

GCE

Edexcel GCE

General Studies (6452)

Summer 2005

advancing learning, changing lives

Mark Scheme (Results)

6452: Scientific Horizons

Section A

- 1 Give one example of a medical problem arising from the easy availability of international air travel. (1)

Many possible answers here:

Transfer of infectious disease during incubation period/transfer of disease vector/eg malaria examples/DVT/strokes and any other valid example of exacerbation of a health condition.

DO NOT ALLOW risk of crash/hijack/accident OR anxiety/fear of flying.

- 2 Marie Curie carried out research on the element, radium, at the end of the 19th century. She showed that there are rays that come out of atoms of radium. The rays are formed of particles and in the process the atoms of radium turn into atoms of different elements. (2)

In what way were these findings a revolution in science?

- Represented a radical/highly significant change in scientific ideas/theory leading to major discoveries;
- Previous idea was that atoms were smallest/indivisible particles;
- Results in line with a new idea that atoms are made up of smaller particles;

1 mark each point up to 2

- 3 The first child in a family was born with a genetic disease. The parents later decided to have another baby. They asked doctors to help them by using IVF and selecting an embryo which could be used to provide special cells that they hoped would cure their first child. (4)

Explain one reason why this request could be said to be ethical, and explain one reason for deciding that it is unethical.

Reasons for ethical:

- (Use of cells) To help another (might mention altruism, but not strictly since the cell provider has no say, only the parents); because it is altruistic or similar argument
- No significant risk to new embryo/baby (although this risk is not actually stated, the parents do want another child and it is safe to assume that they don't wish to subject it to increased risks); no harm caused to new baby; which would be unethical/bad thing

Reasons for unethical:

- Conflicts with a belief; that a new baby should only be wanted for itself alone;
- Conflicts with a belief; that embryos are new individual human beings and should not be used for other purposes;
- Conflicts with a belief; that IVF is wrong; reasons for this
- Conflicts with a belief that may be religious/phrase that is sensible

It is not sufficient just to refer to 'playing at God' arguments

Other ethical/unethical beliefs should be credited if clearly relevant to the situation.

1 mark for each point

4

A small notice on an electric hand drier in a public toilet says: "These driers help protect the environment. They save trees from being used for paper towels. They eliminate paper towel waste. They are sanitary and help maintain cleaner facilities."

(3)

In what ways do electric hand driers damage the environment?

- The device uses electricity which has to be delivered to it (cables, substations etc.;
- The electricity might or might not be produced from environmentally damaging systems, but potential damage is possible; Generating power/energy can cause environmental damage. This damage is remote/does not occur at the point of consumption/is not apparent to the consumer. Therefore judgement about environmental costs is more difficult.
- The device is made from materials which have to be mined, treated with industrial processes/chemicals;
- All manufacture (towels/driers/cables/power stations etc) has an energy cost. The 'more manufactured' the item, the higher the energy cost.
- problems of disposal/waste or recycling arguments

1 mark for each point, up to 3. Allow reasonable other points. If the answer dwells on comparing the environmental costs of paper towels vs. driers, then allow 1 mark at least.

5 Some scientists say that adding very small amounts of fluoride to water supplies is the cheapest and most effective way of reducing tooth decay in the population as a whole. Others say that because fluoride in small quantities is a toxic (poisonous) substance, adding it to drinking water is an unknown danger to everyone and should not be done. (4)

What information is needed to decide which of these views is correct?

The question is intended to test understanding of some principles of scientific method. Therefore the answer should contain four elements:

- Establish the toxicity of fluoride (exactly how is not necessary);
- Establish how much is needed in tap water to reduce tooth decay (exactly how is not necessary);
- Compare these amounts;
- Consider other factors - fluoride toxicity in different ages groups/problems arising from tooth decay (may not be just cosmetic); length of time need to acquire evidence.

1 mark each point up to 4

6 A mathematically minded friend remarked, "Every time you drink a glass of water you are swallowing at least one water molecule that passed through the bladder of Oliver Cromwell (died 1658)". (3)

Briefly explain how this remark can be justified.

A classic little shocker. Oliver Cromwell is a diversion, it could be anybody in history.

- Need to know how many glasses of water are available from all the water on the earth (W);
- Need to know how many water molecules there are in a glass of water (M);
- If $M > W$ then, assuming good mixing over time - which is reasonable - then there is a very good chance that one or more molecules will fit the bill;
- Odds are greatly increased because OC must have passed much water in his lifetime;

Give credit however the candidate works it out - will probably use words rather than symbols.

1 mark each point up to 3 marks

Total for Section A:17 Marks

Section B

- 7 (a) Identify and write out two facts from the passage that support the view that students' choices of career within veterinary science have changed. (2)

1 mark for each answer indicated below up to a maximum of 2 marks. The answers may appear in either response paragraph 1 or 2.

- Mr Eddy (of the Royal College of Vet. Surgeons [RCVS]) notes a big change in student aspirations (line 17)
- *Ten years ago, half of all veterinary students wanted to do farm work (line 18)*
- Today, just one in ten wish to do farm work (line 19)

The wording may vary in detail but must clearly indicate the facts given above. For example:

- The RCVS has noted a big change in the work students want to do.
- Years ago, many vet students expected to do farm work (ie the exact number of years do not matter).
- Today only a small minority want to work with animals (ie the exact proportion does not matter).

Spelling may be ignored, but each answer must be a complete sentence.

- (b) Referring to paragraphs 1 and 2, which of the following describes the effect of Rolf Harris' programme? (1)

C: correlation

All the evidence given in the passage is from correlation, and nowhere is there any evidence from the actual views and linked behaviour of the students.

(c) Consider the statement "This is not sexist in any way, but the majority of applications for veterinary college places are from women and most of them seem to prefer to work with cuddly animals rather than farm animals". (lines 20-22)

(i) What objective information is given in this statement? (1)

The majority of applications for veterinary college places are from women.

1 mark for the answer indicated.

"The majority of applications for veterinary college places are from women."

The wording may vary in detail but must clearly indicate the fact given above. For example:

- Most applications for veterinary college places are from women.
- The majority of applications for veterinary colleges are from women.
- Most applicants for veterinary colleges are women.

Spelling may be ignored, but each answer must be a complete sentence.

(ii) Give two examples of the ways in which this statement displays subjectivity. (2)

Using the phrases:

- "this is not sexist in any way"
- "with cuddly animals"

1 mark each point

(d) In the last paragraph, a BBC employee argues that, 'If... fewer vets want to work with farm animals then, whilst regrettable, it's not something that either Rolf or the programme can be held responsible for.' (lines 24-26)

(i) Which two of these measures could help to support the argument? (1)

B and E

(ii) Explain how the two proportions you have chosen could be used to support the argument.

B gives estimate of the students who could be affected. (3)

B, if large might support or if small, might not.

E gives inverse estimate of students who have chosen to work with pets.

E, if large might not support OR if small, might do so.

Measures might be used to show trends/the measures could be useful/might be possible to show correlations (but not causes) to support argument.

AO2 Mark Scheme:

A mark should be given for the level of written communication using these level guidelines:

The answer is clear and lucid, (writing in correct form is taken as a matter of course) arguments are coherent and well laid out, there are very few grammatical or spelling errors.	3 marks (above average)
The answer is broadly understandable, writing is in the correct form, arguments are on the whole coherent, and grammar and spelling do not inhibit communication.	2 marks (average)
The answer is only understandable in parts, writing may be in an inappropriate form, arguments are not clearly expressed, and in places grammar and spelling inhibit communication.	1 mark (below average)
The answer is badly expressed or fails to treat the question seriously, there many serious lapses of grammar and spelling OR there is too little of the candidate's own writing to assess reliably (as is sometimes the case in Section B).	0 marks (exceptionally poor)

NB The Quality of Communication marks are not dependant upon the AO3 mark

AO2: 3 Marks
(Total Section B: 13 Marks)

Section C

- 8 'Scientists must not be blamed for the future technological applications of their work.' (17)

Examine this statement. You may wish to refer to technological applications such as nuclear weapons, genetic modification, or any others.

Indicative Content

Candidates need to consider the responsibility for their work shown by:

teachers, doctors or lawyers, but not necessarily all three. This might be through the codes of conduct exhibited by these professions (although candidates may not express it quite in this way). Responsibilities of these professions are sometimes expressed solely in to duties or obligations to the child, patient or client. Responsibilities to society are not pre-eminent - and this may be one thrust of the argument in this question, since the duties of scientists and technologists may be thought to be in relation to all of us.

The examples provided are intended as food for thought:

Nuclear Physics:

Are we considering scientists who do research into the fundamental nature of matter? If so consider Einstein's remark about his work leading to the atomic bomb.

And/or scientists who work on peaceful applications, such as power generation, and the risks of accidents.

Long term effects of radiation on the environment and living organisms. Duties of scientists in relation to the general public, as well as governments that employ them.

Weapons:

Mostly scientists/technologists who adapt existing technologies

What codes might apply to scientists whose work is on devices or agents designed to cause death and destruction?

Cloning:

The intentions of work in this area are scientific since they arise from attempting to understand better how organisms work.

Also for the benefit of sufferers from genetically derived problems and other medical conditions

There are therefore major ethical considerations from the nature of the material.

Generally speaking, we need to consider:

- How are the risks arising from the use of various technologies and scientific procedures assessed? Governments, industries, scientific bodies, individuals?
- How is the responsibility allocated and exercised?
- Codes of practice for different technologies, or one overall?
- National or international agreements?
- Competing countries, who may demand less (of ethical standards) of their scientists and technologists
- Can science be independent of political control or supervision?

The candidate needs to balance views on the justification for the statement.

- 9 'The discovery of the molecular structure of DNA in 1953 was credited to two scientists. The working out of the complete genetic structure of the human genome was carried out by thousands of scientists over a period of at least 10 years.' (17)

To what extent can you justify the conclusion that, 'It is, therefore, most unlikely that a single scientist will ever again make a major scientific discovery'?

Indicative Content:

The question gives some background which may not be familiar to all candidates, but it is intended to stimulate thought about the thrust of the conclusion.

Candidates are likely to answer in the form "On one hand...but on the other...", but do need to draw some sort of conclusion.

Answers should include some reference to previous scientific discoveries - they can draw on their knowledge and understanding of one or two scientific revolutions, and we consider the unpicking of the chemical structure of genetic material as one such. If they pick up on this stimulus, they may look back to Mendel and his work on inheritance of characteristics, and the fact that he was working almost completely on his own. Hence, in the past it was clearly possible for one scientist to come up with a major discovery.

Candidates need to produce counter-examples, for example of recent discoveries which are the product of a single (or a very small group) scientist's insight. This may not be easy - but even if the candidate does not know of any, they may argue that inventions such as the hovercraft, jet engine, even the vacuum cleaner are the result of a single gifted individual and scientific discovery may be of the kind.

On the other hand, the complexity of modern science and the theories behind it means that team working is now far more likely. Not only that but the costs of research nowadays are so enormous that it is unlikely that a single scientist will have access to the resources necessary to test out new hypotheses, so might be forced to share thoughts and ideas, hence collaborate in large teams.

Another idea that might/should come up, is whether the “thousands” of scientists are actually scientists or technicians/technologists who are just working on standard procedures directed to the result of exercise. Whose was the original, major discovery? Against that might be put the fact that as time went on in this project (HGP) new techniques and discoveries greatly improved its progress. These were presumably made by members of teams working on the problem.

Candidate will almost certainly struggle to get satisfying examples, but should be credited with their ability to speculate on the problem, using their general knowledge of specification section 2.3. They should be rewarded for working from their speculations and validating or otherwise the conclusion to the given argument.

10 **‘Humanity is continually faced with problems, for example: rising population, shortage of food, traffic congestion and new diseases.’ (17)**

How necessary is a scientific approach in solving such problems? In your answer show clearly what you understand by scientific method.

Indicative content:

It is quite important that the candidate considers, perhaps briefly, but clearly, what is a “problem” and what is “scientific method”.

Scientific method:

Identification of the possible causes of the problem (hypothesising)

Making testable predictions on the basis of the hypothesis

Devising tests of the predictions (experiments)

Assessing the outcomes of the experiment - does the hypothesis stand up, or do we need to consider a different one?

“Problems” occur everywhere, and we should expect the candidate to identify some. Since the question is about all problems, examples might cover some political, social, ethical, moral, mathematical, technical, scientific and cultural problems. Each must be judged on its merits.

Scientific methods are devised in relation to scientific and, by analogy, technological, problems, which are based on an objective outlook.

They may not succeed when applied to a problem which is about ethical or moral beliefs or conflicts.

If an approach to a problem is, however, methodical, following some logical sequence, then it may seem possible to tackle all problems. Scientific method in a sense defines what science is.

It is possible that a candidate brings up mathematical proof of problems, and notes that it can be shown that there are mathematical systems in which statements may be unverifiable.

It is enough, however, for the answer to balance the views that some problems can, and others cannot, be solved using scientific methods.

AO3 Level Descriptors and Mark Distributions

No marks are to be awarded for answers that are completely irrelevant or frivolous.

Level 1	<p>Partial, incomplete and inconclusive answers</p> <p>Selects and marshals a limited range of evidence relevant to the question, but with no conclusion, implied or explicit.</p>	1-2 marks
Level 2	<p>Limited, one sided answer with a simple conclusion</p> <p>Selects and marshals a limited range of evidence to draw a simple conclusion, which may or may not be appropriate. There may be little explanatory comment.</p>	3-7 marks
Level 3	<p>A developed answer which largely examines one viewpoint or looks at two sides of the argument in a superficial and unspecific manner.</p> <p>Selects and interprets evidence, and uses it to draw a justified conclusion or conclusions.</p> <p>At the lower end, explanatory comment is simple and restricted.</p> <p>At the top end it is:</p> <p>either clearly interpreted and applied to a single view of the question or addresses different views in a superficial way with few specifics and little or no development.</p>	8-12 marks
Level 4	<p>Evidence is used to examine contrasting viewpoints.</p> <p>Selects, interprets and begins to evaluate evidence to show clear awareness of differing points of view, and uses it to draw a justified conclusion or conclusions.</p> <p>At the lower end, the range is limited and the evidence is evaluated in a simple way.</p> <p>At the top end, the range is wider and the evaluation is more developed.</p>	13-16 marks
Level 5	<p>A balanced answer evaluating a wide range of evidence.</p> <p>Selects, interprets and evaluates a wide range of information, concepts and opinions relevant to the question. Marshals and evaluates the evidence clearly and coherently to draw a justified, substantiated conclusion or conclusions.</p>	17 marks

Total AO3: 17 Marks

A mark should be given for the level of written communication using these level guidelines:

The answer is clear and lucid, (writing in correct form is taken as a matter of course) arguments are coherent and well laid out, there are very few grammatical or spelling errors.	3 marks (above average)
The answer is broadly understandable, writing is in the correct form, arguments are on the whole coherent, and grammar and spelling do not inhibit communication.	2 marks (average)
The answer is only understandable in parts, writing may be in an inappropriate form, arguments are not clearly expressed, and in places grammar and spelling inhibit communication.	1 mark (below average)
The answer is badly expressed or fails to treat the question seriously, there many serious lapses of grammar and spelling OR there is too little of the candidate's own writing to assess reliably (as is sometimes the case in Section B).	0 marks (exceptionally poor)

NB The Quality of Communication marks are not dependant upon the AO3 mark

AO2: 3 Marks
(Total for Section C: 20 Marks)