| Surname | | Other Names | |
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| Centre Number | | Candidate Number | |
| Candidate Signature | | | |

General Certificate of Education
June 2005
Advanced Subsidiary Examination

**AQA**

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

**SCIENCE FOR PUBLIC UNDERSTANDING**      **SPU1**
**Unit 1**    **Issues in the Life Sciences**

Friday 10 June 2005    Morning Session

**No additional materials are required**.
You may use a calculator.

Time allowed: 1 hour 15 minutes

**Instructions**
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- 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 60.
- Mark allocations are shown in brackets.
- In your answer to Question 1(d) and Question 4(d) you will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate. The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

| For Examiner's Use | | | |
|---|---|---|---|
| Number | Mark | Number | Mark |
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| Examiner's Initials | | | |

**SPU1**

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

1   Smallpox is a highly infectious viral disease, transmitted only from person to person.  The virus cannot survive for long outside the human body.  About 30% of those infected with smallpox die and others are left blind or disfigured.  An effective vaccine has existed since around 1800, requiring only a single injection for protection, yet there were an estimated 50 million smallpox cases worldwide in the 1950s.

(a)   Explain briefly how vaccination works.

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*(2 marks)*

(b)   Suggest **two** reasons why so many people in less developed parts of the world were **not** receiving the smallpox vaccine in the 1950s.

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*(2 marks)*

(c)   In 1979 the World Health Organisation declared smallpox eliminated after a 13 year mass vaccination campaign.  During the campaign, health workers detected each new case and then vaccinated everyone in the area.

   Explain why this approach gradually led to elimination of the disease.

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*(2 marks)*

(d)   Smallpox is one of the diseases that would be a suitable weapon for bioterrorists.  In response to this threat scientists in some countries are studying animal viruses very similar to smallpox.  The scientists have shown that it is possible to use genetic manipulation to make these diseases even more deadly.  Their aim is to develop vaccines against such diseases.

Do you think scientists are right to do such research?  Explain your answer.

You may be awarded up to 2 additional marks for the quality of written communication in your answer.

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*(4 marks)*

**Quality of Written Communication**   *(2 marks)*

$\overline{12}$

**TURN  OVER  FOR  THE  NEXT  QUESTION**

**2**  Drinking alcohol has health risks.  A study estimated the extent of the risk, relative to that of non-drinkers.  **Figure 1** shows the relationship between alcohol consumption and the relative risk of death in one year from all causes, for men aged 16-24.  **Figure 2** shows the same relationship for men aged 45-54.
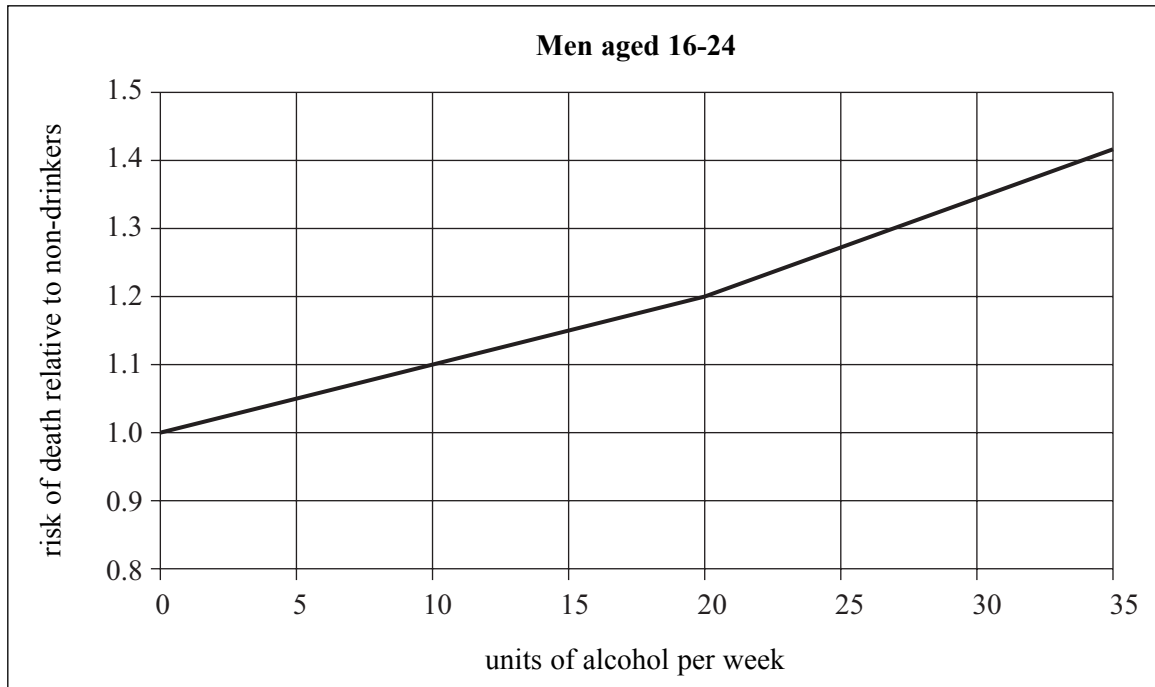
**Men aged 16-24**

*risk of death relative to non-drinkers*

*units of alcohol per week*

**Figure 1**

**Men aged 45-54**

*risk of death relative to non-drinkers*

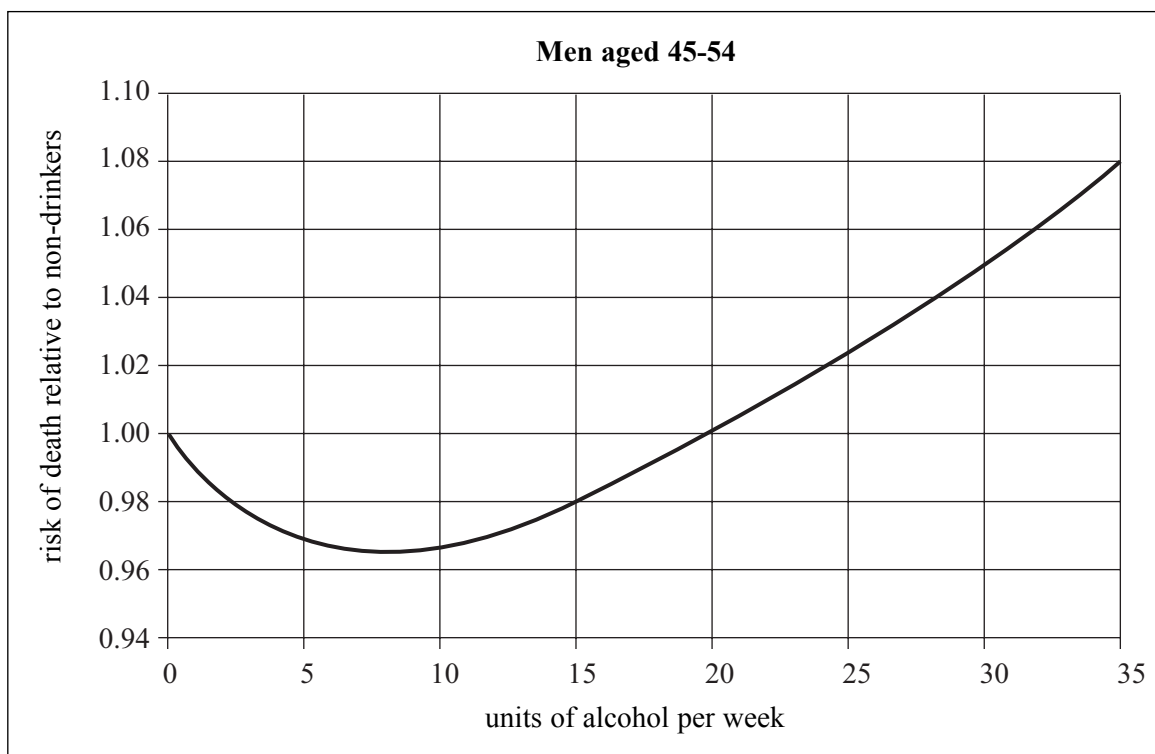*units of alcohol per week*

**Figure 2**

(a)  (i)  Summarise the relationship between alcohol consumption and relative risk of death for men aged 16-24, as shown in **Figure 1**.

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*(1 mark)*

(ii)  Summarise the relationship between alcohol consumption and relative risk of death for men aged 45-54, as shown in **Figure 2**.

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*(2 marks)*

(iii)  "*Research proves drinking up to 20 units of alcohol per week lowers your risk of death if you are male and over 45.*"

On the basis of **Figure 2** do you think the above statement is justified?  Explain your answer.

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*(2 marks)*

(b)  Suggest **two** pieces of information you would need about the researchers, or the sponsors of this research study, before deciding how reliable the study's conclusions were.

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*(2 marks)*

**QUESTION  2  CONTINUES  ON  THE  NEXT  PAGE**

**Turn over** ▶

(c)  (i)  Use the information from **Figure 1** and **Figure 2** on **page 4** to complete the table below.

|  | **men aged 16-24** | **men aged 45-54** |
|---|---|---|
| **relative risk of death in 1 year – if drinking 20 units per week** |  |  |
| **actual risk of death in 1 year – if drinking 20 units per week** | 8 per 10 000 | 41 per 10 000 |

*(1 mark)*

(ii)  Men aged 16-24 who drink 20 units per week have a higher relative risk of death than men aged 45-54 drinking the same amount. As shown in the table, their actual risk of death is lower. Explain this difference.

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*(2 marks)*

(d)  Alcohol related deaths have doubled in the UK since the 1980s and other health and social costs of drinking have also grown. Despite health education campaigns, many people continue to risk their health by drinking too much.

Suggest some reasons why.

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*(3 marks)*

13

**TURN  OVER  FOR  THE  NEXT  QUESTION**

**3** Cystic fibrosis is an inherited disease which affects 1 in 2400 babies born in Britain. It is caused by a mutation on the CF gene. The normal version of this gene (**R**) is dominant; the mutated version (**r**) is recessive.

The disease affects the lungs and digestive system. Even with intensive modern treatments, patients are often ill and have a shorter than normal life expectancy, usually between 25-40 years.

(a) **Figure 3** shows a family in which only 'Child 3' has cystic fibrosis.

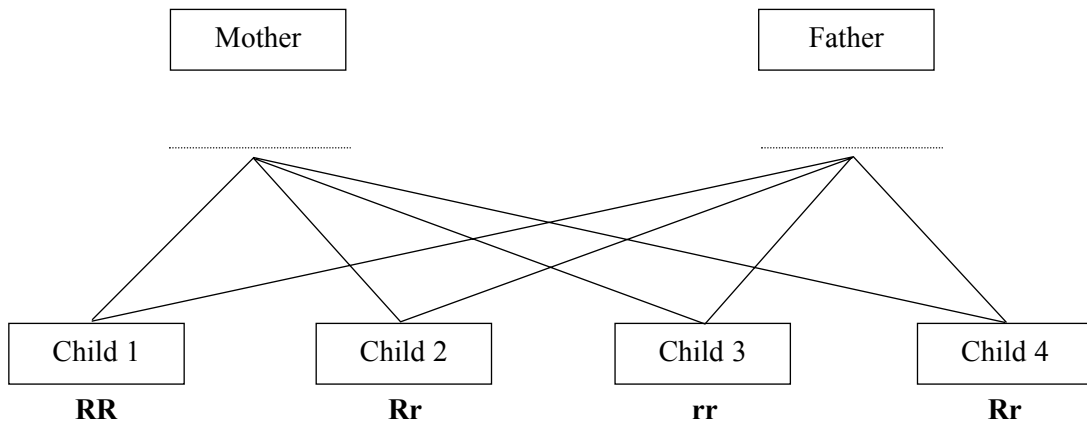| Mother | | Father |
| :---: | :---: | :---: |

| Child 1 | Child 2 | Child 3 | Child 4 |
| :---: | :---: | :---: | :---: |
| **RR** | **Rr** | **rr** | **Rr** |

**Figure 3**

On **Figure 3**, in the way already shown for the children:

(i) indicate the CF genes of the mother;                    *(1 mark)*

(ii) indicate the CF genes of the father.                    *(1 mark)*

(b) Genetic tests are now available to identify carriers of the mutated gene. A couple are each found to carry one mutated CF gene. Outline the options available to them to prevent the birth of a child with cystic fibrosis, if they want to have children together.

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*(4 marks)*

(c) In the US all future parents are offered a test to identify carriers of the CF gene. In the UK tests for cystic fibrosis and other inherited diseases such as sickle cell anaemia are, at present, only offered to those with a higher than average risk. This policy is actively under review.

(i) How might those at 'higher than average risk' be identified in order to decide whom to test?

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*(1 mark)*

There are many different mutations on the CF gene. If the person being tested has an unusual mutation their test result may show a false negative. **Figure 4** indicates the situation in different ethnic groups in Britain.

| | **Frequency of a CF defect in population** | **False negatives (percentage)** |
|---|---|---|
| **European** | 1 in 2000 | 20% |
| **Asian** | 1 in 14 000 | 65% |
| **Black** | 1 in 90 000 | 59% |

**Figure 4**

(ii) Explain what is meant by a 'false negative'.

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*(2 marks)*

(iii) Give **one** argument against testing all future parents in Britain for CF mutations. Base your argument on the information in **Figure 4**.

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*(2 marks)*

*11*

**Turn over ▶**

**4**  Many crops have been genetically modified (GM) to increase their tolerance to a specific herbicide. Herbicides are chemicals that kill plants.

Britain delayed approving any commercial growing of GM crops until the results of research were available.  Research between 2000 and 2003 investigated the effects of GM crops on the environment.  Fields were divided and half sown with GM and half with conventional crops. **Figure 5** shows some of the results of this research.

| | weeds biomass/ grammes per m² | | plant-eating insects/ mean number per sample | | insect-eating insects/ mean number per sample | |
|---|---|---|---|---|---|---|
| | **Conventional** | **GM** | **Conventional** | **GM** | **Conventional** | **GM** |
| **maize** | 8 | 14 | 11.57 | 15.18 | 11.09 | 11.32 |
| **beet** | 22 | 4 | 17.14 | 12.27 | 15.93 | 14.73 |
| **oilseed rape** | 46 | 13 | 20.75 | 16.67 | 14.15 | 11.88 |

Data from *Philosophical Transactions of the Royal Society 2003*

**Figure 5**

(a)  Researchers found different amounts of weeds and insects with different crops.

(i)  With which **conventional** crop did they find the **least** weeds and insects? Justify your answer.

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*(1 mark)*

(ii)  Which GM crop appears to be the least harmful to weeds and insects **relative to** the same conventional crop?  Justify your answer.

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*(2 marks)*

(iii)  Suggest a reason why the insect population fell when herbicide tolerant GM beet was grown.

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*(2 marks)*

(b)  Explain why the GM and conventional crops to be compared were grown in two halves of the same field.

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*(2 marks)*

(c)  Do these trials show that GM maize is "safe"?  Explain your answer.

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*(2 marks)*

**QUESTION 4 CONTINUES ON THE NEXT PAGE**

(d)  Before making a decision on GM crops the UK government carried out:

- the research described on **page 10**;
- a public consultation on GM;
- an analysis of the economic case for GM.

The majority of the public was opposed to GM.  The economic analysis suggested that it was important for Britain to introduce GM in order to encourage further research in new applications of the technology.

In 2004 the government agreed that GM maize, but not GM beet or oilseed rape, could be grown in Britain.

Discuss whether you think the government made the right decision.

You may be awarded up to 2 additional marks for the quality of written communication in your answer.

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*(4 marks)*

**Quality of Written Communication**  *(2 marks)*

15

**TURN  OVER  FOR  THE  NEXT  QUESTION**

**5** Humans and chimpanzees are both primates. Many other primate species are now extinct. The lines in **Figure 6** show one suggested relationship between modern humans (*Homo sapiens*), some of the other extinct human-like (*Homo*) species and chimpanzees.
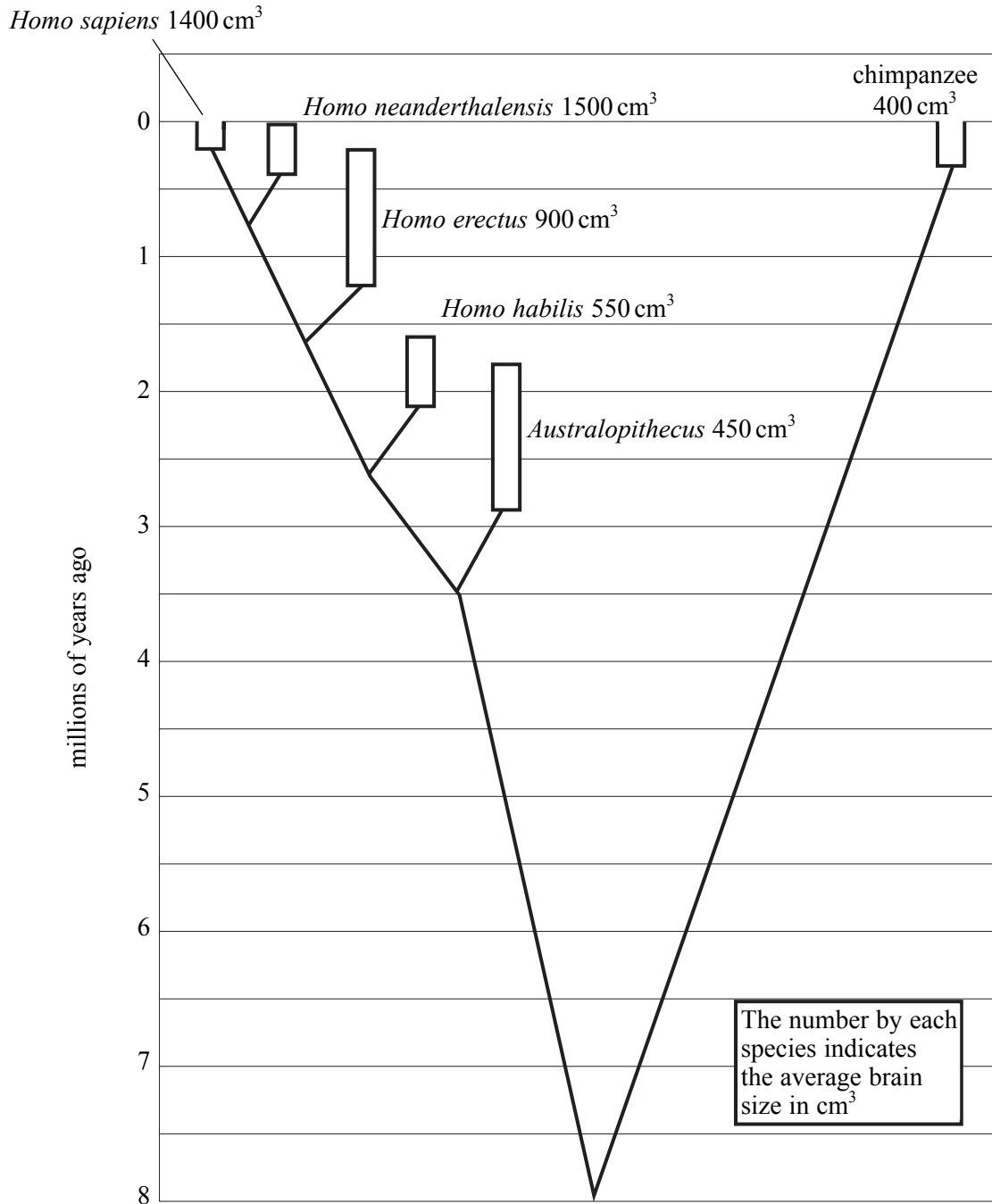


*Homo sapiens* 1400 cm³

chimpanzee 400 cm³

*Homo neanderthalensis* 1500 cm³

*Homo erectus* 900 cm³

*Homo habilis* 550 cm³

*Australopithecus* 450 cm³

millions of years ago

The number by each species indicates the average brain size in cm³

**Figure 6**

(a) Name **two** *Homo* species that became extinct less than 1 million years ago.

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*(1 mark)*

(b)   Suggest how some of the information in **Figure 6** can be explained by Darwin's theory of evolution by natural selection.

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*(4 marks)*

(c)   (i)   The information in **Figure 6** is derived from fossils.  Scientists agree on most dates and the overall pattern.  They disagree on some of the evolutionary relationships between one species and another.

The theory of the evolutionary origins of humans is widely accepted despite these disagreements.  Explain why.

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*(2 marks)*

(ii)  Suggest **two** reasons why some people find it hard to accept that humans have evolved from other species.

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*(2 marks)*

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**END OF QUESTIONS**

**THERE  ARE  NO  QUESTIONS  PRINTED  ON  THIS  PAGE**