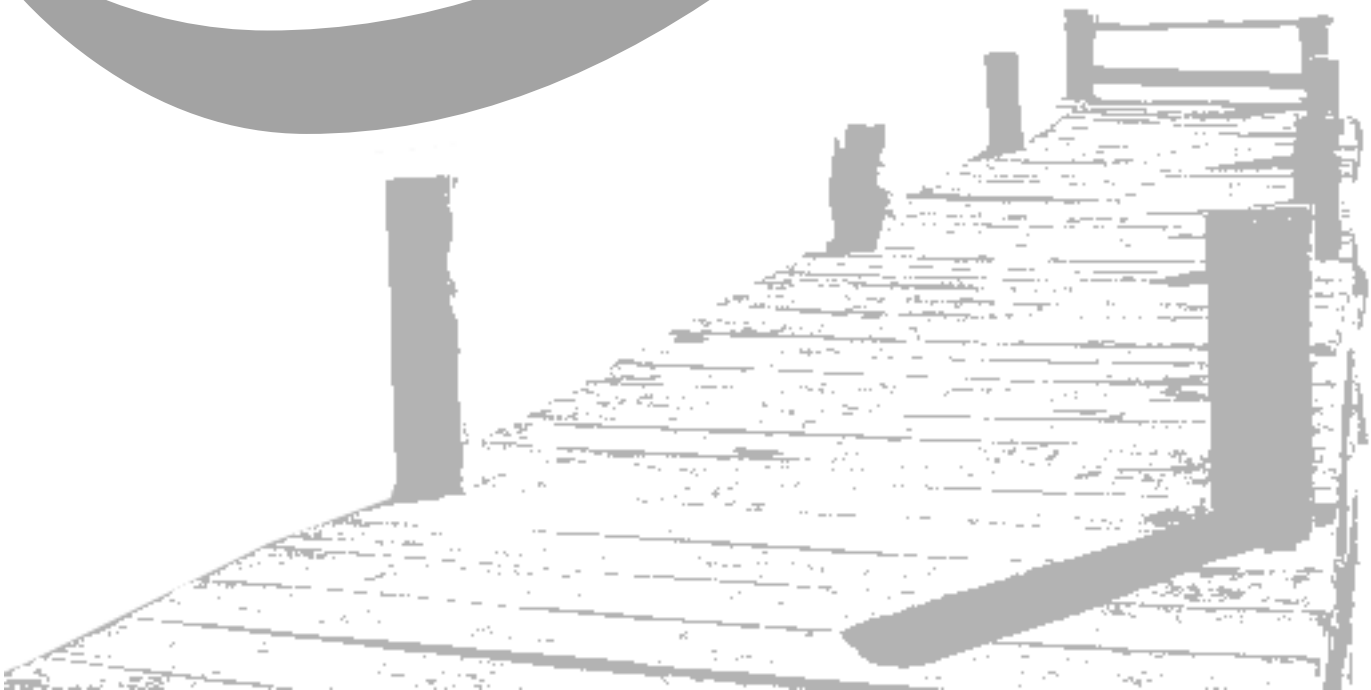
GCE
AS and A Level

Science in Society

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 3: Approved specimen question paper

Version 1.1



version: 1.1

GENERAL CERTIFICATE OF EDUCATION
SPECIMEN

SCIENCE IN SOCIETY UNIT 3: A2 EXPLORING KEY SCIENTIFIC ISSUES

In addition to this paper you will require
A 4-page answer book
You may use a calculator

Time allowed 2 hours

Instructions

- Use black ink
- Answer **all** questions
- This paper is divided into **two** sections. Answer section A questions in the spaces provided in this book. Answer the section B question in the separate answer book.
- Do all rough work in this book. Cross through any work you do not want marked.
- Show your working in all calculations.

Information

- The maximum mark for this paper is 90
- Mark allocations are shown in brackets
- You are reminded of the need for good English and clear presentation in your answers. Questions 5(d), 6(d) and 7 should be answered in continuous prose. Quality of Written Communication will be assessed in these answers.

SECTION A

Answer **all** questions in the spaces provided.

1 Premature babies have to undergo repeated medical procedures such as taking blood or inserting tubes. Older children and adults would certainly find these painful. No one knows if very small babies can feel pain. For a long time it was assumed that the very immature brain did not feel pain. Now researchers are actively investigating the issue.

It seems certain that the pain receptors on the babies' skin do detect pain and babies show responses, such as withdrawal or change in heart rate, to pain stimuli. However such responses can originate in the brain stem, even in fully conscious adults. The baby may not be conscious of the pain because the stimuli may not reach the cerebral cortex.

Researchers used near infra red spectroscopy, NIRS, to measure brain activity during 'painful' procedures. This involves wearing a special cap, much less stressful than most other scanning procedures, as shown in **Figure 1**. They found increased blood flow in the part of the cortex that processes bodily sensation in adults. This increase was not found when the baby was touched in a non-painful way.

Figure 1

A baby having an IR scan of its brain

(a) All organisms have reflex responses to pain that originate in the brain stem. What is the advantage of such responses, compared to conscious responses that originate in the cortex?

.....

.....

.....

(2 marks)

(b) What do we know about the development of the brain that makes it reasonable to suggest that premature babies may not be sufficiently conscious to experience and be emotionally distressed by pain?

.....

.....

.....

(2 marks)

(c) The data from IR scans described above conflicts with predictions made using current theories of how the brain develops.

Describe what you might expect researchers or doctors to do next as a result of the challenge presented by these findings.

.....

.....

.....

.....

.....

(3 marks)

(d) How should medical researchers plan research of this kind, to ensure that their experiments on small babies meet ethical guidelines?

.....

.....

.....

.....

.....

.....

(3 marks)

Total 10 marks

2 **Figure 2** shows the energy use, relative to every $1000 of GDP, for a range of countries. GDP, stands for Gross Domestic Product and is a measure of the value of all the goods and services produced in the country. **Figure 3** shows how GDP and energy consumption have changed over time in the UK.

Figure 2

Energy consumption in different countries in 2003

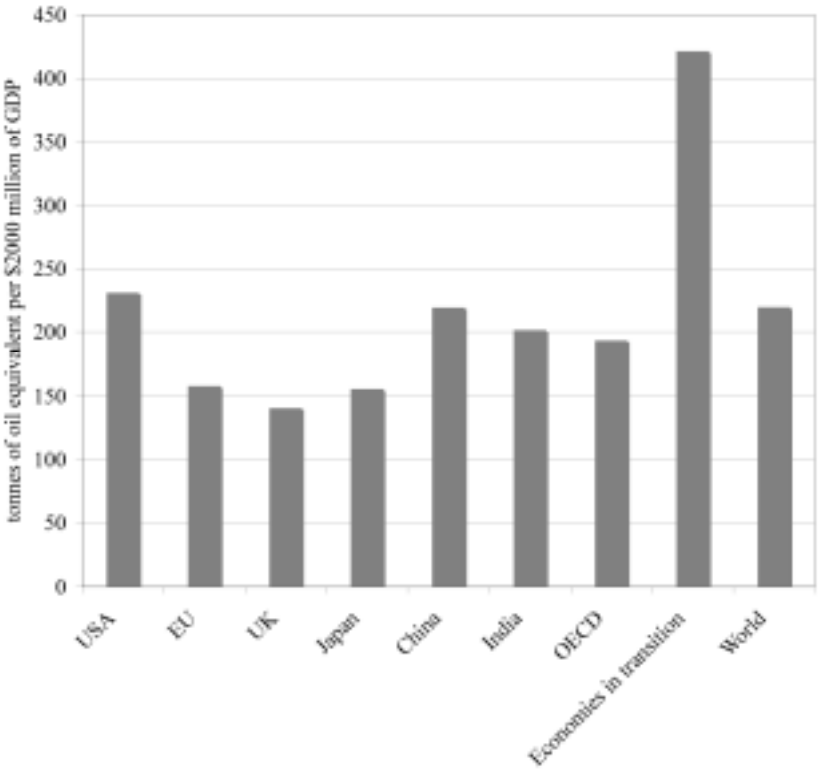
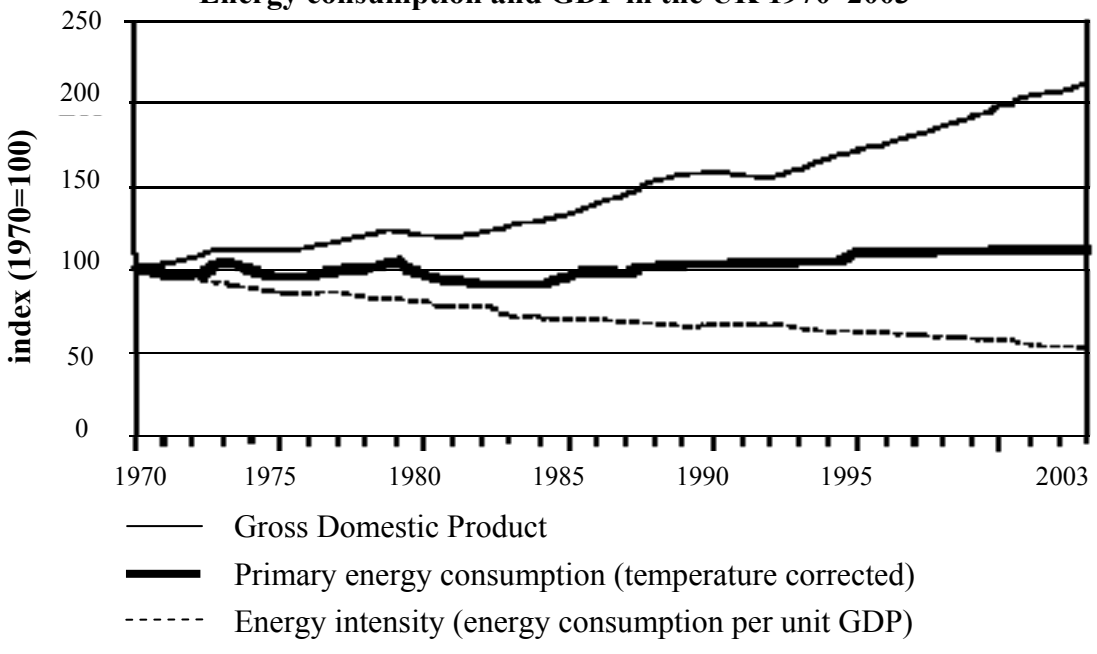


Figure 3

Energy consumption and GDP in the UK 1970–2003



(a) (i) In order to meet future demand for electricity, it is necessary to plan in advance. For many years planners assumed that the demand for energy would be proportional to GDP. Use the information in **Figure 2** and **Figure 3** to show that this assumption is no longer valid.

.....

.....

.....

.....

.....

.....

(2 marks)

(ii) Give **two** reasons why it has become possible to create the same wealth in a country using less energy than would have been needed 30 years ago.

.....

.....

.....

.....

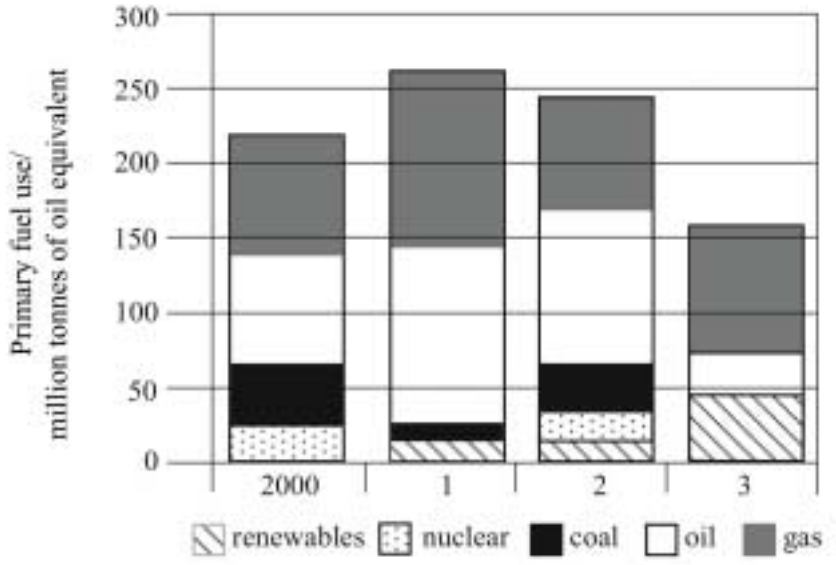
.....

(2 marks)

(b) Planners have to ensure a secure supply of energy in the future. The UK government recently produced a report predicting the amount of different primary fuels required in the future, using three different scenarios. These scenarios were based on different assumptions about future energy supply and use.

Figure 4 shows the use of the primary energy sources; renewable, nuclear, coal, oil and gas in 2000 and three predictions for 2050 based on 3 different scenarios.

Figure 4



(i) Suggest one assumption about energy resources that might be included in scenario 1.
Explain your reasoning.

.....

.....

.....

.....

(1 mark)

(ii) Suggest one assumption about energy technologies that might be included in scenario 2.
Explain your reasoning.

.....

.....

.....

.....

(2 marks)

(iii) Suggest one assumption about energy policy and society that might be included in scenario 3.
Explain your reasoning.

.....

.....

.....

.....

(2 marks)

Total 9 marks

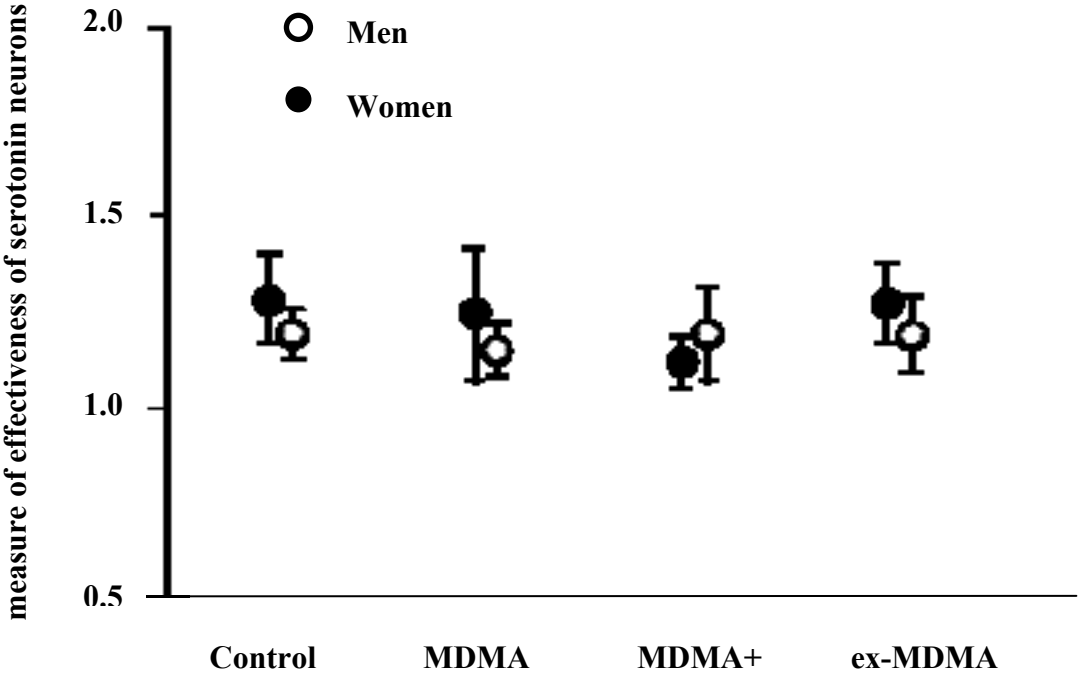
3 Ecstasy, MDMA, is a widely used recreational drug. It is known that it prevents reuptake of the neurotransmitter serotonin. This causes an increase in the concentration of serotonin in synapses, leading to pleasant feelings of well-being and empathy with others.
However there is debate about the long term risks created by regular use of the drug. One suspected long term effect is damage to serotonin neurons, leading to low levels of serotonin in the brain, but evidence is very contradictory. In 2001 one team carried out brain scans on ecstasy users to measure the effectiveness of the serotonin neurons. They compared four groups as shown in **Figure 5**. The results are shown in **Figure 6**.

Figure 5

	MDMA Moderate use over 4 – 5 years	**MDMA+** Heavy MDMA use over 4 – 5 years	**ex MDMA** Used over 4 – 5 years Stopped at least one year before trial	**Control group** No MDMA use
Number of men	9	12	8	7
Number of women	6	11	8	8
Total mean lifetime dose (number of tablets)	28.6	530.0	268.1	0

Figure 6

Mean measures of effectiveness of serotonin neurons for different subgroups of MDMA users and controls



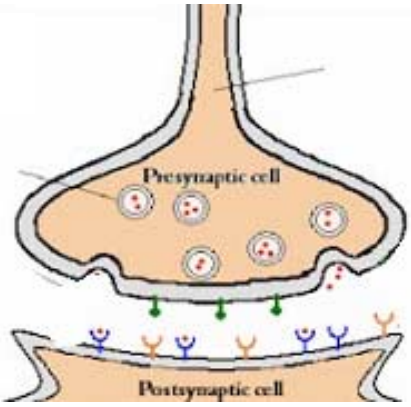
Other groups, using similar scanning techniques, have shown stronger evidence of harm to serotonin neurons.

Some animal studies show clear signs of neuron damage when the brain is dissected some time after large doses of Ecstasy.

(a) Add to and label **Figure 7** to explain how neurotransmitters, such as serotonin, contribute to the transmission of information in the brain.

Figure 7

Model of the Synapse



(3 marks)

(b) (i) The vertical bars on **Figure 6** indicate the standard deviation (SD) of the measure of effectiveness of serotonin neurons. What does the SD tell us about the values found in the heavy MDMA user groups?

.....

.....

.....

(2 marks)

(ii) Discuss the extent to which the data in **Figure 5** and **Figure 6** provide evidence of long term harm from MDMA use.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(c) Different teams of competent and professionally respected scientists have carried out detailed research and reached different conclusions about the long term risks of regular Ecstasy use. Outline reasons why such differences are possible.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

Total 14 marks

4 There are two main factors which determine how human activities change climate:

- the rate of greenhouse gas emissions, and
- the response of climate to these emissions.

The second of these factors can only be explored through the use of climate models.

The UK Climate Impacts Programme (UKCIP) has published a report presenting possible climate scenarios for the United Kingdom. The scenarios are based on different assumptions about population, economic growth and energy futures. They do not make any allowance for targeted interventions to reduce greenhouse gas emissions. The assumptions are the basis for the data fed into the climate model experiments that lead to descriptions of future changes in climate

Figure 8

Climate change estimates for three scenarios.

	2020s		2050s		2080s	
Assumption about greenhouse-gas emissions used in scenarios 1-3	Average temperature rise (°C)	Concentration of carbon dioxide (ppm)	Average temperature rise (°C)	Concentration of carbon dioxide (ppm)	Average temperature rise (°C)	Concentration of carbon dioxide (ppm)
1 - Low emissions	0.79	422	1.41	489	2.00	525
2 - Medium emissions	0.88	435	1.87	551	3.29	715
3 - High emissions	0.94	437	2.24	593	3.88	810

All temperature changes in **Figure 8** are calculated with respect to the mean for 1961-1990. The pre-industrial level of carbon dioxide in the atmosphere was about 280 ppm (parts per million). Mean temperatures have risen by about 0.74°C in the northern hemisphere since the start of the twentieth century.

(a) Use a diagram to explain in outline why an increase in the concentration of carbon dioxide in the atmosphere leads to a rise on the mean surface temperature of the Earth.

(3 marks)

(b) Summarise **one** important conclusion about changes to the UK climate during this century you can draw from the data in **Figure 7**. Identify the relevant evidence in the table and show how it supports the conclusion.

.....

.....

.....

.....

(2 marks)

(c) The UKIP report states that 'the scenarios illustrate possible effects on UK climate over the coming century of choices being made around the world about technologies, about lifestyle and about values'.

(i) Explain the implications for the future of climate in the UK of a possible change in people's lifestyles.

.....

.....

.....

(2 marks)

(ii) Explain the implications for the future of climate in the UK of a possible choice about technology.

.....

.....

.....

(2 marks)

(d) Scientists are steadily improving the models they use to predict climate change. How are scientists able to test their climate models and show that they have improved?

.....

.....

.....

(2 marks)

(e) Results from the latest models show that in some regions, such as the northern parts of South America, a combination of rapid warming and a large drop in rainfall will cause forests to die back and their carbon be returned to the atmosphere.

Use this example, or another example, to explain the significance of 'positive feedback' to climate modelling.

.....

.....

.....

(2 marks)

(f) The results of modelling presented in the report are important to planners of the way that land is used in the UK.

(i) Give an example of a decision that a land-use planner might have to make that would be affected by the information in the report.

.....

.....

(1 mark)

(ii) What type of data is needed to make an informed decision? Give **two** examples and justify your choices.

.....

.....

(2 marks)

Total 16 marks

5 In 2003 a scientific paper was published in the journal Science with the title:

Influence of Life Stress on Depression

The abstract of the paper starts:

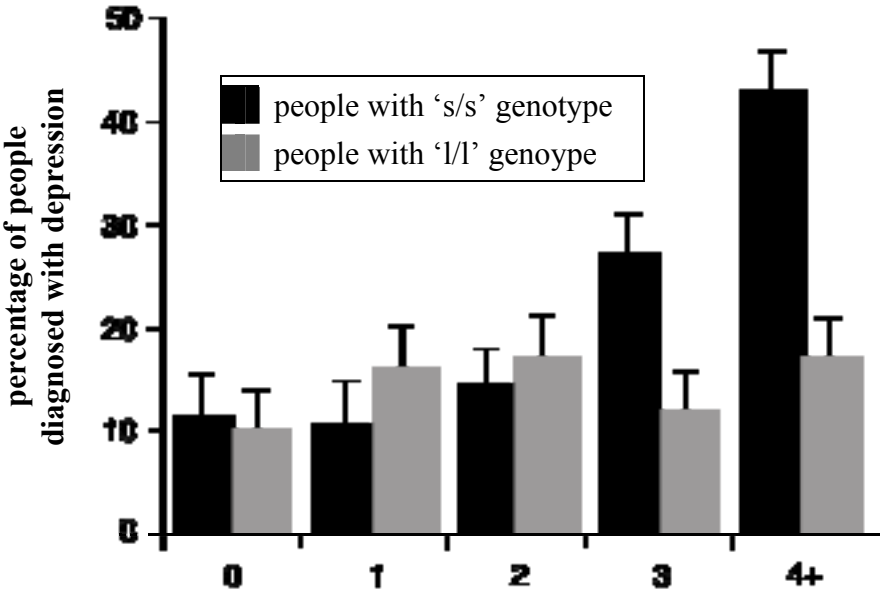
"In a prospective-longitudinal study of a representative birth cohort, we tested why stressful experiences lead to depression in some people but not in others."

There is evidence that both stressful life events and genetics influence the risk of depression. The researchers investigated the interaction between the two. They planned the research to test the hypothesis that alleles of the 5HTT gene have an influence on response to stressful experiences.

The 5HTT gene has two alleles known as short, *s*, and long, *l*. In the study 847 twenty six-year-olds in the cohort were tested for these alleles and assessed for depression using widely accepted criteria. Stressful events included financial, health, housing and relationship problems.

Figure 8

Whether or not life stress gets you down depends on your genetic make-up



***s/s* people have only the *s* allele for the 5HTT gene, 147 people in the study**
***l/l* people have only the *l* allele for the 5HTT gene, 265 people in the study**

(a) What is the most probable genotype of the group of 435 people (of the original 847) not represented in **Figure 8**?

.....

(1 mark)

(b) This research used a cohort study, monitoring the participants from birth.

(i) Explain **one** reason why this type of study has an advantage over a retrospective case control study as a way of investigating factors that influence depression.

.....

.....

.....

.....

(2 marks)

(ii) Suggest **one** reason why you might start your research with a case control study rather than a cohort study if you had a completely original hypothesis for a cause of depression.

.....

.....

(1 mark)

(c) The researchers planned this study to test the hypothesis that alleles of the 5HTT gene have an influence on response to stressful experiences. Use the example of this research to explain how scientists test hypotheses or theories. Use the terms prediction, observation and falsification in your answer.

.....

.....

.....

.....

.....

.....

(3 marks)

(d) Write a short article explaining the significance of this research. The article should be suitable for publication on an information web site for sufferers of depression and their families.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(8 marks)

Total 15 marks

6 WWF (the Worldwide Fund for Nature) has been publishing Living Planet Reports since 1998. Each year the report describes the changing state of global biodiversity.

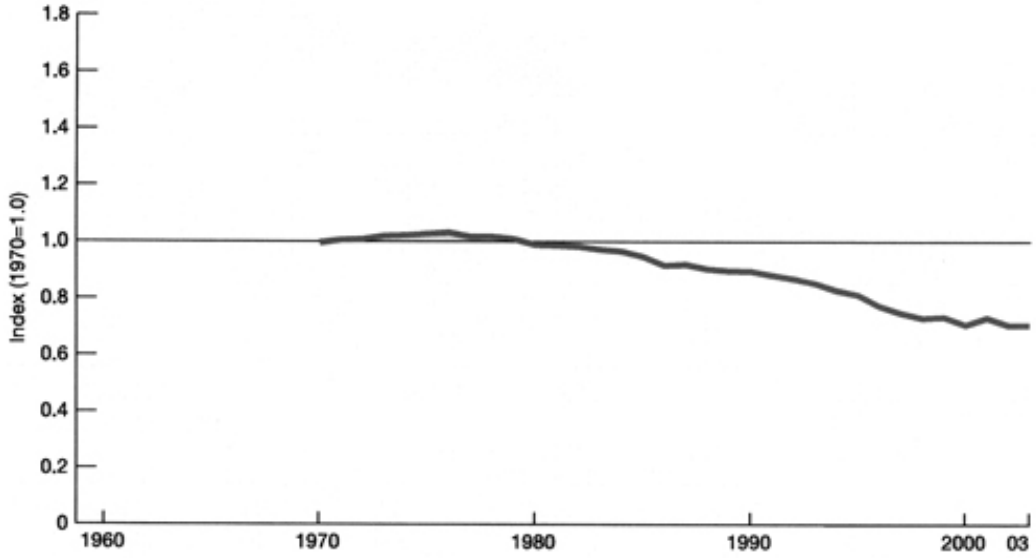
One of the two indicators in the report is the Living Planet Index which measures trends in the Earth's biological diversity. It tracks populations of 1313 vertebrate species – fish, amphibians, reptiles, birds, mammals – from all around the world.

The data used to calculate the Living Planet Index are measures of population size gathered from a variety of sources including scientific journals, reports from Non Governmental Organisations (NGOs) and from the Internet. Some data are estimates of the total population of a species; others are density measurements, such as the number of birds in a given area; others are proxies of population size such as the number of turtle nests on beaches.

The 2006 report includes a graph which shows the overall Living Planet Index (see **Figure 9**)

Figure 9

Living Planet Index (1970 – 2003)



(a) Scientists have a wide range of data available from which they might select to calculate the Living Planet Index. Suggest **two** criteria they should apply when deciding whether or not a particular set of data is reliable enough to be included the overall calculations.

.....

.....

.....

.....

.....

.....

(2 marks)

(b) (i) Estimate from **Figure 9** the percentage fall in the overall Living Planet index between 1970 and 2003.

.....

(1 mark)

(ii) The authors of the 2006 report claim that the global trend in the index suggests that we are degrading natural ecosystems at a rate unprecedented in human history. Does the information in **Figure 9** support this claim? Give your reasons.

.....

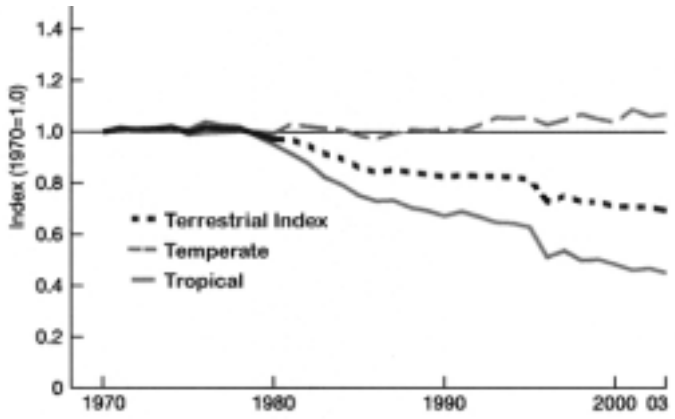
.....

(1 mark)

WWF scientists calculate a value of the Living Planet Index just for organisms that live on land (terrestrial species). They also calculate separate values for land species that live in the tropics and species that live in temperate regions (that is regions with a mild climate between the tropics and the polar regions).

Figure 10

Living planet indices, 1970 – 2003:
overall terrestrial index (dotted line);
the separate indices from temperate (dashed line)
and tropical regions (solid line)



(c) Suggest an explanation for the difference in the trends in the index for temperate and tropical habitats in **Figure 10**.

.....

.....

.....

(2 marks)

(d) The 2006 WWF report states that the consequences of our accelerating pressure on the Earth's natural systems is predictable and creating a disastrous situation. Discuss whether or not you agree with this view giving your reasons.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(8 marks)

Total 14 marks

SECTION B

- Answer **Question 7** in the separate answer book provided.
- Quality of written communication will be taken into account in awarding marks for this question.

7 "The UK Government is committed to 'evidence-based policy making'. However science policy making requires judgement in the use of evidence.

Some of the types of evidence requiring judgement in their use are:

- the level of risk
- the cost and consequences of dealing with risk
- the practicality of dealing with risk
- public opinion".

Discuss the above quote, choosing any illustrative examples you wish from one or more contexts.

(12 marks)