempt, few were awarded full credit. In questions of this type, it is important for candidates to read the text surrounding the equations as this text often gives information about the equation they are required to write. For example, in this case, the text tells the candidates that the products are carbon monoxide, carbon and water and candidates could achieve partial credit for writing the correct formulae of these products even if they were then unable to balance the equation.

Question 2

(a) There were many varied descriptions of polymerisation seen here. Most candidates understood the process but far fewer were able to clearly explain what happens during the process. It was very common to see descriptions of small molecules becoming longer without describing the fact that the small molecules are joined together to form the larger molecule. Candidates would do well to learn the definition of polymerisation as 'many small molecules joining together to become one longer molecule' so that they can answer questions of this type in the future.

(b) This question was asking candidates to identify and draw the single unit (monomer) of the polymer PVC. It was expected that they would use the diagram to help them and some clearly did as there were some good answers seen. The commonest error was to only have a single bond joining the two carbon atoms in the molecule.

(c) It is very important that candidates understand and can explain the difference between bonds within chains and the forces of attraction between the chains. This question allowed candidates to demonstrate their understanding of how the addition of a plasticiser affects the forces between the polymer chains. Many candidates talked instead about there being weaker bonds in the chains which is not correct. The plasticizer gets between the molecules of polymer and reduces the forces of attraction between the chains. It is far better to use the term 'forces of attraction' than 'bonds' in this case.

(d) Candidates found this question difficult and there did not seem to be a very clear understanding of the idea of Life Cycle Assessment. Candidates were sometimes able to recognise that there would be differences in how the items are made or disposed of, but far fewer candidates could properly explain their examples. Some candidates gave two examples but no explanation. It is quite common on these papers to see questions where candidates are asked to 'suggest **and** explain' and candidates need to be taught to realise that two suggestions will not be enough to achieve full credit.

Question 3

(a) This question was well answered with all candidates being able to give at least one example of a food type that may be helping to cause obesity.

(b) There were a large number of responses seen here where it was clear the candidates had the right idea but they did not talk explicitly about risk and consequence as the question asked. If candidates are given guidance in the question about the points they should include in their answers then it is always a good idea to follow that guidance. Some more able candidates talked about the risk of choosing a diet that might cause obesity but it was rare to see any description of what consequences this might have.

(c) There were some very good answers which gave two clear reasons why people remain obese and take the risk of getting heart disease. The most common reason given was that people would not think it will happen to them. Some candidates incorrectly talked about other risk factors such as exercise and smoking and how by doing more exercise and/or not smoking, it would counter the fact that the person was obese. This argument was not credited as candidates were expected to think about diet only.

Question 4

(a)

(i) This question was very well answered and most candidates were able to give two pieces of evidence to supported Wegener's theory.

(ii) Equally, candidates seemed to be well prepared for this question and most were able to identify that Wegener was not a geologist or that there was no mechanism for the movement that he described.

(b) Candidates clearly had some understanding of seafloor spreading and some were able to describe the rising of molten rock and how that forces the plates apart. Some of the most able candidates were then able to link this to the evidence for continental drift. Candidates performed reasonably well on this difficult question.

(c) Most candidates were able to describe at least one action that the government could take to prepare for earthquakes before they happen. A large number of candidates talked about evacuation but some seemed to think this would need to happen before the earthquake hit. This was not credited, as people cannot be moved out of the areas where earthquakes happen. Instead it is important to practise and plan evacuations should an earthquake occur.

Question 5

(a) This question expected candidates to describe what fossils are and then link them to evidence for evolution. Few candidates did both of these things. Some recognised that they could be dated and some recognised that they could show a sequence of changes but few stated that fossils actually show the features of living things which is of course the crucial point. Fossils effectively show us how some living things looked in the past and this can then be used to show how living things have potentially changed over time.

(b) The ideas discussed here were rather confused. Most candidates identified that living things vary but far fewer were then able to link this to the idea that when organisms are forced to compete with each other some of them are better adapted to survive. Instead, a large number of candidates incorrectly described how organisms adapted as a result of the competition. Equally, very few candidates went on to describe how the most successful organisms survive and then are able to pass on their alleles to their offspring.

(c) Few candidates correctly identified sentences 1 and 4. This was an example of a question where candidates were given new information about Lamarck and expected to compare it to their knowledge of Darwin. It was clear that many candidates found this difficult.

(d) This question was very similar to **Question 4(a)(ii)** and, as with that question, it was well answered with many candidates able to give one good reason why Darwin's ideas were not accepted. The most common reasons given were the lack of knowledge about DNA and genes (i.e. the lack of a mechanism) and the fact that the alternative views of creation by God were already very well established.

Question 6

(a) This question received some mixed responses. Some candidates followed the instructions carefully talking only about arrows **A** to **D** and therefore scored at least partial credit. A few candidates talked about the entire diagram which meant that they got quite confused and moved away from the focus of the question. Candidates were guided to using the arrows **A** to **D** only so that they could refer only to the two processes of respiration and photosynthesis and the fact that they were balanced. Any discussion about decay or feeding was therefore not credited.

(b) Most candidates described the burning of fossil fuels as the main activity that has caused an increase in carbon dioxide in the atmosphere. A few candidates talked about having more factories or driving more cars but did not link these activities to increased burning of fossil fuels and so the answers were not credited.

(c) The more able candidates did as the question asked and correctly used the terms correlation and cause. They described the correlation between the increase in the amount of carbon dioxide in the atmosphere and the increase in global temperatures but they also recognised that a correlation alone does not indicate a cause. To be certain that it is the increase in carbon dioxide causing the increase in temperature, there needs to be a proven mechanism as to how this is happening. This can also be called a causal link. Many candidates also recognised that there are other factors likely to be involved and were awarded credit for this.

Question 7

(a)

(i) Most candidates found this question difficult and struggled to identify the differences that there might be between the radiation used for a heart and a lung scan. This question was getting candidates to suggest ideas and did not rely on them having any knowledge about this.

(ii) A few candidates correctly calculated this answer. However, many candidates did not make any attempt at this question or did not really seem to know where to start. Candidates need to read the questions carefully as all the information they need for the calculation will be there. They should expect to be asked to calculate percentages or some other basic mathematical functions. Those that might be included in questions are listed in the specification.

(iii) This part of the question was well answered with most candidates recognising that, although there is a risk from the heart scan, it is very small and most people would happily take that risk in order to benefit from finding out whether there was anything wrong with their heart.

(b) Equally, most candidates were able to suggest one way that the hospital should protect Bina's health. Fewer were able to explain their suggestion which raises the same point mentioned earlier in **Question 2(d)**.

Question 8

(a)

(i) Some candidates correctly identified the chemicals as proteins. Some of the incorrect responses included chromosomes and DNA. A few candidates gave a correct function of a protein here instead of in **(a)(ii)** and unfortunately it could not be credited here.

(ii) Candidates needed to select a specific function of proteins to achieve credit here. A few identified the role of proteins as enzymes. Most candidates however described the function of genes in determining our appearance and giving us specific features, rather than specifically considering the proteins that are made from each gene.

(b) Most candidates were correctly able to complete the Punnett square and were awarded full credit. Some candidates incorrectly gave the father's genotype, but they could still obtain partial credit if they then went on to correctly fill in the Punnett square based on the genotype they had given. It was felt that all candidates were well prepared for questions of this type.

(c)

(i) Most candidates were able to identify that someone might want to be tested to find out if they carry the allele and therefore they can work out how likely it is that their children might have the disease passed onto them.

(ii) Some candidates recognised that people may not wish to know whether they have the allele and that there is no guarantee the outcome of the test is correct. Other candidates gave answers about it being 'wrong' but these answers could not be credited without further details about why it could be seen as wrong.

Question 9

(a) Most candidates were correctly able to sequence the stages: **C** (tests on human cells in a laboratory), **B** (tests on animals), **D** (tests on healthy human volunteers) and **A** (tests of humans with the illness).

(b) Similarly, most candidates were able to describe a double-blind trial recognising that neither the patient nor the doctor is aware of which people are being given the treatment and which are given the placebo. Fewer candidates explicitly described that there were two groups of people taking part in the trial.

(c) Most candidates described what a placebo is but they were not really able to explain why they are not used in human trials. This is because, in these sorts of trials, the people are often so ill that they are unlikely to get better by themselves. It is therefore felt unethical to give some of these patients a placebo that will not help them to get better when other patients are receiving a treatment that could help them. In cases like this, all patients tend to be given the treatment.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/05

Comprehension, Practical Procedures, Data Handling and Analysis

General comments

The first question required candidates to understand and interpret what they had read in the article. Where answers could be obtained directly from the article most candidates performed well. Where some additional knowledge or understanding was required only the more able could put together a coherent and relevant answer. In the ***Section B*** questions many candidates showed good knowledge and understanding of some parts of the syllabus. A smaller number demonstrated a breadth and depth of knowledge, together with an understanding of the key concepts in the syllabus. Those concepts involved with 'Ideas about science' were appreciated by only the most able. The practical application of ideas was poorly understood by the majority of candidates. Most were not aware of correct experimental design and did not appreciate issues to do with controlling variables and making conclusions.

Comments on Specific Questions

Question 1

Candidates scored well in questions that required information to be extracted from the article, but less well when some additional knowledge or understanding was required.

(a) Most candidates correctly identified the three gases. A common error amongst weaker candidates was to put nitrogen and oxygen in the wrong boxes.

(b)

(i) The majority of candidates correctly wrote sunlight in the first blank and organic in the third blank. Far fewer correctly wrote one of nitrogen dioxide, particulates or ozone in the second blank.

(ii) The article says that nitrogen and oxygen from the air react at high temperature in a car engine. Only a small number of candidates extracted this information. Even fewer went further than this to say that nitrogen monoxide was formed and that this, when released into the air, reacted with oxygen to produce nitrogen dioxide. Weaker candidates wrote long, rambling answers about smoke and car exhaust, gaining no credit. Many of these thought that the nitrogen involved in the reactions came from petrol rather than the air.

(iii) Very few candidates wrote a correct symbol equation. The more able often included N, O_2 and NO, but did not realise that nitrogen is diatomic. Many weaker candidates included other elements. Some tried to write a word equation rather than a symbol equation, or simply did not attempt the question.

(iv) Many candidates gained partial credit for the mention of acid rain. This information was given in the article. Only a few of the more able included details of the reaction of nitrogen dioxide with oxygen and water to form acid rain.

(c) Answers that suggested why the air, and therefore the smog, could not move away from the area gained credit. A common correct answer was that the hills prevented wind from blowing the smog away. Many candidates simply copied the sentence from the article about warm air preventing circulation or the sentence that mentions a build up of smog over densely populated cities. This did not answer the question and was not given credit.

(d)

(i) Almost all candidates correctly identified the three medical conditions mentioned in the article.

(ii) The article mentions two areas of research: one in Canada and the other in America. Most candidates correctly quoted one of these and many quoted both. Some mentioned the data for City C given in Table 2, which was accepted. A small but significant number simply stated that hospital admissions and respiratory deaths often increase during periods when smog levels are high, quoting from the text. This did not gain credit.

(e) Only the more able candidate could successfully complete the calculation. Many weaker candidates worked out answers that were well in excess of 100%.

(f)

(i) The fact that this value is an outlier was appreciated by most candidates. Those who did not gain credit here generally suggested the value was low or the lowest, but did not indicate that it was so low that it did not fit with the other values.

(ii) Most of the more able candidates correctly calculated the mean. Some candidates incorrectly missed out the value 48 in their calculations. This was the lowest value but clearly not an outlier.

(iii) Only the more able realised that the values were close together, showing their reliability. Some scored credit for pointing out that there were no outliers amongst the values.

(iv) This question required some knowledge of the concept of 'real difference'. Here there is no real difference between the sets of results for City A and City B since the mean of each set is a value included in the range of the other. Credit was given for those candidates who mentioned that the ranges overlap. Candidates who simply said the values or means were close to each other did not gain credit.

(v) Many candidates correctly stated that as the particulate level increases, the number of asthma deaths also increases. Weaker candidates often expressed their answer ambiguously. Some mentioned smog rather than particulates and incidence of asthma rather than deaths. In this question some precision of wording was necessary to gain credit. More able candidates realised that the trend is a correlation to gain further credit.

(vi) Very few candidates realised that the additional information required was a causal link between particulates and asthma. Many simply stated that particulates cause asthma. Some tried to explain why. Suggestions that more data or data from other cities was required were not relevant to the question, and gained no credit.

Question 2

Few candidates seemed to be familiar with the apparatus involved. Many did not really understand what was being done and what was being measured in the experiment.

(a)

(i) All but the weakest candidates correctly chose the ruler.

(ii) More able candidates realised that the height the marble was dropped from and the diameter of the crater were the two things that should be measured. Many other suggestions were seen from weaker candidates. A common incorrect suggestion was the depth of the crater.

(iii) Most candidates did not seem confident in describing how to carry out an experimental procedure. Some of the more able candidates understood that you would measure diameter of the crater produced as the marble was dropped from a range of heights. For some reason a large number of candidates thought that the marble should be thrown rather than dropped. Others thought that the depth of the crater or the time taken for the marble to drop should be measured. Few candidates suggested repeating the experiment or measuring from the same point on the marble each time.

(b) Jake made two mistakes: he read the wrong value from the ruler and he did not place the ruler across the diameter of the crater. The former was most commonly given correct answer. Many candidates had difficulty in expressing their ideas, and the vagueness of some answers resulted in no credit being awarded. To get a good estimate several measurements of the diameter should have been made in different directions and a mean calculated. This idea was appreciated by very few candidates.

(c) Most candidates gained credit here for stating that as height increases the diameter increases. A much smaller number realised that the successive increases got smaller as the height increased, to gain further credit. A few candidates made separate statements about the height increasing and the diameter increasing. Many simply wrote the same answer twice with slightly different wording.

Question 3

Many candidates had little idea of how to use the apparatus listed to perform this experiment. Very few could use their experience of practical work to make sensible suggestions. Many became confused about the purpose of the experiment.

(a) Many candidates seemed to have little idea of what the experiment was trying to achieve or of how to use the apparatus to get the desired results. A large number of candidates did not seem to be familiar with the items of apparatus, suggesting their use in a variety of unsuitable ways. Many descriptions failed to mention the blood vessel at all, simply stating that the mass hanger is hung from the clamp and a measurement is made with the ruler. A common misconception was to think that the intention of the experiment was to measure the mass of the blood vessels. Credit was most commonly awarded for saying that the blood vessel would be held in the clamp or that the masses would be hung from the blood vessel.

(b)

(i) Most candidates seemed to choose one piece of apparatus at random. Many of those who correctly chose the ruler clearly did so by chance since they could not give a sensible alternative in **(ii)**.

(ii) The alternative given by many candidate did not match the piece of apparatus they suggested in **(i)** e.g. replacing a ruler with a clamp. Only a few of the more able candidates gained credit by suggesting the use of a ruler with finer divisions or vernier callipers.

(c) Only the more able candidates could give a correct reason for repeating the experiment. Correct answers commonly referred to the identification and discarding of outliers.

(d) There was a fairly even split between candidates suggesting **A** and those suggesting **B**. Credit was given only if **B** was suggested with the accompanying observation that it stretched more than **A**. Few candidates then continued to explain why arteries needed to stretch more. It was not uncommon to see answers incorrectly referring to the masses of the two blood vessels.

(e) Almost all candidates correctly read the forces from the diagrams to gain full credit.

Question 4

For most candidates this question gave the highest score in ***Section B***. Graph plotting skills were generally good.

(a)

(i) More able candidates correctly read the values from the diagram. Although told to take measurements from the top of the strip, many of the weaker candidates did not. Some seemed confused by the markings on the ruler and the fact that the 'after' strip was between two of the marked values.

(ii) Almost all candidates used their values from **(i)**, even if incorrect, to obtain the difference between them.

(b)

(i) Only a very small number of candidates realised that a more accurate best estimate could only be obtained by taking several measurements and calculating a mean. Despite the instruction in the stem a number of candidates suggested using a ruler with finer divisions.

(ii) Since most candidates gave an incorrect answer to **(i)**, their answer to this part was irrelevant. Of the few who did give a valid suggestion in **(i)**, very few could explain why it would be better e.g. to identify and rule out outliers.

(c)

(i) The plotting of the points on the grid was generally performed well. Only a few candidates made significant errors.

(ii) Candidates who used a ruler to draw their best-fit line usually gained credit. Many candidates drew wobbly freehand lines which did not gain credit.

(iii) Those who extrapolated their line correctly generally read off the intercept value correctly to gain credit.

(iv) Most candidates scored credit here, though a significant minority did not because they simply stated that the strip had bent more or was more flexible, without mentioning increasing the % of plasticiser. Some simply quoted one result rather than describing the trend linking the two variables.

TWENTY FIRST CENTURY SCIENCE

Paper 0608/06

Case Study

Administrative aspects

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

- the MS1 sheet or other CIE approved method should be completed showing the total marks awarded,
- candidates' work should be fastened in the left-hand corner with the appropriate CIE Candidate Record card,
- details should be included of how each of the tasks used for assessment had been introduced and presented to candidates,
- candidates' work in the sample should be annotated showing where and why credit was 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.** Each aspect of performance should be considered in turn, comparing the piece of work first against the lowest performance description, then each subsequent higher one in a **hierarchical** manner until the work no longer matches the performance description. Where performance significantly exceeds that required by one description in Strands B or C 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.

Calculating the Strand mark

The single, overall mark for the whole strand is determined by taking the average of the aspect marks and rounding up or down to a whole number as shown in the following examples. 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.

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) = 2, (c) = 0	[(a)+(b)+(c)] / 3	= 1.33 round down = 1

Strands B and C:

There are only two aspects for each of these strands. From experience it is often best to consider both strands B and C together when arriving at the final strand mark 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,

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

Case Studies

General comments

The purpose of the Case Study is to encourage candidates to use their scientific knowledge and understanding of Ideas about Science (IaS) to make judgements when presented with controversial issues in science which have claims and opinions for both sides of the case. 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' and 'technical feasibility and values' it is easier to match the performance descriptions of the criteria and gain further credit.

Case Studies are always best formulated in terms of a question to provide a focus in an area of controversy. For example, 'does air pollution cause asthma?' rather than just 'asthma'. A question will encourage candidates to look for different opinions and views, and to consider the evidence base 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 account.

Assessment

Strand A: Quality of selection and use of information.

A(a): The key aspect here is for candidates to use sources of information to provide evidence for **both sides** of their case study. If no sources are credited then a maximum of 1 mark will be allowed, unless annotation confirms that a suitable range of sources were used. Higher marks require that sources represent a variety of different views or opinions. In addition to the requirements of 3 marks candidates must assess their sources in terms of reliability in a meaningful and appropriate way. Those candidates who used the language and ideas from IaS 4 e.g. ideas about peer review, the nature of the source or the status of the author were much more likely to secure the top mark.

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, 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. Credit is given, not so much for the quotation itself but for the comment made by the candidate to explain why it was chosen, and how the candidate thinks it contributes to the arguments being compared in the study.

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).

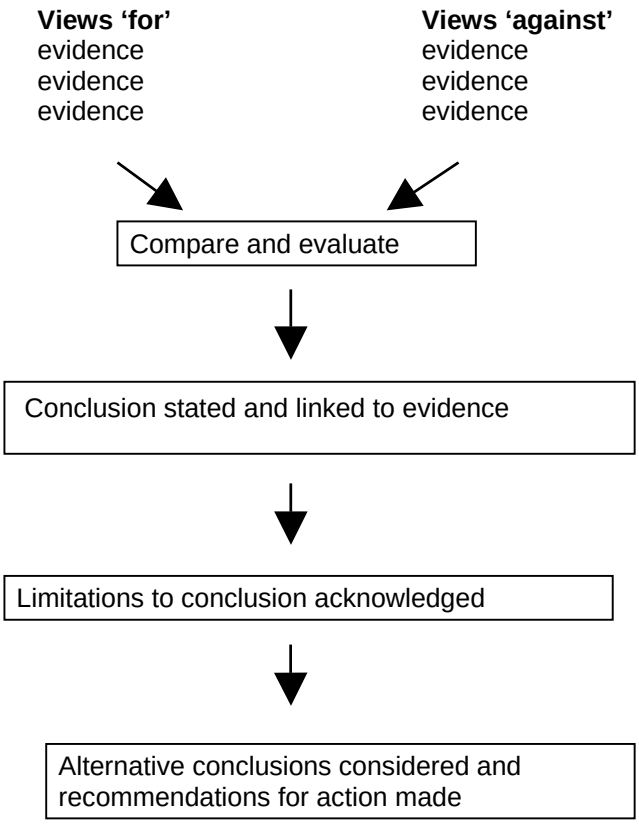
B(a): Candidates often describe the relevant background science in the introduction to their case studies with the more able candidates going to a greater depth and detail. However, only the most able link their scientific knowledge and understanding to the claims and opinions that they had found from 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. an experiment, a collection and review of existing data, a computer simulation etc. Candidates obtaining 7 or 8 marks looked 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. Even strong candidates tended to rely too much on summaries of conclusions rather than describing the evidence base.

Strand C: quality of conclusions

Strand C awards credit to candidates who provide individual input comparing and evaluating the evidence, considering its significance, importance and reliability and using their own judgement to arrive at a suitable conclusion on a controversial issue. 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. When making their conclusions, many candidates referred to the evidence that they had gathered and were awarded 4 marks in **C(b)** whereas those who omitted any reference were limited to 2 marks. More able candidates described their own viewpoint or position in relation to the original question justifying this by reference to the sources and to the evidence that the claims were based on. Far too often the conclusion was limited and too brief. Alternative conclusions should be considered where appropriate and recommendations for action in the future should also be included. Many candidates simply chose to report information about their topic, without any real analysis of the scientific evidence and incorporation of personal decision making.

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. 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.

D(c): Candidates' use of scientific terminology and the level of spelling, punctuation and grammar were generally very fairly assessed by Centres.