OCR
RECOGNISING ACHIEVEMENT

GCE

General Studies

Advanced Subsidiary GCE

Unit **F732:** The Scientific Domain

Mark Scheme for January 2011

Oxford Cambridge and RSA Examinations

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Guidance for Examiners

Do not use ticks in Section B.

Use the following annotations. (In any one script you are not expected to use all of these.)

Yes	recognises a point worthy of credit
Dev	a developed point or development of a point
No	a content error
NAQ	not answering the question
eg	appropriate example
SP/G/Eng	spelling, grammar and language error; you are not expected to correct all of them
(…)	indicates a choice or a key phrase
Rubric	rubric infringement
D	description
R	reason
Rep	repetition, often of the question
Ev	evaluation

Stages to an essay mark

Read and annotate the candidate's response.

Consider its position within the level and a possible mark.

Write a one or more line comment reflecting the AO statements.

eg	AO1	good knowledge very limited knowledge and eg
	AO2	examples given
	AO3	personal experience relevant restricted personal experience
	AO4	clearly written inaccurate Spg

Enter the final mark in a circle.

Assessment Objective Weighting

	AO1	AO2	AO3	AO4
Marks	**8**	**10**	**6**	**6**

Generic Mark Scheme for Questions with 30 marks

Level 5

AO1	• select, use and integrate a very good range of relevant knowledge • show a good understanding of the concepts involved	**25–30**
AO2	• interpret and analyse issues and problems well and evaluates them appropriately • use evidence to develop complex reasoned arguments and draw sound conclusions on the evidence	
AO3	• demonstrate very good awareness of the differences between types of knowledge • have a very good appreciation of the strengths and limitations of the different types of knowledge	
AO4	• communicate complex ideas clearly and accurately, using specialist vocabulary where appropriate, in a concise, logical and relevant way • use a wide range of the rules of grammar, punctuation and spelling with accuracy and facility.	

Level 4

AO1	• select, use and integrate a good range of relevant knowledge • show an understanding of the concepts involved	**19–24**
AO2	• interpret and analyse issues and problems well and evaluates them competently • use evidence to develop reasoned arguments and draw sound conclusions on the evidence	
AO3	• demonstrate good awareness of the differences between types of knowledge • have a good appreciation of the strengths and limitations of the different types of knowledge	
AO4	• communicate ideas clearly and accurately, using specialist vocabulary where appropriate, in a concise, logical and relevant way • use a range of the rules of grammar, punctuation and spelling with accuracy and facility.	

Level 3

AO1	• select, use and integrate a range of relevant knowledge • show an adequate understanding of the concepts involved	**13–18**
AO2	• undertake some interpretation and analysis of issues and problems and make a superficial evaluation • use evidence to develop arguments and draw conclusions	
AO3	• demonstrate awareness of the differences between types of knowledge • have an appreciation of the strengths and limitations of the different types of knowledge	
AO4	• communicate clearly, using some specialist vocabulary with facility • use some of the rules of grammar, punctuation and spelling with facility.	

Level 2

AO1	• select, use and integrate a limited range of relevant knowledge • show a modest understanding of the concepts involved	**7–12**
AO2	• demonstrate limited interpretation and analysis of issues and problems with limited evaluation • use evidence to develop limited arguments and draw limited conclusions	
AO3	• demonstrate limited awareness of the differences between types of knowledge • have a restricted appreciation of the strengths and limitations of the different types of knowledge	
AO4	• communicate ideas with limited clarity, using some specialist vocabulary • uses some rules of grammar, punctuation and spelling.	

Level 1

AO1	• select, use and integrate some knowledge which may not be accurate • show a restricted understanding of the concepts involved	**0–6**
AO2	• demonstrate poor interpretation and analysis of issues, problems and evaluation • recognise arguments and conclusions	
AO3	• demonstrate very limited awareness of the differences between types of knowledge • have a very restricted appreciation of the strengths and limitations of the different types of knowledge	
AO4	• communicate with little clarity using occasional specialist terms • use poor grammar and punctuation and inaccurate spelling.	

Section A

Answer **all** the questions in this section.

1 **Three significant components of air pollution in the UK are Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_x) and Carbon Monoxide (CO). Figs 1, 2 and 3 (opposite) show the main sources of these chemicals in air pollution.**

(a) **Identify the main source of air pollution for <u>each</u> of SO_2, NO_x and CO.** **[1]**

SO_2 Power stations
NO_x Transport
CO Transport
1 mark if all three correct.

(b) **Using Figs 1, 2 and 3, state whether you agree or disagree with <u>each</u> of the following the statements and give your reason.**

(i) **Transport makes the smallest contribution to the SO_2 found in the atmosphere.** **[2]**

Agree. In Fig 1 it is shown to contribute 1% which is the smallest of those shown. 1 mark for agree and 1 for evidence. Require a figure to indicate smallest. If a candidate disagrees but brings forward evidence, eg difficulty measuring contribution of transport, to support their conclusion it could be possible, though unlikely, to award two marks for disagreement. Disagree on its own = 0 marks

(ii) **Domestic and commercial sources account for twice the NOx contributed by refineries and iron and steel industries to air pollution.** **[2]**

Agree. In Fig 2 D & C contribute 6% whilst R, I &S contribute 3%.
1 mark for agree and 1 for evidence. Require figures to show twice as much.

If a candidate disagrees but brings forward evidence, eg overlap between sources, to support their conclusion it could be possible, though unlikely, to award two marks for disagreement. Disagree on its own = 0 marks

(c) **(i)** **'Adding together the percentages for each of the sources suggests that Transport (124%) is the largest contributor to air pollution.' Explain the flaws in this statement.** **[3]**

- the percentages are of different wholes
- to find the amount contributed by transport, need information about relative contributions
- in terms of share 124% is not possible
- with others contributing 99% is the maximum.

Accept other correct explanations.
Three simple points @ 1 each or elaborated points up to 3.

(ii) Give <u>two</u> disadvantages of using the pie charts shown in Figs 1, 2 and 3 to display this data. **[2]**

1 mark for each disadvantage.

Disadvantages include:
- circles all same size yet contributions may be different
- difficult to compare segments other than that at the start
- calculation to construct can be tedious
- segments of some very small.
- some people are not able to read colours
- actual amounts not shown
- the category called other is vague
- the numbers are rounded to whole numbers
- totals not shown.

Allow alternatives related to divided circles.

(d) Table 1 shows how air pollution emissions have been declining in the UK since 1960.

Table 1

POLLUTANT (annual emissions in thousand tonnes)	**1960**	**2007**
Sulphur dioxide (SO_2)	6370	676
Nitrogen oxides (NO_x)	3125	1595
Carbon monoxide (CO)	12120	2270

Suggest <u>two</u> reasons for the changes shown in Table 1. **[8]**

Outline <u>two</u> further ways in which air pollution could be reduced in the future.

Reasons (R1,R2) include:
- cleaner petrol and oil
- less power generated by fossil fuels
- filters on chimneys
- 'smokeless fuels' and fewer domestic fires
- catalytic converters as standard to cars
- awareness campaigns
- fewer factories.

Two ways @ 1 mark each.

Two further ways (W1,W2), must be additional to those already given:
- use of electric/ hydrogen cars
- gas generated electricity
- use of nuclear power
- use of renewable energies eg wind, water, tides, solar, geothermal
- regulation of casual sources eg domestic bonfires
- increased use of public transport
- smaller carbon footprint
- recycling.

Two further ways @ 1 mark each.

Examiners may allow further ways that are already in use.

Two additional AO4 marks are available for each part.
AO4 to be shown separately inside the margin

AO4 marks as follows:

0 marks if the meaning is not clear.
1 mark if the meaning is partially clear but the text contains frequent errors of SPG.
2 marks if the meaning is clear and the text contains very few errors of SPG.

2 **The following article describes one of the ways in which the Royal Horticultural Society marked the bicentenary of the birth of Charles Darwin.**

“Treasure chests” containing tools, seeds, flower presses and plant guides are being distributed to every state primary school in the UK as part of the ‘Great Plant Hunt’.

A visiting expert told the children at a London primary school they would be the "Charles Darwins of the 21st century". He handed over the first of the 23,000 chests designed by experts from the Royal Botanical Gardens at Kew. Darwin himself frequently collaborated with his own children on experiments as they explored the landscape around his house.

A director at Kew explained: 'We are facing a skills shortage in science in the UK especially in botany. By the time many children reach secondary school, they already feel science is not for them. By 16, the majority are lost to science, seeing it as dull and repetitive. The Great Plant Hunt is setting out to change some of that by offering opportunities to engage with real science and to explore the wonder and beauty of the world of plants.'

As part of the project, children will be encouraged to go on 'thinking walks', as Darwin reportedly did when formulating his theories of evolution and natural selection. With no laboratory, he used the grounds around his home to devise experiments and test his ideas.

The flower press in The Great Plant Hunt treasure chest is modelled on the one Darwin used. Among the specimens pupils are encouraged to collect are seeds. Inside the chests, the children will find details about the experiments they can do, magnifiers, a plant identikit and a mini seed bank.

(adapted from www.greatplanthunt.org, RHS 2009)

(a) Read the passage above and state briefly, in your own words, what you understand by the following:

(i) 'the 'Charles Darwins of the 21st century" [lines 3–4]. [2]

Allow up to two marks for each point made.

- an interest in the natural environment
- interest in ecology, evolution, species
- inductive or exploratory approach
- collectors of plants.

Credit alternative appropriate statements.

(ii) 'to go on 'thinking walks" [line 13]. [2]

Allow up to two marks for each point made.

- awareness of the environment around the walker
- conscious of nature and thinking about how it works
- testing and devising experiments.

Credit alternative appropriate statements.

(b) Using your own words outline <u>two</u> reasons given in the article for the 'skills shortage in science' [line 7]. [4]

Teaching in secondary school suggests science is dull and repetitive.
Lack of engagement with real science.
Lack of opportunity to explore the wonder and beauty of the world of plants.
Lack of access to equipment.

Candidates need to translate 'dull and repetitive', 'real science', 'wonder and beauty' into their own words.

Two reasons required @ 1 mark each.
Two marks for AO4 to be shown inside the margin.
AO4 marks as follows:

0 marks if the meaning is not clear.
1 mark if the meaning is partially clear but the text contains frequent errors of SPG.
2 marks if the meaning is clear and the text contains very few errors of SPG.

(c) Justify <u>one</u> way, other than 'The Great Plant Hunt', in which more students might be encouraged to choose to study science at A-level. [4]

One way at 1 mark for basic idea and 1 mark for its elaboration. The key point here is the logic of the justification. Eg it applies to science and not to PE or Media Studies.

Possible ideas include:

- reform of science teaching in lower school
- greater investigative experiences in laboratory
- focus on relevance to everyday life eg global warming
- integration with more popular subjects eg science of movement
- media promotion/celebration of some jobs/careers.

Two marks for AO4 to be shown inside the margin.
AO4 marks as follows:

0 marks if the meaning is not clear.
1 mark if the meaning is partially clear but the text contains frequent errors of SPG.
2 marks if the meaning is clear and the text contains very few errors of SPG.

Section A Total [30]

Section B

Answer <u>one</u> question in this section. Answers should be in continuous prose.

3 **Why are governments currently so concerned about global warming? Explain <u>two</u> actions that governments could take to slow the rate of global warming.** **[30]**

	AO1	AO2	AO3	AO4
Marks	**8**	**10**	**6**	**6**

This question involves:
- implied recognition of the phenomenon of global warming
- reasons for governmental concerns
- two actions that could be taken to slow global warming.

The question is in two main parts (concerns and actions). Exceptionally candidates answering only one part of the question can be awarded marks up to the top of Level 3. If an examiner is uncertain about scoring an answer they should consult their Team Leader.

Recommended annotation
Intro for introduction
R1, R2… for reasons for governmental concerns
A1 and A2 for two further actions that could be taken
Dev for development
eg for examples
Conc. for conclusion.

Indicative content

Implied recognition of the phenomenon of global warming.
- Global Warming is defined as the increase of the average temperature on Earth
- May be defined in terms of climate change with hurricanes, droughts and floods more frequent
- Over the last 100 years, the average temperature of the air near the Earth's surface has risen a little less than 1° Celsius (0.74 ± 0.18°C, or 1.3 ± 0.32° Fahrenheit)
- Out of the 20 warmest years on record, 19 have occurred since 1980. The three hottest years ever observed have all occurred in the last eight years.

Holes in the Ozone layer are not to be connected to Global Warming though the increase in chlorofluorocarbons from aerosol use may be mentioned.

Reasons for governmental concern about global warming include:

- rise in temperatures threatens existing ecosystems
- greater frequency of extreme weather conditions
- rising sea levels threaten coastal areas
- loss of the Amazon Rainforest as rainfall decreases
- collapse of the Great Barrier Reef as sea temperatures change
- falls in salinity cause ecological change
- desertification of some populated areas
- changing climate threatens some commercial activities
- industrialisation of China and India may accelerate effects.

Two actions that could be taken to slow the rate of global warming include:

- power generation from nuclear and renewable sources
- cleaner cars eg electric and hydrogen
- further reductions in carbon and methane footprints
- reductions in use of air travel through higher taxes
- increased education and public awareness
- joint international action and collaboration
- reshape the insurance industry to cope with volatile climate changes
- recycling.

Examiners should accept other suggestions that are related to the topic. Check the internet if uncertain.

Examiners tolerance:
Some answers may be sceptical of the concept of global warming suggesting that in fact the earth is experiencing a fluctuation. Examiners should be understanding of this possibility.

Levels descriptors
These descriptors are intended as a first guide to examiners. They indicate the characteristics of a top of level answer. Marks within a level are awarded when an answer does not include all the parts or qualities shown in the descriptor.

Level 5	These candidates will produce very good developed responses to the two parts of the question. Their answers will be very clear and written with accuracy and fluency.	**25–30**
Level 4	These candidates will produce good responses to the two parts of the question. One of these will be developed. Their answers will be clear with few limitations to their SPG.	**19–24**
Level 3	These candidates will produce answers containing relevant knowledge linked to two parts of the question. Their understanding of one part will be adequate though there may be some imbalance. Their answers will be clear with some limitations to their SPG.	**13–18**
Level 2	These candidates will produce answers showing limited knowledge linked to two parts of the question. Their understanding of one of the parts will be modest and partial. Their answers will not be clear with insecurity in their SPG.	**7–12**
Level 1	These candidates will produce answers showing very limited knowledge linked to one part of the question. Their understanding will be modest and partial. Their answers will lack clarity using poor grammar and punctuation and inaccurate spelling.	**0–6**

4 **The American mathematician John Allen Paulos, in his book 'Innumeracy' [2001], concludes that the three mathematical concepts a person needs in daily life are proportion, risk and probability.** **[30]**

Explain, using an example of <u>each</u>, how these <u>three</u> concepts inform decision making in daily life. Justify <u>one</u> further mathematical concept you would add to the list.

	AO1	AO2	AO3	AO4
Marks	**8**	**10**	**6**	**6**

This question involves:
- understanding the three concepts of proportion, risk and probability
- explanation of how each informs decision making in daily life
- justification of one further mathematical concept to add to the list.

The question is in two main parts (interpretation of three plus further suggestion). Exceptionally candidates answering only one part of the question can be awarded marks up to the top of Level 3. If an examiner is uncertain about scoring an answer they should consult their Team Leader.

Recommended annotation
Intro. for introduction
P1, P2 … for points about proportion and links to daily life
R1, R2… for points about risk and links to daily life
C1, C2 for points about probability or chance and links to daily life
Dev for development
FMC for points about a further mathematical concept
Conc. for conclusion.

Indicative content

The concept of proportion includes:
- a part considered in relation to the whole
- a relationship between things or parts of things with respect to comparative magnitude, quantity, or degree
- a relationship between quantities such that if one varies then another varies in a manner dependent on the first
- dimensions/proportions; size. Often used in the plural
- a statement of equality between two ratios. Four quantities, *a, b, c, d,* are said to be in proportion if $^{a}/_{b} = {}^{c}/_{d}$
- proportion could refer to the arts, architecture, mixtures or stand point (link to keeping things in proportion).

The concept of risk includes:
- the uncertainty of outcome
- the precise probability of specific eventualities
- in general usage the convention is to focus only on the potential negative impact to some characteristic of <u>value</u> that may arise from a future <u>event</u>

- the probability that an action or event will adversely or beneficially affect the ability to achieve an objective
- an assessment of danger in almost any activity such as outdoor pursuits, sport or travel. Also part of financial life.

Probability

- probability, or chance, expresses the knowledge or belief that an event will occur or has occurred
- in mathematics the concept has an exact meaning in probability theory, that is used in such areas of study as mathematics, statistics, finance, gambling, science, and philosophy to draw conclusions about the likelihood of potential events
- some refer to probability only for random events whilst others use the concept for all events
- may appear in terms of weather forecasts, personal relationship, and prediction of outcome.

Examiners should note that 'risk' and 'probability' can be seen to overlap and this should be allowed.

Further concepts that might be added to the list include:

- rate of change
- area and volume, capacity
- shape, geometric figures
- cost, sum and difference
- centre of gravity
- time
- spatial awareness.

Examiner tolerance

Examiners should be ready to accept alternatives provided they are linked to mathematics. They should be relaxed about concepts that may overlap the three given ones.

Levels descriptors
These descriptors are intended as a first guide to examiners. They indicate the characteristics of a top of level answer. Marks within a level are awarded when an answer does not include all the parts or qualities shown in the descriptor.

Level 5	These candidates will demonstrate a very good understanding of the three concepts provided and their involvement in daily life. They will provide a very good justification of a further mathematical concept. Their answers will be very clear and written with accuracy and fluency.	**25–30**
Level 4	These candidates will demonstrate a good understanding of the three concepts provided and their involvement in daily life. They will provide a good justification of a further mathematical concept. Their answers will be clear with few limitations to their SPG.	**19–24**
Level 3	These candidates will demonstrate an adequate understanding of the three concepts provided and their involvement in daily life. They will provide an adequate justification of a further mathematical concept. Their answers will be clear with some limitations to their SPG.	**13–18**
Level 2	These candidates will demonstrate a limited understanding of two of the three concepts provided and their involvement in daily life. They may provide a further mathematical concept. Their answers will not be clear with insecurity in their SPG.	**7–12**
Level 1	These candidates will demonstrate a very limited understanding of two of the three concepts provided and their involvement in daily life. Their answers will lack clarity using poor grammar, punctuation and inaccurate spelling.	**0–6**

5 **Describe how you would use the hypothesis testing model (Fig 4) to test the suggestion that females aged 17 are better at examinations than males of the same age.** **[30]**

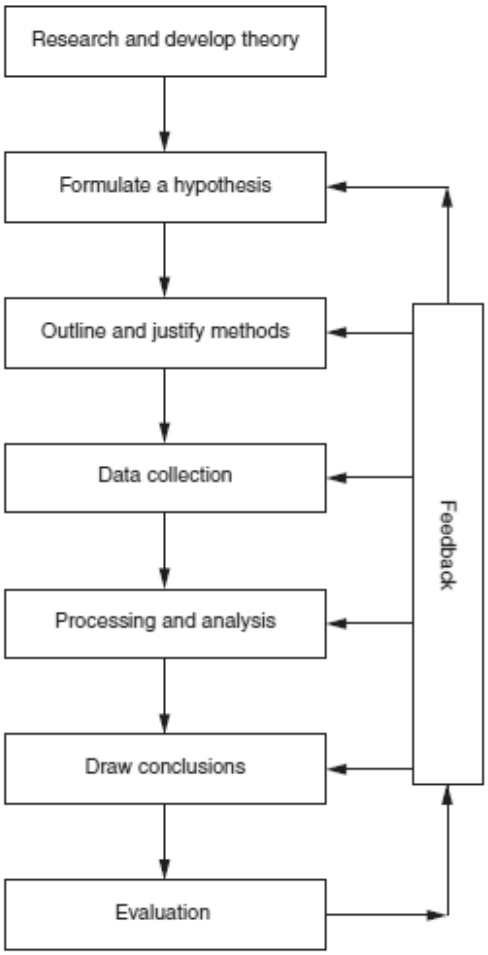

Fig. 4 Hypothesis testing model

	AO1	AO2	AO3	AO4
Marks	**8**	**10**	**6**	**6**

This question involves:

- use of the model shown in Fig 4
- recognition of the two groups being studied
- recognition of the focus of the study.

The question is in two main parts (use of model and application). Exceptionally candidates answering only one part of the question can be awarded marks up to the top of Level 3. If an examiner is uncertain about scoring an answer they should consult their Team Leader.

Recommended annotation
Intro for introduction
M1, M2 … for explicit use of terms from the model
A1, A2… for applications of the model to the specific hypothesis given
Dev for development
eg for examples
Conc. for conclusion.

Indicative content

Thinking and hypothesis formulation
- newspaper reports of AS outcomes
- background reading from web sites eg Google produced 2.2 million sites in response to the search ‘gender and performance in examinations’
- null hypothesis ‘there is no difference in performance…’.

Methods, data, sources
- secondary data such as previous years results
- primary data from current year 13
- different subjects or sub-groups.

Data collection
- confidentiality
- tabulation.

Processing and analysis
- means
- correlation
- graphs and regression
- presentation in diagrams
- commentary on focus, data, collection, processing and findings.

Conclusions
- main findings
- reservations
- feedback.

Evaluation
- validity of findings
- findings
- further work.

Level descriptors
These descriptors are intended as a first guide to examiners. They indicate the characteristics of a top of level answer. Marks within a level are awarded when an answer does not include all the parts or qualities shown in the descriptor.

Level 5	These candidates will demonstrate a very good understanding of the model provided. Their accounts of its application will be well developed and clearly focused on the model. They may explore definitions, ethical issues or personal experience. These answers will be clear and well structured and written with facility.	**25–30**
Level 4	These candidates will demonstrate a good understanding of the model provided. Their accounts of its application will be clearly focused on the model and may include some definitional comment or personal experience. Their answers will be clear with few limitations to their SPG.	**19–24**
Level 3	These candidates will demonstrate an adequate understanding of the model. Their accounts of its application will be adequate if unbalanced. They may include personal experience to inform their accounts. These answers will be clear but contain some errors of spelling, punctuation and grammar and a modest structure.	**13–18**
Level 2	These candidates will have limited recognition of the parts of the model and modest understanding. The accounts of its application will be partial and modest. Their answers will not be clear with insecurity in their SPG.	**7–12**
Level 1	These candidates will address parts of the model in more general terms. They will have a rather insecure focus. Some personal material may be included. The clarity will be insecure and their command of spelling, punctuation and grammar as well as structure will be limited and inaccurate.	**0–6**

Section B Total [30]

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