



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme

June 2003

GCE

General Studies A

Unit GSA5

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Unit 5 Question 1

(GSA5 Science, Mathematics and Technology)

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

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

Unit 5 Question 2

(GSA5/2 Science, Mathematics & Technology)

INTRODUCTION

The overall assessment objectives for General Studies are set out below:

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

All mark schemes will allocate a number or distribution of marks for some or all of these objectives for each question according to the nature of the question and what it is intended to test.

Note on AO2

- In all instances where quality of written communication is being assessed this must take into account the following criteria:
- select and use a form and style of writing appropriate to purpose and complex subject matter;
- organise relevant information clearly and coherently, using specialist vocabulary when appropriate; and
- ensure text is legible and spelling, grammar and punctuation are accurate, so that meaning is clear.

Note on AO4

This is a new element in General Studies specifications. In the past, there has been a focus on the knowledge of facts, and the marshalling of evidence – on what might be called ‘first-order’ knowledge. This is still fundamental; but AO4 is about understanding what counts as knowledge; about how far knowledge is based upon facts and values; and about standards of proof.

By ‘different types of knowledge’ we mean *different ways of getting knowledge*. We might obtain knowledge by fine measurement, and calculation. This gives us a degree of certainty. We might obtain it by observation, and by experiment. This gives us a degree of probability. Or we might acquire it by examination of documents and material remains, or by introspection – that is, by canvassing our own experiences and feelings. This gives us a degree of possibility. In this sense, knowledge is a matter of degree.

Questions, or aspects of them, which are designed to test AO4 will therefore focus on such matters as:

- analysis and evaluation of the nature of the knowledge, evidence or arguments, for example, used in a text, set of data or other form of stimulus material;
- understanding of the crucial differences between such things as knowledge, belief or opinion, and objectivity and subjectivity in arguments;
- appreciation of what constitutes proof, cause and effect, truth, validity, justification, and the limits to these;
- recognition of the existence of personal values, value judgements, partiality and bias in given circumstances;
- awareness of the effects upon ourselves and others of different phenomena, such as the nature of physical, emotional and spiritual experiences, and the ability to draw upon and analyse first-hand knowledge and understanding of these.

GENERAL MARK SCHEME FOR A2 ESSAYS

The essay questions in General Studies A are designed to test the four assessment objectives (see INTRODUCTION above) as follows:

AO1 – 6 marks AO2 – 5 marks AO3 – 7 marks AO4 – 7 marks **Total – 25 marks**

Each answer should be awarded two separate marks, comprising a mark out of 20 for content (Assessment Objectives 1, 3 and 4) and a mark out of 5 for communication (Assessment Objective 2). The mark for content should be awarded on the basis of the overall level of the candidate's response in relation to the following general criteria and descriptors for each level.

Level of response	Mark range	Criteria and descriptors for Assessment Objectives 1, 3 and 4: knowledge, understanding, argument and illustration, evaluation.
LEVEL 4	16 – 20 (5)	Good response to the demands of the question: sound knowledge of material (AO1); clear understanding and appreciation of topic, nature of knowledge involved and related issues (AO4); valid arguments and appropriate illustrations, coherent conclusion (AO3).
LEVEL 3	11 – 15 (5)	Competent attempt at answering the question: relevant knowledge (AO1); reasonable understanding and appreciation of topic, nature of knowledge involved and related issues (AO4); some fair arguments and illustrations, attempt at a conclusion (AO3).
LEVEL 2	6 – 10 (5)	Limited response to the demands of the question: only basic knowledge (AO1); modest understanding and appreciation of topic, nature of knowledge involved and related issues (AO4); limited argument and illustration, weak conclusion (AO3).
LEVEL 1	1 – 5 (5)	Inadequate attempt to deal with the question: very limited knowledge (AO1); little understanding and appreciation of topic, nature of knowledge involved and related issues (AO4); little or no justification or illustration, inadequate overall grasp (AO3).
LEVEL 0	0	No response or relevance to the question

The mark for communication (AO2) should be awarded using the following scale and criteria.

5 marks	Clear and effective organisation and structure, fluent and accurate expression, spelling, punctuation and grammar.
4 marks	Clear attempt at organisation and structure, generally fluent and accurate expression, spelling, punctuation and grammar.
3 marks	Some organisation and structure evident, variable fluency, occasional errors in expression, punctuation and grammar.
2 marks	Limited organisation and structure, little fluency, a number of errors in expression, spelling, punctuation and grammar.
1 mark	Lacking organisation, structure and fluency, frequent errors in expression, spelling, punctuation and grammar.
0 marks	No response

Note: A totally irrelevant response (Level 0) should also receive 0 marks for communication. A brief and inadequate response (Level 1) should be awarded not more than 2 marks and a limited response (Level 2) normally not more than 3 marks for communication. Responses at Level 3 and 4 for content may be awarded up to 5 marks for communication.

2.1

Discuss ways in which science and technology may be used to address the United Kingdom's growing transport problems.

A straightforward question capable of fairly wide interpretation. A good candidate will define the growing transport problems and there is possible AO4 in the discussion of how science and technology may be used to address these problems. UK **air travel** not on the same scale as internal US travel:

- pressure for a fourth London airport
- cheap travel and mass travel expected in the future
- safety need for good air traffic control
- polluting effect of air fuel and noise although manufacturers claim that emissions and noise levels have halved over the last thirty years
- aircraft industry plans to make 16000 new jets over the next 20 years.

Some candidates may limit their responses to the need for an **integrated transport** policy which makes the best of public and private land travel:

- toll lanes/congestion tax and the technology to identify users and charge them
- bus lanes, park and ride schemes for shoppers and visitors
- rail travel improvements – the TGV to Scotland? Or at least through Kent!
- Virgin's tilting trains? Safety through sound infrastructure maintenance
- freight goods to trains rather than juggernauts
- Urban cycling and pedestrians to be more valued
- Car sharing to be encouraged
- Life organised for less travelling – home shopping, teleworking.

The problems of **air pollution** by cars are being addressed with new engine designs e.g. fuel cells, gas, electric – Emissions and their effects include:

- Benzene; a particular problem in super unleaded petrol is significantly reduced by using catalytic converters and carbon canisters designed to decrease hydrocarbons
- Carbon Dioxide; on average, a car will produce one tonne a year. Emitted whenever fossil fuels are burned. It is the main gaseous contributor to the greenhouse effect and global warming
- Carbon Monoxide is lethal at both high and low doses – can cause headaches, tiredness and stress
- Lead; not found in diesel fuels but put into petrol to increase its octane level and boost energy efficiency, it can build up in our blood and bones damaging the brain and central nervous system. Children are particularly vulnerable
- Nitrogen Oxides (NOx); Nitrogen dioxide is a major part of vehicle emissions – can damage the immune system
- PAHs; produced in diesel vehicle exhausts in small quantities – powerful cancer causing chemicals
- Particulates; at its worst at the kerb side – main source is burning of diesel. There has been growing concern about PM10s (less than one hundredth of a mm) which can penetrate deeply into lungs
- Sulphur Dioxide: from diesels and to a much lesser extent from leaded and unleaded petrol.

2.2

Computers with increasingly more technical hardware and software are being sold for use in the home.

Discuss the items that such a range may comprise and their potential application by a family

A good candidate ought to be able to discuss a credible range of hardware/software and then go on to sensibly discuss how these might be applied by members of a family (possible AO4).

Hardware items that are pretty standard now include an inkjet printer, a modem for connection to the internet, graphics and sound cards, a scanner, a monitor, a mouse and a keyboard. Other optional hardware items could be a larger (17 inch) or TFT flat screen, digital camera, webcam, wireless mouse, laser printer, joystick. Software packages are bundled with the sale and usually include a wordprocessor, a spreadsheet and a database e.g. Microsoft Office, an operating system e.g. Windows and options might include games, an educational or other specialist package e.g. Photosuite. The retailer will either be already linked to an ISP (Internet Service Provider) or will have a free CD from one of the major providers. This ISP will also provide the web space for one's own website along with email and text facilities. A scanner will usually have a FAX facility included.

Family use will probably be expressed in age group interests and hopefully will not reinforce gender stereotyping. Children, teenagers and adults seem to be reasonable divisions for the purposes of this question. Children are exposed to a growing range of IT items in school and most parents would see the acquisition of a home PC as a means of reinforcing a positive attitude in the child, practising the skills needed to manipulate mice and keyboards and accessing educational software that will enhance learning opportunities. There may be some debate about the value of games in this context but many pieces of educational software for young children use a game framework as a means to an end. Colour, music and animation are fully used often by Noddy in Toyland, Bob the Builder in his yard or other well known and loved figures.

Teenage children would, in the main, be interested in access to the internet for educational research and to use email, text services and chat rooms. Information can be sought by inserting key words into a search engine e.g. Google. Games playing would feature strongly with this group. This can now be done with friends participating in the same game over the internet. Some enthusiasts would be able to set up web pages and download music files to an MP3 player. Friends Reunited is a website, specialising in identifying what old school friends are doing now, that seems to be popular with this group and younger adults.

Adults may be interested in using the computer for their work e.g. accounting, banking records or keeping in touch with their emails at work and using the computer for specific personal interests e.g. photography, genealogy, or for shopping on-line. Holidays and accommodation are being bought more and more over the internet. Estate agents, car sales and job searches are becoming popular.

Finally, the most reluctant but growing group are the silver surfers. Many are fascinated with the way distantly separated families can stay in touch using webcam and email communications.

2.3

Discuss the effectiveness of the design features used by supermarkets to assist customers and stimulate demand.

This question requires a good understanding of the psychological and ergonomical principles that are employed in influencing customers to buy more goods, or goods that they did not really need in the first place. The discussion ought to demonstrate a good knowledge of the visual, aural and physical ploys adopted by supermarkets and some judgement (possible AO4) of the effectiveness of these ploys.

The location of the supermarket is vital. Generally it will be near or within an area where many people live. It caters for customers arriving by car, leaving with them laden and will have ample car parking. Wider spaces for disabled people followed by many for parents with children take priority by being nearer the store entrance. Fuel stations, selling cheaper fuel, near the exits of the car parks are common. Well maintained trolleys of different types are readily available for different types of customer – “Please report me if my wheels stick!” The store entrance is often capacious- with very wide revolving doors e.g. and this is the point where special offers and free samples are most effective. There will be toilets not far from the entrance and a café or restaurant is becoming a common feature of supermarkets. Many are trying to emulate IKEA which has a reputation as a “destination shop” i.e. People will travel quite some distance to go to this shop and that is the only point of the journey.

Generally speaking, advertising is unavoidable. The majority of adverts fit into a small range of stereotypes. Advertising can’t change our basic needs but it changes the way we satisfy them. In the future they will become more persuasive with individuals targeted. Store loyalty cards give supermarkets the opportunity to target individuals with tailored special offers based on previous purchasing patterns.

Five ways the supermarket has you covered!

- Different colours (a blue fish counter suggests freshness. Green for fruit/veg is restful)
- The order in which a shopper looks over goods – eye level first then lower shelves
- Varying depth shelves puts more goods into view – a sense of limitless stocks
- Strategic positioning of mirrors implies abundance esp. in fruit and veg
- Careful design of shelves – curved shelving leads seamlessly to the next aisle.

Psychologists have estimated that 90% of stimuli perceived by individuals come through sight.

Notice the amount of trolley and floor advertising and hand written signs that attract you because they are different. Many chains have ditched the highly lit white hangars and gone for muted and pastel colours with sectioned off parts of the shop to create an intimate atmosphere. Red is aggressive and gets things noticed or speeds things up e.g. McDonalds or KFC. Coffee shops tend to have autumnal colours – a tip for house selling is to have the smell of freshly made coffee and/or bread in the background. The smell of freshly baked bread is often in supermarkets from the in-store bakery.

The tempo of background music affects the way people shop. Slow music has been shown to reduce the pace of in-store traffic and make people buy more goods. There is some concern that subliminal messages are being broadcast through sound systems. The ideal temperature for a supermarket (that makes you feel relaxed and comfortable is said to be between 70°F and 73°F).

One area that supermarkets haven’t got right yet is the checkout. This is brash, bright, high ceilinged, narrow and fast – all of which increase shoppers’ anxiety. This is also a sweetie free zone after pressure from hassled parents and the health lobby so no chocolate to de-stress!

2.4

“There are three sorts of lies - lies, damned lies and statistics” (B.Disraeli).

Comment on the validity of this statement and discuss the extent to which statistics may be used properly or improperly.

The quotation suggests that statistics are capable of being used to tell the worst sort of lie. Leaving the degree aside for a minute, it is clear that Benjamin Disraeli clearly thinks that politicians particularly will search for the gloss or angle that will best portray their case. Is it the case that every set of data or statistical technique is capable of two opposed interpretations, or is it the case that those who are not skilled in statistics are capable of being blinded by science? (c.f. He uses statistics rather like a drunk uses lamp posts – for support rather than illumination or The art of drawing straight lines from unwarranted assumptions to foregone conclusions). This question may provide the opportunity for a Statistics or Economics or Government and Politics student to display his/her knowledge about the way the Government uses statistics and make a judgement about the truth of the Disraeli quotation (possible AO4).

The words statistics and state have a common root. Statistics were to be the data and decision making framework in state planning – teachers, schools, doctors, hospitals, highways, railways, police needs are all areas for which the state tries to have the right answers. The ten year census (last one in 2001) may be mentioned. The annual publication of social trends by the government is a useful snap shot of the directions in which we are going.

The most blatant cases of politicians arguing from one specific example to the general case have happened quite recently in trying to discredit the NHS – Emily’s ear grommets during the 1997 election campaign and the old lady who was allegedly left in a bed in A&E without being given proper care was taken up by Iain Duncan-Smith. These are examples of samples not representing the population that they are taken from and also, there is more confidence in any conclusion about the population if the sample is as large as possible – not so in these cases. Also, beware of a biased sample being used – eight out of ten cat owners like cats!

The media are frequently responsible for projecting from a single example to the general case particularly in the crime and punishment area and one of the results of this is an unwarranted fear amongst the public about e.g. street crime which is not supported by the actual statistics. Some candidates may comment upon truth being the first casualty of a war and have examples of e.g. “collateral damage” as at least a euphemism.

A statistical notion that is often abused is “the law of averages” which is based on the probability of something becoming due to happen after a long stretch of something else happening. E.g. If a gambler in a casino sees seven “reds” in a row when watching roulette then he ought to assume that “black” should be coming up soon on the “law of averages”. In fact the probability of “black” on the next turn is still 0.5. However, he may decide that there is something wrong with the mechanism after the reds sequence and confidently bet “red” for an eighth time! Significance testing is an area open to abuse. There is always a small chance of a mistake being made when the null hypothesis is rejected or accepted e.g. In breathalysing drivers it is possible for a man/woman to drunkenly slide out of a car and “pass” the test. Similarly, it is possible for a driver to fail the test having taken the smallest amount of alcohol but to appear to be cold sober to everyone involved. The reasons for this are essentially to do with subjects who would be in the tail of a normal distribution popping up in a test which has its norms based upon individuals who are nearer to the centre of a normal distribution. There have been cases of expensive drugs testing field tests falling foul of this snag. Other examples may be included based upon changes of scale, misuse of percentages (e.g. 10% of £100 is £10 but 10% off £110 leaves you with £99) or a lack of understanding of probability.

2.5

Explain the science which may be used by a successful gardener.

Discuss the benefits of a well-planned and maintained garden.

This question ought to provide good candidates with the opportunity to display their knowledge of this application of science across a broad range of gardening activities and then go on to make some value judgements in the discussion about the motivations for doing it (possible AO4).

Gardening is a highly popular activity. The number of books in retailers, the success of radio programmes e.g. “Gardener’s Question Time” and TV programmes e.g. “Ground Force” are testament to this. Also, the success of the Chelsea Flower show, RHS events, visiting National Trust Properties and their gardens, the large number of local garden centres, local annual shows of produce are tokens of this popularity.

A knowledge of elements of Biology, Chemistry, Physics, seems to be essential for the good gardener. Design principles in landscaping the garden are also needed.

The science of gardening is to be found in a knowledge of biology; the conditions for successful plant growth – the cycle of a seed becoming a fruit, pollination – the birds and the bees, seasonal variation and the gardener’s calendar, digging/rotavation of the soil, natural pest and weed control, composting, the need for pruning, an awareness of possible diseases and how to combat them, harvesting techniques.

Chemistry is needed in use of fertilisers, pH soil values and chemical pest and weed control.

A knowledge of physics and the effects of the technology may be used in pursuit of plant growth or alternative uses of the garden e.g. cold frame and greenhouse techniques, temperature and humidity control; pond or water feature maintenance, decking, patio, lighting, fencing, security needs – the garden is often now perceived as an additional living room.

Finally, the discussion ought to take into account the reasons people become gardeners – the sense of achievement one gets from doing something well – this may be a response to relieve the demands of a full time sedentary job. In the case of a garden, there is certainly a great deal of aesthetic pleasure in shaping or arranging living organisms into a pleasing sight and there is the primordial satisfaction in growing one’s own food. The garden is a living space for the non-gardeners in the family and the gardeners sense of provision for them will be strong affecting his/her sense of worth. Many people who have retired get a great sense of doing something useful from their gardening and this gives them a topic to converse about knowledgeably in company. This phenomenon is not all middle class! Many people who have no direct access to a garden may have an allotment or may take great care with window boxes.

2.6

What are the physical requirements of a bridge?

Discuss how such a structure may have different aesthetic and engineering qualities. Use examples to illustrate your answer.

There are three major types of bridges:

- the beam bridge
- the arch bridge
- the suspension bridge

the biggest difference amongst the three is the distance that can be covered in a single span. A modern beam bridge is likely to span a distance upto 60 metres, a modern arch can safely span a distance upto 300 metres whilst a suspension bridge is capable of spanning upto 2100 metres.

The differences lie in the way each type of bridge deals with compression and tension forces in its components – compression force tries to shorten the component and tension tries to lengthen the component. Buckling and snapping, respectively are the outcomes when the component is not strong enough. The best way to deal with these forces is to dissipate them over a greater area e.g. in an arch bridge, or transfer them from an area of weakness to one of strength e.g. in a suspension bridge.

A beam bridge is a rigid horizontal structure that is resting on two piers. The weight of the bridge and any traffic on it are directly supported by the piers. The top part of this structure is in compression and the lower part of the structure is in tension. Many beam bridges use concrete or steel beams to dissipate the load by increasing the height of the bridge – a supporting lattice or truss made up of triangular elements.

An arch bridge is a semicircular structure with abutments at each end. The force of compression is pushed outwards along the curve towards the abutments where it is dissipated. The tension in an arch is negligible. However, the natural strength in an arch may be overcome if the arch gets too big.

A suspension bridge is one where cables are strung across a gap and the deck is suspended from these cables. Most modern suspension bridges have two towers through which the cables are strung and these towers support the weight of the deck and its traffic. The cables are anchored to the earth at the edges of the bridge and the tension forces in the cables are dissipated through the anchorages and the towers. Almost all also have a supporting truss beneath the deck which helps to stiffen the deck and reduce the tendency of the deck to be twisted by winds. A variation on the characteristic M shape is an A shaped cable-stayed bridge-with the deck suspended from a single tower.

Resonance – a vibration caused by an external force that is in harmony with the natural frequency of the bridge can be fatal to the bridge. (The Tacoma Narrows bridge fell apart in 1940 in gusts of 40 mph winds). An army does not march across a bridge but breaks step – the millennium footbridge on the Thames near St Paul's was liable to sway when many people were walking across it and this was eliminated by building in dampeners to interrupt resonance waves. Bridge designers have learned their craft by studying the failures of the past. Wood has been replaced by iron which has been replaced by steel. Pre-stressed concrete is used in many road bridges. Each new material or design technique builds off the lessons of the past.

The second part of this question will allow good candidates – budding engineers and architects- to go on and wax lyrical about the beauty of their chosen bridge(s) – showing good harmonious proportions in three-dimensional space. It is not sufficient for structures just to be functional and structurally correct nor is it acceptable that the advantages of modern construction should be exploited for economic benefit without due consideration to appearance and aesthetics. The golden ratio (0.618) is used extensively in many eye-catching bridge designs.