

GCE

Edexcel GCE

Scientific Horizons (6452)

Summer 2006

advancing learning, changing lives

Mark Scheme (Results)

## 6452: Scientific Horizons

### Section A

1 The invention of the jet engine was an important technological development. The following are important scientific revolutions:

- i) Newton's Laws of Motion
- ii) Dalton's Atomic Theory
- iii) Einstein's Theory of Relativity
- iv) The nuclear model of the atom
- v) The Laws of Thermodynamics

For the development of the jet engine to take place, technologists needed some understanding of:

- A i) and ii)
- B i), ii) and v)
- C i), iii) and iv)
- D iii) and v)

(a) Clearly write the letter of your response. (1)

B

(b) Briefly explain your choice. (2)

Up to 2 marks for reasonable points that may explain why the three choices have been made, or explain why others were ruled out. However, each answer must indicate which point (i - v) or named revolution is referred to.

- Laws of motion linked to operation of a jet/relationship of forces (can mention gravity, but not for credit)
- Atomic theory needed to understand fuels/combustion/materials
- Inventor of the jet engine did not need to know about relativity/relativity doesn't noticeably effect aircraft's motion
- Nor about radioactivity/jet engine doesn't use radioactive materials etc.
- Thermodynamics help to explain the energy transformations in the engine

If candidates make the wrong selection in (a), but make one reasonable point in (b), then allow 1 ECF mark

2 Tragically, a baby's lungs have been damaged at birth, so much so that it is unable to breathe without a ventilator. At the same time the baby's brain was damaged through lack of oxygen. The heart keeps stopping and has to be started again. What ethical problems arise:

(a) for the medical staff caring for the baby? (3)

- the pain/discomfort for the baby;
  - judgement about quality of life;
  - deciding when or if the situation is hopeless/turning off life support systems;
  - what advice to give the parents;
  - how to decide on the advice to give the parents;
  - deciding on the distribution of medical resources in the hospital/NHS;
- Any other valid ethical points, up to a maximum of 3  
See point about lack of attribution of ethical views under 2b)

(b) for the parents of the baby? (2)

- assessing the quality of life and whether the baby is suffering;
  - whether this judgement involves their ethical beliefs about sanctity of life;
  - what to do if their ethical beliefs do not coincide;
  - what to do if they do not agree with the advice given by the medical team;
- Any other ethical points up to 2 marks.

- 3 The topics of fuel prices and energy resources are frequently in the headlines of the news media. Give three reasons why the media devote attention to these topics. (3)
- economic effect(s);
  - nature and supply of energy (decline/using up non-renewable resources);
  - environmental issue(s);
  - human interest (life/death drama - e.g. pensioners in winter);
  - public information/contentious views;
- Any valid points up to 3
- 4 The human body, a petrol driven car, and a diesel powered train all produce carbon dioxide, which is a greenhouse gas contributing to global warming. List the information you need in order to assess the relative effects of these on global warming. (3)
- the number of human beings;
  - the number of petrol driven cars and/or the number of diesel engine trains;
  - the average amount of CO<sub>2</sub> produced by each category;
  - this amount for each category on an annual (or equal time) basis;
  - do they produce any other greenhouse gases?;
  - how much CO<sub>2</sub> is produced in manufacture etc, as well as running?;
- Up to 3 marks
- 5 British Summer Time involves changing clocks by one hour in the spring and autumn. The reason is to allow people to enjoy as much daylight in the working day during the summer as possible. The following note appeared in a local newspaper: (3)
- “Why don’t we get up in the light, put the clocks forward during the day - say at 3pm since no-one likes doing anything between 3 and 4 pm - and then get a nice light evening? Put the clocks back overnight - giving us an extra hours sleep - and repeat daily.” What is wrong with this suggestion? In what ways is this reasoning in the newspaper flawed?
- the thinking is fallacious/you can’t change daylight hours/hours in day;
  - although we have made the clock move forward from 3 to 4, or back during the night, this does nothing to the actual time we experience;
  - will employers pay for the missing hour in the afternoon?;
  - the generalisation about everyone’s attitudes to work in the afternoon may not be justified;
  - we could decide to move the clock to anything we wish, but conventions will ensure that our activities fit the hours available;
  - doing this will lead to confusion/examples of this;
  - the problem of dark mornings and evenings is because of the precession of the motion of the earth and varies with the seasons, except in the tropics/ reference to BST and reasons for having it;
- Any valid points up to 3

AO1: 17 Marks  
(Total Section A: 17 marks)

## Section B

6 (a) The writer of letter A opposes the introduction of a law to stop smoking in public places. Give three pieces of evidence in the letter that is used to justify opposition. (3)

- smoking in public places/pubs has decreased;
- most space in public places is given to non-smokers;
- the legislation is being introduced by people who are only interested in “doing good”, and by implication not interested in the actual case;
- the argument is about regulation;

One mark for each point.

(b) The writer of letter B supports the use of legislation to stop smoking in public places. Give three pieces of evidence in the letter that is used to justify support. State whether each is fact or opinion. (3)

- none of the 560 public bars in central Manchester are completely smoke-free (this is fact, based possibly on personal observation, but more likely on available statistics);
- most of these bars do not have “no-smoking” areas (this is fact, as above);
- if people who have quit smoking go back to smoky public areas, they will start smoking again (this is opinion);
- outdoor consumption of alcohol has been banned by law (this is a supportive analogy, but is also a fact)
- resources have been committed (fact);
- **substantial** resources have been committed (opinion);
- non-smoking services are reducing drinking in public place (fact);
- passive smoking (fact);

One mark for each point (including the correct attribution to fact or opinion), up to 3

(c) Explain how the evidence in the two letters is conflicting (3)

- A says that most space in public places is given to non-smokers
- B quotes the more specific case of licensed premises in central Manchester
- A’s opinion is that the ban is being introduced to satisfy “do-gooders”, and that it best to get people to agree voluntarily to change their behaviour
- B’s opinion is that people need to be helped and legislation is an effective way to do it.

One mark each point, and any others that are relevant, up to 3. Allow points made from each letter, and the candidate must make reference to a conflict of evidence to gain more than 1 mark.

(d) What form of argument does the writer of letter B use in the last sentence of the letter? (1)

Argument by/from analogy.

## 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, where are very few grammatical or spelling errors.	<b>3 marks (above average)</b>
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.	<b>2 marks (average)</b>
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.	<b>1 mark (below average)</b>
The answer is badly expressed or fails to treat the question too seriously, there may be serious lapses of grammar and spelling <b>OR</b> there is too little of the candidate's own writing to assess reliably (as is sometimes the case in Section B).	<b>0 marks (exceptionally poor)</b>

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

**AO2: 3 Marks**

**(Total Section B: 13 marks)**

## Section C

- 7 **Darwin's Theory of Evolution completely changed humanity's view of itself, from something unique and specially created, to an animal related to and similar to other animals.**

**How far does any scientific revolution change human understanding and behaviour, not just that of scientists? (17)**

The question is directed at **all** scientific revolutions, not just evolution. However, candidates may discuss one or several revolutions.

The answer needs to consider the basic idea of a scientific revolution: it changes the whole nature of a science; it is a major break with previous thinking; it enables much more powerful and wide-ranging explanations and predictions to be made; it brings more, unexpected, phenomena into the explanatory framework.

All of these characteristics help a scientist recognise that a revolutionary development has taken place - what about the rest of the population?

One argument could be that most people don't think about science and its effects in their daily lives, why on earth should a scientific revolution make them do so?

Well, it might, if the outcomes of that revolution bring about changes in the health and wealth (and public understanding?) of the population. This would, no doubt, be a utilitarian view of scientific development.

Another argument could be that anything so significant that it changes scientists' understanding completely, must be also significant for everyone's understanding - the concept of evolution would be a good example of that, but so too would be the change to a heliocentric view of the solar system, the big bang theory in cosmology, or the atomic theory. There would be knock-on effects for philosophy and the religious belief systems - to which most people are exposed.

Pragmatically, however, does the great majority of the public need to know or understand any of these advances? Will they affect their daily life, their work, their relationships? Answers may try to demonstrate these.

The most reasonable conclusion would be that scientific revolutions do in fact alter human life and society in profound ways - not always obviously.

- 8 **Modern technologies such as X ray machines and mobile phones may present risks to health.**

**Examine the view that if the risk is small, it is worth taking. (17)**

The answer is best dealt with in two parts - and this is what we might expect candidates to do.

If the candidate develops arguments about mobile phones:

One assumption is that the phones produce EM radiation, and all radiation can, under the right circumstances, damage living tissues. Manufacturers of phones need to measure the type (wave-lengths) of radiation emitted, their penetrative power in human tissue and from the energy transferred deduce whether damage to cells is likely. The effect might be by heating the tissue, or, much less likely from ionising effects, or even from the presence of magnetic fields. Candidates do not need to demonstrate knowledge of all of these to develop their argument - they may express their ideas in simple forms and with non-scientific language.

A different approach, in parallel perhaps, would be to sample the population of phone users, and see if they develop any health conditions compared with those who do not use the phones. The difficulty of this is that different phones emit different levels of radiation, and users change phones, or use the phone for different times; it is therefore very difficult to standardise the sample populations. People also live and work under very different electromagnetic circumstances, and these too would have to be standardised, for any correlations to be significant. Also some effects - such as the development of cancers,

could take many years to appear.

The health risks from radiation may be less significant than other risks - for example the use of the phone by the driver of a car is known to be create a highly significant accident risk.

The arguments related to X ray machines can be more definite, since the adverse effects of X ray radiation are much better known.

Evaluating the risk and balancing the risk against usefulness is a more difficult exercise. Candidates only have access to everyday knowledge and understanding of these issues, so we must not expect detailed or well-calculated answers. They can call upon personal experience, and their own views. They need to develop an argument, hopefully containing some objective evidence (or at least with an indication of how such evidence can be obtained, or is necessary), reaching a conclusion about the use of mobile phones. If they are clear-thinking enough, they will contrast the arguments about the risks to the person using the phone (frying your brains), which manufacturers claim are negligible, and the introduction of legislation against drivers' use of the phone, where the risks to driver and others are demonstrable and significant.

- 9 **The Internet has been welcomed as a huge benefit to mankind since it enables cheap and rapid sharing of information and messages.**

**Assess the comparative benefits and problems arising from this technological development. (17)**  
This is likely to be a popular choice. Candidates will probably have more knowledge about this than the other questions, but this does not necessarily give them an advantage. Answers should contain critical thinking and evaluation, and an attempt to distinguish fact and belief.

Candidates may reflect on the origin and early days of the Internet - as a tool for the sharing of information between academics. They may have some understanding of the technicalities - the need for large "servers" which are joined by cable or wireless links; the development of the use of the telephone system to allow data to be sent via modems, making the Internet available to the domestic user. Improvements in speed and bandwidth now allow very large files to be transferred, and even the use of streaming media to view entertainment channels. Reference to email and file accessibility are probably rather trivial aspects of the essay - all candidates should be familiar. To develop the topic they need to consider the problems presented by the access to vast amounts of data - the most obvious is how to find what is is you want to know. The development of search engines and everyday language implementations of these to help users.

Benefits are too numerous to mention, and candidates are likely to mention many of these. Problems are also well rehearsed - viruses, spam, Internet "grooming", financial scams, identity theft etc. Virus checkers, firewalls and spy ware are all grist to the mill. Good candidates are likely to be more reflective - and consider the problems for society if dependence on the Internet becomes inbuilt - what happens if an unforeseen threat makes it unusable? Something that is less obvious is the fact that the Internet can carry on functioning, even if parts of it fold up and become unusable. Other problems might come from governmental control through the use of information, although it can be credited this is more a synoptic element and should not necessarily be expected.

AO3 Level Descriptors and Mark Distributions

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

Level 1	<p><b>Partial, incomplete and inconclusive answers</b></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><b>Limited, (mainly) one sided answer with a simple conclusion</b></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><b>A developed answer which largely examines one viewpoint or looks at two sides of the argument in a superficial and unspecific manner</b></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</p> <p>or addresses different views in a superficial way with few specifics and little or no development.</p>	8-12 marks
Level 4	<p><b>Evidence is used to examine contrasting viewpoints.</b></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><b>A balanced answer evaluating a wide range of evidence.</b></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, where 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 too seriously, there may be 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 C: 20 marks)