Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
June 2006
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Friday 9 June 2006 9.00 am to 10.15 am

You will need no other materials.
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.
- Answer the 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.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers. Questions 2(d) and 4(b) should be answered in continuous prose. Quality of Written Communication will be assessed in these answers.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
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Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 Malaria is an infectious disease, caused by a parasite. It is transmitted by mosquitoes from one person to another, mainly in tropical regions. It is responsible for about 25% of all deaths in children under five in Africa.

An international programme called Roll Back Malaria started in 1998. The programme aims to halve the death rate from malaria by 2010. It recommended a range of local health measures and also proposed an increase in malaria research. Research areas include:

- vaccines to immunise against the disease
- new medicines to treat malaria
- better statistical information on the number of cases and deaths.

(a) (i) Explain how vaccination works.

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(2 marks)

(ii) The malaria parasite undergoes frequent mutation.
Explain why this makes it difficult to produce an effective vaccine.

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(1 mark)

(iii) It is proving very difficult to develop a really effective vaccine against malaria and most research reports describe failure. Suggest **one** reason why in this research it is important to report failure as well as success.

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(1 mark)

(b) The parasite is resistant to most of the medicines that are being used now. New ones are needed.

Explain the process by which resistance to a widely used medicine develops in bacteria or parasites.

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(2 marks)

(c) The middle column of **Figure 1** shows one estimate, made in 2002, of the total world expenditure on research into five different diseases. The right hand column shows the expenditure per death from the disease. This provides a way of relating expenditure to the number of people affected.

Figure 1

Disease	**Total research expenditure/ million US dollars**	**Research expenditure per death from the disease /US dollars**
Cardiovascular	9402	566
HIV/AIDS	2049	731
Diabetes	1653	1653
Tuberculosis	378	236
Malaria	288	240

(i) Which **two** of the diseases in **Figure 1** are **not** infectious.

.....

.....

(1 mark)

Question 1 continues on the next page

(ii) **Figure 1** shows that the total research expenditure on each disease is not distributed evenly relative to the number of people dying from the disease.
Suggest **two** reasons why cardiovascular and diabetes research each receive more funding per death from the disease than either tuberculosis or malaria.

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(2 marks)

(iii) List **two** criteria you would like to see used to determine how research money is shared out between these five diseases.
Explain why you think each criterion is important.

Criterion 1 .....

.....

Explanation .....

.....

Criterion 2 .....

.....

Explanation .....

.....

Suggest which of the diseases in **Figure 1** would get the most research money using your criteria.

.....

(4 marks)

13

2 About 540 babies are born in Britain each year with Neural Tube Defects, NTD, because the nervous system of the fetus has failed to develop normally. Most of these babies die in the first few weeks of life; others are permanently handicapped. Low intake of folic acid in the mother's diet is known to be a major risk factor, particularly in the first three weeks after conception. Folic acid is found in fruit and green vegetables.

(a) What is meant by the term *risk factor*?

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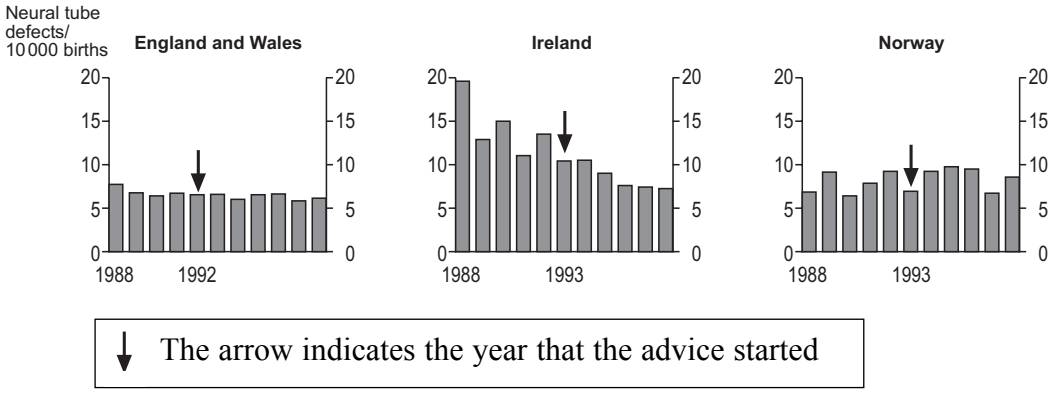
(1 mark)

One way to reduce the risk is for all women planning to become pregnant to start taking folic acid supplements before they conceive. **Figure 2** shows how the incidence of NTD changed in three countries before and after widespread advice to do this.

Figure 2



(b) (i) Describe the trend in the incidence of NTD in Ireland before and after 1993.

before 1993

.....

after 1993

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(2 marks)

Question 2 continues on the next page

(ii) Suggest **two** different possible explanations for the trend in the incidence of NTD in Ireland since 1993.

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(2 marks)

(iii) How strong is the overall evidence in **Figure 2** that giving advice on taking folic acid before conception reduces the incidence of NTD? Justify your answer.

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(2 marks)

Another way to reduce the risk of NTD is to add folic acid to everyone's food. In 1998 the US Government made it compulsory to add folic acid to flour and other cereal products. **Figure 3** shows the incidence of NTD cases in the USA before and after the ruling.

Figure 3

		NTD per 10 000 live births	**Total NTD in USA**
1995-1996	When folic acid was **not** added to flour	10.6	4130
1999-2000	When folic acid was added to flour	7.6	3020

Source: www.cdc.gov/

(c) A newspaper article claimed that adding folic acid to flour led to a 30% reduction in NTD cases in the USA.

(i) Calculate the percentage reduction in NTD cases shown in **Figure 3**.

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(2 marks)

(ii) How well does your answer support the newspaper claim?

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(1 mark)

(d) In 2000 the UK Government considered whether to add folic acid to flour in Britain. Some of the other risks and benefits of folic acid that they considered are:

- it can interfere with drugs taken for epilepsy
- it masks vitamin B12 deficiency in older people. This can lead to nerve damage, unless those at risk have additional medical checks
- it may reduce the risk of heart disease.

Do you think the UK Government should take an active role in reducing individual risk and require folic acid to be added to flour as has been done in the US? 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)*

16

Turn over for the next question

3 Extracts from the Echinacea plant are widely used to 'boost the immune system' and to help recovery from the common cold. These extracts are all commonly known simply as Echinacea.

(a) Researchers have carried out randomised placebo control trials using extracts from the Echinacea plant to treat the common cold.

The results of these trials are shown in **Figure 4**.

Figure 4

Trial	Echinacea		Placebo	
	Number of patients	Average days with symptoms	Number of patients	Average days with symptoms
A	70	9.1 ± 1.8	44	12.9 ± 2.1
B	32	3.4 ± 1.2	32	4.4 ± 1.6
C	69	6.3 ± 0.3	73	5.8 ± 0.3

(i) What is meant by a *placebo control trial*?

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(2 marks)

(ii) What is meant by ±1.8 in the entry '9.1 ± 1.8 average days with symptoms' in Trial A?

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(1 mark)

(iii) Do the results shown in **Figure 4** provide strong evidence for the effectiveness of Echinacea against the common cold? Explain your answer.

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(2 marks)

(b) The use of Echinacea to fight the common cold is popularly justified on three main grounds. These are given in the statements below.

Statement 1: It has been widely used by American Indian societies for hundreds of years.
Statement 2: In cell culture it seems to improve white blood cells' ability to engulf microbes.
Statement 3: Many people say that it has helped them fight off a cold.

(i) Choose **one** of these statements and explain why it does not provide sufficient evidence of effectiveness.

Statement chosen: .....

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(2 marks)

(ii) Many alternative remedies such as Echinacea are widely used for the common cold although there is often no scientific evidence that they are effective. Suggest **two** reasons why such alternative remedies continue to be popular.

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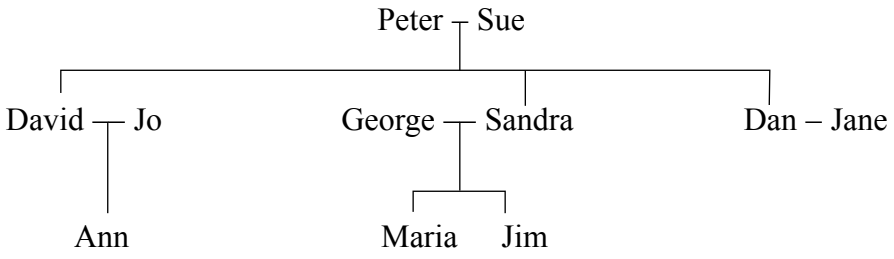
(2 marks)

9

Turn over for the next question

4 Huntington's disease is an inherited disorder of the nervous system that causes mental and physical decline in middle age and an early death. It is caused by a **dominant** gene. This means that anyone who inherits a single defective gene will eventually develop the disease.

(a) Peter has Huntington's disease. He has three children as shown in the family tree below.



(i) What is the probability that David will develop the disease? Explain your answer.

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(2 marks)

(ii) Maria's mother Sandra has refused to be tested for the Huntington's gene. She does not want to know whether she will develop the disease. Maria does want to be tested herself. Explain how Maria's test results may conflict with Sandra's interests.

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(2 marks)

(iii) When Peter is diagnosed with Huntington's disease Jane is six weeks pregnant. If Dan and Jane want to avoid having a child with Huntington's disease they would be advised to have genetic tests. Would it be better to test Dan or the developing fetus first? Explain your answer.

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(1 mark)

(iv) If this first test shows the presence of the Huntington's gene, what further steps might they be advised to take?

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(2 marks)

(b) Recent research using mice has raised the possibility of using gene therapy to cure Huntington's disease. So far most human trials of gene therapy have shown limited success and in a few cases caused death. People who agree to take part in trials are taking a risk.

Describe the steps that researchers planning such trials should take to ensure that the trials are ethically responsible.

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)*

13

5

The text for this question cannot be reproduced here due to third-party copyright constraints.

(a) (i) Give **two** environmental changes caused by humans that are leading to the present *mass extinction of species*.

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(1 mark)

(ii) Refer to **one** such environmental change and explain why it is causing species to go extinct rather than adapt by evolution.

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(2 marks)

(b) The scientists claim that we are influencing the future course of evolution because we are determining which species survive and the environment that these surviving species live in.

(i) Use the theory of evolution by natural selection to explain why the particular species that survive now will influence what sort of species evolve over the next 5 million years.

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(2 marks)

(ii) Use the theory of evolution by natural selection to explain how the environment will exert an influence on the characteristics of the species that evolve over the next 5 million years.

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(2 marks)

(c) The scientists have published these warnings in the popular press. Do you think scientists are right to use their position to publicise such warnings? Explain your answer.

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(2 marks)

9

END OF QUESTIONS

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