AQA

AS-LEVEL
General Studies A

Unit 2 (GENA2) AS Science and Society
Mark scheme

2760
June 2015

Version V1 Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Unit 2 Section A

GENA2 AS Science and Society

This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

1.1	**D**	**1.16**	**A**
1.2	**C**	**1.17**	**B**
1.3	**D**	**1.18**	**A**
1.4	**C**	**1.19**	**D**
1.5	**C**	**1.20**	**B**
1.6	**D**	**1.21**	**C**
1.7	**B**	**1.22**	**A**
1.8	**A**	**1.23**	**C**
1.9	**D**	**1.24**	**B**
1.10	**A**	**1.25**	**C**
1.11	**C**	**1.26**	**A**
1.12	**A**	**1.27**	**D**
1.13	**C**	**1.28**	**A**
1.14	**A**	**1.29**	**B**
1.15	**D**	**1.30**	**B**

Unit 2 Section B (AS Science and Society)

INTRODUCTION

The nationally agreed assessment objectives in the QCA Subject Criteria for General Studies are:

AO1	Demonstrate relevant knowledge and understanding applied to a range of issues, using skills from different disciplines.
AO2	Marshal evidence and draw conclusions: select, interpret, evaluate and integrate information, data, concepts and opinions.
AO3	Demonstrate understanding of different types of knowledge, appreciating their strengths and limitations.
AO4	Communicate clearly and accurately in a concise, logical and relevant way.

- The mark scheme will allocate a number or distribution of marks for some, or all, of the above objectives for each question according to the nature of the question and what it is intended to test.
- Mark schemes for individual questions worth more than just a few marks are usually based on **levels** (see further guidance below) which indicate different qualities that might be anticipated in the candidates' responses. The levels take into account a candidate's knowledge, understanding, arguments, evaluation and communication skills as appropriate.
- **Answers given in the mark scheme are not necessarily definitive. Other valid points must be credited, even if they do not appear in the mark scheme.**

Approximate distribution of marks across the questions and assessment objectives for **Unit 2, Section B** (**GENA2/2)**

Question Numbers		**Q2 & Q3**	**Q4 & Q5**	**Q6 & Q7**	**Total marks for Section B**
Assessment Objectives	**AO1**	**12**	**12**	**12**	**12**
	AO2	**8**	**8**	**8**	**8**
	AO3	**5**	**5**	**5**	**5**
	AO4	**10**	**10**	**10**	**10**
Total marks per question		**35**	**35**	**35**	**35**

Levels of Response marking

1. It is essential the **whole response is read** and allocated the level it **best fits**.

2. Marking should be positive, rewarding achievement rather than penalising for failure or omissions. The award of marks must be directly related to the marking criteria.

3. Levels are tied to specific skills. Examiners should **refer to the stated assessment objectives** (see above) when there is any doubt as to the relevance of a student's response. When deciding upon a mark in a level examiners should bear in mind the relative weightings of AOs (see AO grid above). For example, in Sections B and C more weight should be given to AOs 1 and 2 than to AOs 3 and 4.

4. Use your professional judgement to select the level that **best** describes a student's work; assign each of the responses to the most appropriate level according to **its overall quality**, then allocate a single mark within the level. Levels of response mark schemes enable examiners to reward valid, high-ability responses which do not conform exactly to the requirements of a particular level. Length of response should be not be confused with quality: a short answer which shows a high level of conceptual ability, for example, must be recognised and credited at that level.

5. Credit good specialist knowledge when it is applied appropriately to the question, but be aware that the subject is General Studies and responses should be addressed to the general reader. Relevant points that are well developed and substantiated should be well rewarded, as should be arguments that are supported with examples, and not just asserted.

6. Answers should be assessed at the level that is appropriate to the expected knowledge and skills of a post-16 General Studies student. Avoid applying greater demands to responses on topics that are more closely related to your own specialist knowledge.

7. Levels of response mark schemes include either examples of possible students' responses or material which students typically might use. *Indicative content* is provided only as a guide for examiners, as students will produce a wide range of responses to each question. The *indicative content* is not intended to be exhaustive and any other valid points must be credited. Equally, candidates do not have to cover all points mentioned to reach the highest level.

Assessment of Quality of Written Communication (QWC)

Quality of written communication will be assessed in all units where longer responses are required by means of **Assessment Objective 4**. If you are hesitating between two levels, however, QWC may help you to decide.

Marking methods

In fairness to students, all examiners **must** use the same marking methods. The following advice may seem obvious, but all examiners **must** follow it as closely as possible.

1. If you have any doubt about which mark to award, consult your Team Leader.
2. Refer regularly to the mark scheme throughout marking.
3. **Always** credit **accurate, relevant and appropriate** points which are not given in the mark scheme.
4. Do **not** credit material irrelevant to the question / stated target, however impressive it might be.
5. If you are considering whether or not to award a mark, ask yourself 'Is this student nearer those who have given a correct answer or those who have little idea?'
6. Read the information on the following page about levels of response mark schemes.
7. **Use the full range of marks**. Don't hesitate to give full marks when the answer merits them (a maximum mark does not necessarily mean the 'perfect answer') or give no marks where there is nothing creditable.
8. The marks available for each answer include up to 5 communication marks (AO4); well communicated answers should be appropriately rewarded.
9. **You must** annotate items in the body of the response to acknowledge a creditworthy point.
10. **You must**, at the end of the response, use the **text box** icon to write a summative comment. N.B. schools/colleges can request scripts back post results; it is therefore **essential** that the annotation/comments are appropriate, relevant and relate to the mark scheme.
11. The key to good and fair marking is **consistency**. Once approved, do **not** change your standard of marking.
12. Your assessments will be monitored throughout the marking period. This ensures you are marking to the same standard, regardless of how many clips you have marked or what time of day you are marking. This approach allows senior examiners to ensure your marking remains consistent. Your Team Leader can bring you back to the right standard should you start to drift.

Levels mark scheme for Questions 02 to 07

Level of response	Mark range	Criteria and descriptors for Assessment Objectives 1-4
LEVEL 3	13–17 (18)	**Good response to question** Good to comprehensive knowledge, understanding and approach demonstrating overall grasp of the range and nature of issues (AO1). Capacity to interpret evidence and sustained ability to present relevant arguments, analysis and exemplification, focusing on the main points of the question (AO2). Shows some understanding of different types of knowledge, with some appreciation of their limitations in seeking to reach a reasoned and logical conclusion (AO3). Ability to communicate clearly and accurately in a fluent and organised manner (AO4).
LEVEL 2	7–12	**Reasonable attempt to answer question** Modest to quite good knowledge, understanding and approach demonstrating some grasp of the nature of some key issues (AO1). Moderate range of arguments, analysis and exemplification covering some of the main points of the question (AO2). Limited understanding of different types of knowledge but some ability to work towards or achieve a reasoned conclusion (AO3). Mostly clear and accurate communication and organisation (AO4).
LEVEL 1	1–6	**Limited response to the question** Restricted / narrow knowledge and understanding of key issues (AO1). Simple, perhaps mostly unexplained points – or very narrow range – with limited interpretation or analysis and exemplification (AO2). Lacking in understanding of different types of knowledge with little or no evidence of ability to work towards a conclusion (AO3). Variable levels of communication and organisation (AO4).
LEVEL 0	0	**No valid response or relevance to the question.**

Section B

0 2 Examine **two** different ways in which the practical application of physics has shaped the way we live in society today.

[17 marks]

General guidance

[Spec: 3.3.2, 3.3.3] This question gives candidates considerable scope to choose from a wide range of possible topics. Better answers will demonstrate a sound understanding of their selected applications of physics, and they will make reference to their effects in modern society. Candidates who examine only one application are unlikely to get a mark in Level 3.

Level 1
- 1-3 marks: a brief, weak answer with little or no relevant information.
- 4-6 marks: a limited answer, but with a few basic points.

Level 2
- 7-9 marks: a modest answer, with some relevant points.
- 10-12 marks: a quite good answer, with a range of ideas explained.

Level 3
- 13-15 marks: a good answer, with some development of relevant information.
- 16-17 marks: a very good answer, with accurate and detailed points clearly explained.

Candidates should be able to achieve marks in the highest level with a selection of relevant points, not necessarily the complete range.

Examiners are reminded that up to 5 communication marks (AO4) are available for this section; well communicated answers should be appropriately rewarded.

Indicative content:

Physics is a natural science that studies matter and its motion through space and time, along with concepts such as energy and force.

The range of applications that might be mentioned is vast. A range of possible topics is suggested here, though others are possible and should be rewarded appropriately.

Electricity
Electricity is a set of physical phenomena associated with the presence and flow of electric charge. Electrical phenomena have been known throughout history, but it was only in the 19th century that physicists and engineers were able to put electricity to practical use.

Electricity is now mainly produced by turbines, powered either by steam from the combustion of fossil fuel, by heat from nuclear reactions or from renewable sources such as water or wind.

The ability to generate electric power has had a massive effect on modern industrial society, including:

- electric light and heating have transformed residential properties and living conditions;
- electric refrigeration has significantly widened and improved the range of foods that we eat;
- electric motors are the power behind many forms of transport, particularly trams and trains, but potentially also cars;
- the expansion of telecommunications is only possible because of the utilisation of electric power, with examples ranging from telegraphs to the internet.

Internal combustion engine

This engine combusts fuel in a chamber, producing gases which apply a direct force to some component of the engine, such as pistons or a turbine. This force transforms chemical energy into useful mechanical energy. The internal combustion engine provides the motive force for:

- most forms of road transport – cars, trucks, motor cycles, buses, etc – which have had major impacts on business, leisure, urban development, pollution, etc;
- most forms of air transport, with impacts on business, leisure, settlement, warfare, etc;
- marine transport, affecting freight, passenger and leisure (cruise) craft;
- rocket vehicles, powering the sending of satellites and manned space vehicles into orbit.

Flight

Physicists have been able to apply their understanding of forces to enable objects to fly:

- if an object has a lower density than air, it is buoyant and can float in the air (e.g. hot air balloons);
- fixed wing aircraft and helicopters generate lift by the reaction to an airflow – drag is overcome by thrust;
- propulsive thrust provides the power for flight of rockets and VTOL aircraft.

The ability to fly in a wide variety of craft of different shapes and sizes has affected economic development in terms of business travel and the creation of the travel for leisure industry, as well as the aircraft industry itself. There has also been a huge influence on the practice of warfare, with helicopters, bombers, troop transports and, most recently, drones.

Telecommunications

Telecommunication involves communication at a distance by means of electric signals or electromagnetic waves. Examples of telecommunications include:

- telegraph – developed in the mid-19th century, the transmission of electric signals along wire lines;
- telephone – developed in the late 19th century, the transmission of articulate speech along wire lines;
- radio – developed in the late 19th/early 20th century, the transmission of signals through free space by electromagnetic radiation at low frequencies;
- microwaves – developed in the later 20th century, the transmission of information via very high frequency radio waves, used in cell phone communication, satellite navigation systems, etc.

Space technology
Rocket powered vehicles are used to move objects out of the Earth's atmosphere. They are then put into orbit above the Earth, or move on to other parts of the solar system. Examples of space technology include:

- communication satellites, for radio and television broadcasting, global positioning systems, communication for aircraft, ships, etc;
- observation satellites, used by governments and military organisations for spying purposes, for mapping, Google Earth, weather observation and prediction;
- scientific experimentation, the International Space Station, the Hubble space telescope, landing of people and equipment on the Moon and Mars, flights to other planets and space objects, etc.

Nuclear physics
Nuclear physics involves the study of the constituents and interactions of atomic nuclei. The main applications include:

- generation of electricity – this holds out the prospect of large amounts of energy being generated with little or no impact on carbon emissions and hence global warming, though there are issues over safety and the disposal of nuclear waste;
- nuclear weapons are capable of vast destruction, though have only twice been used 'in anger'; they are variously seen as very dangerous, as the number of nuclear warheads in existence could potentially destroy much of the world – OR are seen as having kept (relative) peace through the 'balance of terror'; there are issues of proliferation as the number of nations with nuclear weapons increases – UK, US, Russia, France, China, Israel, India, Pakistan, N Korea.

Medical physics
This is the application of concepts and methods of physics to medicine and healthcare. Some of the main applications include:

- x-rays, ionising radiation which is absorbed differentially by different body tissues, enabling images of the skeletal structure and other organs of the body to be viewed;
- CT scans, in which x-ray images of slices of the body can be used to build up a 3D image of bodily structures;
- Fluoroscopy – an imaging technique that uses x-rays to obtain real time moving images of the internal structures of a patient through the use of a fluoroscope; one use is to allow radiation absorbing materials to be inserted into the body to be tracked and show up blockages (e.g. a barium ‘meal’);
- radiation therapy in which high doses of radiation are used to kill cancer cells and reduce tumours, either by being directed at the tumour from outside the body, or by a source being placed inside or next to a tumour;
- MRI scans (magnetic resonance imaging), in which strong magnetic fields and radiowaves form images of the body without exposing it to ionising radiation;
- ultrasound, the use of sound pressure waves to form images of the body (e.g. a foetus in utero) without exposure to ionising radiation.

Other valid points, not included here, should be credited.

0 3 Consider reasons why girls are less likely to study physics and why women are under-represented in the science and engineering professions.

[18 marks]

General guidance

[Spec: 3.3.2, 3.3.3] This question is looking for a balanced assessment of the reasons for continued gender differences in education and the workplace. Weaker answers may offer stereotypes with little evidence, while stronger answers will take a balanced look at socialisation in the family, attitudes in the education system, and practices in the workplace, leading to a reasoned conclusion.

Level 1
- 1-3 marks: a brief, weak answer with little or no relevant information.
- 4-6 marks: a limited answer, but with a few basic points.

Level 2
- 7-9 marks: a modest answer, with some relevant points.
- 10-12 marks: a quite good answer, with a range of ideas explained.

Level 3
- 13-15 marks: a good answer, with some development of relevant information.
- 16-18 marks: a very good answer, with accurate and detailed points clearly explained.

Candidates should be able to achieve marks in the highest level with a selection of relevant points, not necessarily the complete range.

Examiners are reminded that up to 5 communication marks (AO4) are available for this section; well communicated answers should be appropriately rewarded.

Indicative content:

The evidence of differences in subject choice between boys and girls is clear, with boys being more likely to study sciences and computing, with girls being more likely to study literature, humanities and social sciences. There is also clear evidence of differences in progress in employment, despite several decades of anti-discrimination and equal pay legislation:
- women are on average, less well paid than men;
- women are more likely to be in jobs that are less well paid;
- women are less likely to break through the 'glass ceiling' and reach the top of the hierarchy in their business or profession.

There is a variety of approaches to explaining gender differences in education and employment:
- those who argue that society is patriarchal, with a culture of male domination;
- those who argue that discrimination and exploitation of women and other groups is an inherent feature of a capitalist economic system;
- those who argue that differences are the result of stereotyping and discrimination, but that this can be overcome by legislation and education.

Subject choice

There are a number of reasons given for differential gender subject choice, including:

- innate abilities – girls and boys are said to have different genes / brain development resulting in different interests and skills; however, there is little or no evidence to confirm this and the consensus is that social rather than genetic influences are important;
- socialisation – parental and family expectations, transferring attitudes from one generation to another, lead to expected gender behaviour patterns; toys given to boys and girls are often different, reflecting gender roles, a behaviour exacerbated by commercial pressures; other elements of socialisation include media stereotyping and the range of role models available, both within families and in wider society;
- school and classroom influences, including the attitudes and expectations of teachers; the fact that girls in single sex institutions are more likely to study science subjects suggests that the school environment is a significant influence.

Women in science and engineering

Clearly, if relatively few girls have traditionally studied physics and other natural sciences, there are likely to be relatively small numbers qualified to progress in the science and engineering professions. Although there is no stated comparison between the success rate of boys and girls, the source indicates that an even smaller proportion of those girls who study the subject reach the higher levels of higher education.

This may be partly due to attitudes to women in employment:

- historically, women were excluded from most workplaces during the period of industrialisation and afterwards; this pattern was altered, temporarily during the wars, when women worked in all areas of industry including engineering; but it broadly reverted to the *status quo* when the wars ended; trade unions often promoted gender discrimination to preserve male jobs;
- in the second half of the 20th century, economic change with the development of service industries and a demand for more flexible working patterns, created opportunities for women to enter the paid workforce;
- at the same time, social changes including the widespread availability of safe and effective contraception, the expansion of higher education, and equalities legislation gave women more opportunities to progress in employment and the professions.

However, there are **limits** to these new opportunities, which affect progress in science and engineering as well as in other businesses and professions:

- socialisation and gender stereotyping at home and schools have a knock-on impact on the skills and qualifications of girls and women;
- it has been suggested in some quarters that women are more cautious than men, hence are more likely to seek employment within their 'comfort zone', whereas men are more likely to take risks – and sometimes fail;
- women are more likely to take career breaks and work part-time because of family responsibilities, limiting the amount of continuous experience they may acquire;
- career breaks may also make it difficult to keep up with knowledge, ideas and research;
- workplace practices to encourage and support women into senior positions are still limited in extent and scope;

- the habits and attitudes of some men (often those in positions of power) are highly discriminatory and demonstrate the barriers still to be overcome.

Nevertheless, the cumulative effect of legislative, economic and educational change, along with increasing numbers of strong female role models, may suggest that improvements will continue, albeit at a relatively slow pace.

Other valid points, not included here, should be credited.

0 4 Explain how you would use scientific methods to test the effectiveness of medical treatments.

[17 marks]

General guidance

[Spec: 3.3.4, 3.3.6, 3.3.8, 3.3.9] This question requires candidates to demonstrate some knowledge of scientific investigation. Weaker answers are likely to have some vague or general understanding, but we should expect better answers to refer to concepts such as a 'fair test', the use of double blind trials, and be aware of the importance of peer review.

Level 1
- 1-3 marks: a brief, weak answer with little or no relevant information.
- 4-6 marks: a limited answer, but with a few basic points.

Level 2
- 7-9 marks: a modest answer, with some relevant points.
- 10-12 marks: a quite good answer, with a range of ideas explained.

Level 3
- 13-15 marks: a good answer, with some development of relevant information.
- 16-17 marks: a very good answer, with accurate and detailed points clearly explained.

Candidates should be able to achieve marks in the highest level with a selection of relevant points, not necessarily the complete range.

Examiners are reminded that up to 5 communication marks (AO4) are available for this section; well communicated answers should be appropriately rewarded.

Indicative content:

Practitioners of conventional medicine strive to use treatments that are supported by clinical evidence showing they are safe and that they work.

If a medicine or form of medical therapy is going to be used on patients, it is essential that is tested for its
- efficacy (will it do what it is supposed to, in terms of curing or ameliorating illness and disease); and
- safety (that possible side effects are identified, and any possible harm is assessed relative to the potential benefits).

There are four main elements to the development of a treatment:
- observation of the effectiveness of existing drugs or treatments, and consideration of how they may be improved by change or combination;
- development of an hypothesis – a proposal for a possible treatment, based on the observation;
- identification of a range of possible outcomes from the application of the new medicine or treatment, that can be tested;

- an investigation, survey or investigation designed to collect data which can be analysed and used to test the hypothesis and the prediction(s) based on it.

Scientists and medical researchers will seek to produce evidence that will confirm (or reject) the hypothesis. The data to be used as evidence must be:

- reliable – data which can be trusted and which can be reproduced by others;
- valid – data which answers the original question and from which appropriate conclusions can be drawn.

The best way to produce good evidence on a health treatment is to conduct a fair test of the treatment. Here, the medicine or treatment being tested is compared to another treatment, or to a fake version of the treatment, called a placebo.

Tests are made as fair as possible by minimising bias and the role of chance, and by minimising the effect of variables other than the test treatment. That means that the results of the test will reflect, as far as possible, the truth about the medicine or treatment, and will not be influenced by other factors such as the way the test was carried out, or the attitudes of the people who take part.

Control groups are often used in biological and medical research to ensure that observed effects are due to changes in the independent variable alone (for example, by using a placebo as a control in medical trials):

- a 'blind trial' is one in which participants do not know whether they are receiving an active treatment or a placebo
- a 'double blind trial' is one in which neither participants nor researchers know who is receiving active treatment or a placebo, in order to avoid any unconscious bias.

Before scientists conclude that a health treatment is safe and that it works, there must usually have been several independent tests of the treatment that have shown this.
Sometimes, different fair tests can give results that disagree.

The results of fair tests can provide:

- results that show that the medicine or treatment does work, and is safe; this is often called positive evidence, or evidence for the treatment;
- results that show that the medicine does not work, or is unsafe; this is often called negative evidence, or evidence against the treatment.

Scientists usually like to see the results of a number of fair tests before they begin to draw conclusions.

Medical journals publish detailed reports of research. The reports are peer reviewed – i.e. checked and commented on by other scientists with expertise in the area of research. The purpose of publication is so that

- other researchers can check and confirm (or challenge) the findings
- other scientists can incorporate the evidence into their own research, to take scientific and medical understanding forward.

Other valid points, not included here, should be credited.

0 5 Discuss whether the NHS should or should not offer patients complementary and alternative medical treatments which are unsupported by scientific evidence.

[18 marks]

General guidance

[Spec: 3.3.4, 3.3.6, 3.3.8, 3.3.9] This question enables candidates to consider the merits, or otherwise, of complementary and alternative medicines in contrast to scientifically validated treatments. Some candidates may generalise from anecdotes, and argue that patient choice should be a relevant consideration. However, better answers will note that the question is focused on the NHS, so issues of financial viability as well as scientific effectiveness will be discussed.

Level 1
- 1-3 marks: a brief, weak answer with little or no relevant information.
- 4-6 marks: a limited answer, but with a few basic points.

Level 2
- 7-9 marks: a modest answer, with some relevant points.
- 10-12 marks: a quite good answer, with a range of ideas explained.

Level 3
- 13-15 marks: a good answer, with some development of relevant information.
- 16-18 marks: a very good answer, with accurate and detailed points clearly explained.

Candidates should be able to achieve marks in the highest level with a selection of relevant points, not necessarily the complete range.

Examiners are reminded that up to 5 communication marks (AO4) are available for this section; well communicated answers should be appropriately rewarded.

Indicative content:

Complementary and alternative medicines are treatments that fall outside of mainstream healthcare. These medicines and treatments range from acupuncture and homeopathy to aromatherapy, meditation and colonic irrigation.

Although 'complementary and alternative' is often used as a single category, it can be useful to make a distinction between complementary and alternative medicine. This distinction is about two different ways of using these treatments:
- treatments are sometimes used to provide an experience that is pleasant in itself. This can include use alongside conventional treatments, to help a patient cope with a health condition. When used this way the treatment is not intended as an alternative to conventional treatment. The use of treatments in this way can be called complementary medicine.
- treatments are sometimes used instead of conventional medicine, with the intention of treating or curing a health condition. The use of treatments in this way can be called alternative medicine.

There can be overlap between these two categories. For example, aromatherapy may sometimes be used as a complementary treatment, and in other circumstances is used as an alternative treatment.

Some complementary and alternative medicines or treatments are based on principles and an evidence base that are not recognised by the majority of independent scientists. The availability of complementary and alternative treatments on the NHS is limited.

A number of complementary and alternative treatments are typically used with the intention of treating or curing a health condition. Examples include:

- homeopathy
- acupuncture
- osteopathy
- chiropractic
- herbalism.

In a few cases, certain complementary and alternative treatments have been proven to work for a limited number of health conditions. For example, there is good evidence that osteopathy, chiropractic and acupuncture can work to treat some persistent low back pain.

In most cases, the NHS does not offer patients complementary or alternative treatments. The National Institute for Health and Care Excellence (NICE) provides guidance to the NHS on the clinical and cost effective use of treatments and care of patients. NICE has recommended the use of complementary and alternative medicines in a limited number of circumstances. For example:

- the Alexander Technique for Parkinson's disease;
- ginger and acupressure for reducing morning sickness;
- acupuncture and manual therapy, including spinal manipulation, spinal mobilisation and massage for persistent low back pain.

NICE bases its recommendations on the available scientific evidence for the clinical and cost-effectiveness of treatments.

From the point of view of the NHS, there are a number of issues to be considered in judging whether or not to fund complementary or alternative medical treatments:

- effectiveness – is there sufficient evidence that the treatment can bring about significant improvements in a patient's condition or can ameliorate their symptoms?
- morality – is it fair to offer hope to a patient that a complementary or alternative treatment can be effective when evidence suggests that this is unlikely?
- ethical – untested or unsubstantiated treatments may expose patients to unnecessary risk and worsen their condition (as happened with Chinese medicines in recent years that caused kidney failure)
- economic – the NHS has a restricted budget, and so has an obligation to patients and taxpayers to use its resources only on treatments that can be shown to be effective;
- legal – if the NHS does not use treatments which, on the best available evidence, are effective and safe, there is the possibility of legal action, at a high cost for the service which reduces resources available for other treatments;
- political – despite the availability (or non-availability) of appropriate evidence, some politicians and prominent individuals (e.g. Prince Charles) are proponents of particular

complementary and alternative medicines, and use their positions to seek to influence NHS provision;

- patients' views – some patients may take the view that, because a particular remedy or treatment makes them feel better, they are entitled to it, and may put pressure on health practitioners to prescribe it regardless of the wider evidence;
- one could argue that 'complementary medicine', which supports evidence-based medicine, might be acceptable for provision through the NHS, but that 'alternative medicine', which not only has no substantive evidence base but seeks to replace conventional medicine, should not be acceptable.

Other valid points, not included here, should be credited.

0 6 Explain how the extraction of natural gas by the process of fracking is different from conventional methods of gas extraction.

[17 marks]

General guidance

[Spec: 3.3.3, 3.3.4, 3.3.8, 3.3.10] This question requires specific factual information to be explained. Because the source contains some obvious clues, we should expect better answers to give a detailed explanation of the fracking process, and to make a clear contrast with more conventional extraction processes.

Level 1
- 1-3 marks: a brief, weak answer with little or no relevant information.
- 4-6 marks: a limited answer, but with a few basic points.

Level 2
- 7-9 marks: a modest answer, with some relevant points.
- 10-12 marks: a quite good answer, with a range of ideas explained.

Level 3
- 13-15 marks: a good answer, with some development of relevant information.
- 16-17 marks: a very good answer, with accurate and detailed points clearly explained.

Candidates should be able to achieve marks in the highest level with a selection of relevant points, not necessarily the complete range.

Examiners are reminded that up to 5 communication marks (AO4) are available for this section; well communicated answers should be appropriately rewarded.

Indicative content:

'Fracking' as a technique has been known since the mid-20th century, but has only relatively recently been adopted and promoted on a significant scale as a means of increasing the production of natural gas by accessing previously difficult to exploit deposits.

Natural gas is a hydrocarbon gas, consisting mainly of methane. It is found in underground rock formations. It is often associated with deposits of coal or oil, but may also be found in isolated natural gas deposits.

The conventional process of extraction involves:
- drilling to the depth at which the gas is located;
- lining the drill hole with metal well casing;
- in many wells, the natural pressure of the gas reservoir is high enough for the gas to flow to the surface unaided; in some cases, however, it must be pumped up;
- in wells that produce gas and oil or other liquid condensate, the liquid hydrocarbon mixture is separated at the well-head or during the processing of the gas.

When the gas is contained in 'tight' rock formations, such as shale deposits, where there is not sufficient permeability to allow gas to flow from the rock at economic rates, some form of

'stimulation' may be used. Fracking, or hydraulic fracturing, is increasingly used to access deeper or more difficult gas formations.

In this process:

- a well is drilled to the gas bearing rock formation;
- horizontal drilling takes place to follow the rock stratum;
- steel casings are used to line the well to prevent any leakage;
- once drilling and lining is complete, small explosive charges are detonated to create cracks in the rock;
- large volumes of fracking liquid (typically 95% water, 4.5% sand, and 0.5% chemical additives) are then pumped into the well at very high pressures, pushing into the cracks in the rock beds;
- the gas is then enabled to flow through the cracks and out through the well.

Other valid points, not included here, should be credited.

The following link may be of use to examiners:

http://blog.thomsonreuters.com/index.php/hydraulic-fracturing-how-it-works/

0 7 Discuss the environmental, economic and social issues that should be considered when making decisions about permitting fracking in the UK.

[18 marks]

General guidance

[Spec: 3.3.3, 3.3.4, 3.3.8, 3.3.10] This topic has been much in the news in recent years, and we should expect candidates to have some understanding of the issues. Better answers will consider the full range of issues and, while we should reward candidates with a strong opinion, one way or the other, the higher marks are likely to go to candidates who show some balance and reach a measured conclusion.

Level 1
- 1-3 marks: a brief, weak answer with little or no relevant information.
- 4-6 marks: a limited answer, but with a few basic points.

Level 2
- 7-9 marks: a modest answer, with some relevant points.
- 10-12 marks: a quite good answer, with a range of ideas explained.

Level 3
- 13-15 marks: a good answer, with some development of relevant information.
- 16-18 marks: a very good answer, with accurate and detailed points clearly explained.

Candidates should be able to achieve marks in the highest level with a selection of relevant points, not necessarily the complete range.

Examiners are reminded that up to 5 communication marks (AO4) are available for this section; well communicated answers should be appropriately rewarded.

Indicative content:

Environmental issues
- fracking requires vast amounts of water, which must be transported to the well head at significant environmental cost;
- methane gas from the well may leak into the air;
- waste water at the well head, caused by flowback from the well, could potentially be heavily contaminated with the chemicals used in fracking, with health effects on workers and others in the vicinity;
- there is concern that the water used in fracking, which contains potentially carcinogenic chemicals, may escape underground and contaminate groundwater near the fracking site, with consequences for residents, wildlife and farm animals;
- there are concerns that the fracking process can cause small earth tremors (as happened in the Blackpool area in 2011 during test fracking), with possible damage to property and injuries to people;
- fracking is used to extract natural gas, which is a fossil fuel and which adds to carbon emissions; as a result it is potentially adding to the problem of global warming;
- it is a distraction from the perceived need to reduce energy use and create renewable alternatives to fossil fuels.

- on the other hand, despite being a fossil fuel, natural gas can generate electricity at half the CO_2 emissions of coal – so it can be seen as providing an environmental benefit overall;
- it is also argued that many of the concerns (leakage, etc) can be avoided with effective safety management and are not necessarily inherent in the process.

Economic issues

- fracking vastly increases the amount of difficult-to-reach reserves that are accessible, giving energy security for several decades at least;
- in the US it is said to have reduced gas prices, though that may not be the case in the UK (see Lord Deben's comments);
- gas prices are also subject to global pressures of supply and demand, as well as national taxation, and national and EU regulation;
- will lead directly to the creation of thousands of additional jobs;
- the more secure and certain (and cheaper?) fuel supply will have more general benefits for industrial production and the economy;
- the coalition government has made clear that it wishes to go 'all out' for fracking, believing that it will bring economic benefits;
- on the other hand, the costs of additional infrastructure (roads, etc) and dealing with pollution must be put against any claimed economic benefits.

Social issues

- fracking on an extensive scale will change the nature of many parts of the UK countryside;
- it will (and already has, e.g. in Balcombe, East Sussex) generate significant local opposition, as people may oppose the industrialisation of their local areas;
- there have been significant costs in policing the demonstrations against the still relatively small-scale fracking test sites; this could become a much greater issue in the future;
- the coalition government has offered benefits to local authorities which permit fracking in their areas, as well as direct payments to communities in areas affected (£100 000 and 1% of revenues);
- this creates a conflict of interest for councils, which may benefit from payments but which also have to act as planning authorities in the best interests of local people.

Other valid points, not included here, should be credited.