

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
 June 2008
 Advanced Subsidiary Examination



SCIENCE FOR PUBLIC UNDERSTANDING
Unit 1 Issues in the Life Sciences

SPU1

Friday 6 June 2008 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 black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be 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 1(c)(iii) and 4(c) should be answered in continuous prose. Quality of Written Communication will be assessed in all answers.

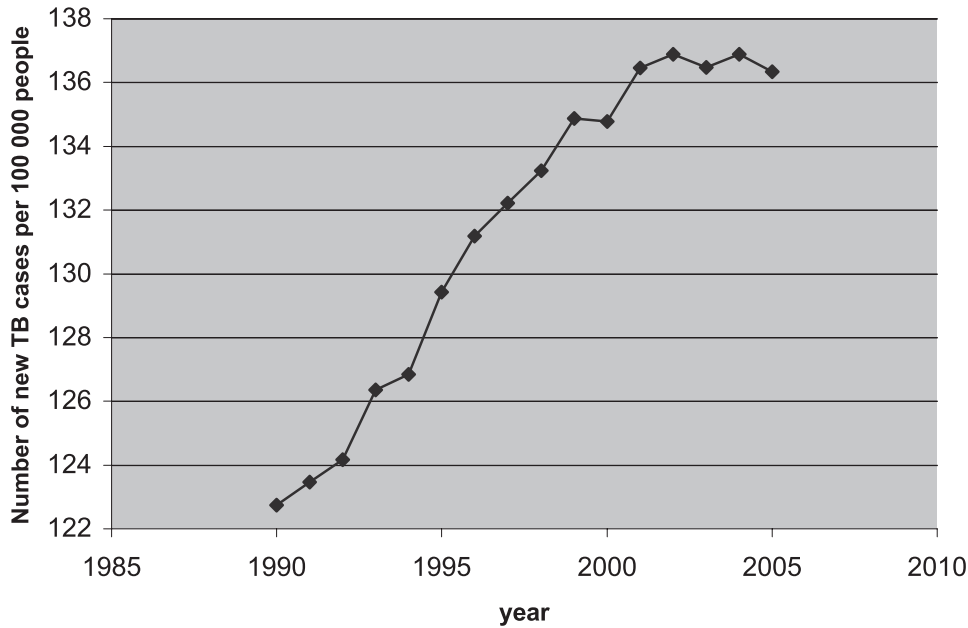
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Question	Mark	Question	Mark
1			
2			
3			
4			
5			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			



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

- 1 Tuberculosis (TB) is mainly an illness of the respiratory system, and is spread by coughing and sneezing. Each year about 1.6 million people worldwide die from this curable disease.

Figure 1
Global incidence of new TB cases per year



- 1 (a) (i) Describe **one** way in which the data in **Figure 1** indicate that the situation was worse in 2005 than in 1995.

.....

 (1 mark)

- 1 (a) (ii) Describe and explain **one** way in which the data in **Figure 1** indicate that the situation was better in 2005 than in 1995.

.....

 (2 marks)

- 1 (a) (iii) Give **one** possible source of error in the data in **Figure 1**.

.....

 (1 mark)



1 (b) It is estimated that about one-third of the world’s population carry TB bacteria but are completely healthy. They are only counted as cases when they show symptoms of TB. A high proportion of TB cases are also infected with the human immunodeficiency virus (HIV). This virus destroys the *immune system*.

1 (b) (i) Explain what is meant by the immune system.

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.....
.....

(2 marks)

1 (b) (ii) Explain why the HIV epidemic may be one of the reasons for the rise in TB cases.

.....
.....

(1 mark)

1 (c) TB can be treated with antibiotics but a full cure requires several months treatment with a combination of four different antibiotics. The TB bacterium readily evolves resistance to any one antibiotic. It is less likely to become resistant to several antibiotics at the same time. A long course of antibiotics is essential to ensure a complete cure although the patient is no longer infectious after a much shorter time.

In the last 20 years multi-drug resistant TB (MDR-TB) has arisen. This form of the disease is resistant to the two main drugs used. Treatment then requires more expensive drugs, with very unpleasant side effects, for about two years. Because this extended treatment is not always completed, an even more resistant form, extensively drug resistant TB (XDR-TB), is now being found. XDR-TB is resistant to nearly all the drugs used to treat TB.

1 (c) (i) The incomplete treatment that leads to resistance happens more often in low income countries. Give **two** reasons for this.

Reason 1

Reason 2

(2 marks)

Question 1 continues on the next page

Turn over ▶



- 1 (c) (ii) Suggest **one** measure the pharmaceutical industry could take in the face of the threat of XDR-TB. Explain why it would help.

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(2 marks)



2 There is a common belief that some human health problems, including cancer, are caused by widely used synthetic chemicals. These chemicals are found in cleaning agents, plastics, pesticides and glues. Our exposure to all of these chemicals has steadily increased over the past 20 years. Points made in media reports include the following.

- A. Many of these synthetic chemicals are known to act like hormones. Over the past 20 years there has been an increase in the incidence of cancers that are affected by levels of hormones in our bodies, such as breast and prostate cancers.
- B. Babies’ developing brains may be particularly vulnerable to synthetic chemicals. Over the past 20 years, the levels of autism, attention deficit hyperactivity disorder (ADHD) and cerebral palsy have all risen.

2 (a) (i) Choose **one** of the above statements and explain why it does **not** provide adequate evidence that synthetic chemicals increase the risk of disease.

Statement chosen

Explanation:

.....
.....

(2 marks)

2 (a) (ii) Health risks can be reduced as well as raised by the use of synthetic chemical products. Name **one** such product (other than a medicine) and explain how it has reduced the risk of catching an infectious disease.

.....
.....
.....

(2 marks)



- 3 It is known that serious vitamin C deficiency leads to an increased risk of ill health. The amount recommended for good health is 40 mg a day. A healthy diet that includes fruit and vegetables provides this. There is also a more controversial claim, that very much larger doses of vitamin C are even more beneficial and reduce both the frequency and severity of the common cold. This claim is based on work published in the 1970s.

Figure 2 shows some of the evidence that has been used to support the idea that large doses of vitamin C prevent colds.

Figure 2

Results of two double-blind trials of large doses of Vitamin C daily

	Experimental group: took large doses of Vitamin C			Control group: did not take large doses of Vitamin C		
	Number in group	Total colds	Colds per person	Number in group	Total colds	Colds per person
University students over 6 winter months – 1939	208	395	1.9	155	341	2.2
University students over 3 winter months – 1956	44	14	0.32	45	15	0.33

- 3 (a) (i) What is a *double-blind* trial?

.....

.....

.....

(2 marks)

- 3 (a) (ii) A problem with conducting a double-blind trial of large doses of vitamin C is that the vitamin has a very distinctive taste. This means that some subjects can work out which group they are in. Why might this affect the results of the studies reported above?

.....

.....

(1 mark)



- 3 (a) (iii) Suggest **three** reasons why the data in **Figure 2** provide very weak support for the idea that high doses of vitamin C reduce the frequency of colds. You might comment on the research design, the reliability of the results or the possibility of an alternative explanation.

Reason 1

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Reason 2

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Reason 3

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(3 marks)

- 3 (b) Websites promoting the use of large doses of vitamin C support their claims with accounts like that below.

Two-time Nobel prize winner, Dr Linus Pauling, was the first to claim that high doses of vitamin C were of crucial importance for the maintenance of a healthy immune system. Although the medical establishment immediately voiced their strong opposition to this idea, many ordinary people believed Dr Pauling and began taking large amounts of vitamin C. Most immediately noticed a great decrease in the frequency and severity of their colds.

- 3 (b) (i) Is the fact that Linus Pauling has won two Nobel prizes, one for chemistry and one for peace, relevant to an evaluation of his claim? Explain your answer.

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.....

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(2 marks)

- 3 (b) (ii) Linus Pauling's research on vitamin C received funding from a major manufacturer of the vitamin. Is this relevant to an evaluation of his claim? Explain your answer.

.....

.....

(1 mark)

Question 3 continues on the next page

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3 (b) (iii) Many people continue to take large doses of vitamin C supplements. This is despite the lack of positive evidence from clinical trials and the advice, given by most members of the medical profession, that it is ineffective.

Suggest **two** reasons why many people continue to believe in the effectiveness of large doses of vitamin C against the common cold.

Reason 1

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Reason 2

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(2 marks)

11



4 About 650 000 babies are born in England and Wales each year. They are all screened for four inherited diseases within a few days of birth. **Figure 3** shows these diseases.

Figure 3

Screening of newborn babies for inherited diseases

Disease	Incidence in UK	Benefit of early diagnosis	Date test introduced for all babies
Phenyketonuria (PKU)	1:12 000	special diet prevents severe mental handicap	1969
Congenital hypothyroidism (CHD)	1:4 000	medication prevents severe mental handicap	1981
Sickle cell disease (SCD)	1:4 000	early treatment reduces symptoms and improves health	2006
Cystic Fibrosis (CF)	1:2 500	early treatment may reduce some symptoms	2007

4 (a) (i) A baby develops PKU only if he or she inherits one faulty gene for PKU from each parent. If a baby is found to have PKU what does this tell us about the parents' genes?

.....
(1 mark)

4 (a) (ii) What is the chance of any other child born to the same parents also having PKU? Explain your answer using a diagram.

.....

(2 marks)

Question 4 continues on the next page

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- 4 (b) Screening for PKU has almost eliminated the mental handicaps it caused. The test costs about £5 per baby but is considered very cost effective. Explain what 'cost effective' means, using PKU as an example.

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(2 marks)

- 4 (c) Despite the success of testing for PKU and CHD, testing for other inherited diseases may not be equally valuable. The recent introduction of CF screening has been more controversial. **Figure 4** shows the criteria used to decide which screening tests to carry out. It also shows relevant information for CF.

Figure 4

Criterion	Information on CF
The incidence of the disease in the UK.	1 : 2 500
The health benefits of the screening – does early detection significantly improve the quality of life or the length of life?	Some studies show long term health benefits, others do not. It is too early to know about survival rates.
The cost of the screening test relative to the costs of caring for or treating a patient with the disease.	The cost of screening is £6400 for every case identified but earlier diagnosis may reduce the overall cost of care by more than this.
The reliability of the test – what is the proportion of false positives or false negatives?	False positives – about 7% of positive results from the initial test are found not to have CF after further tests. False negatives – about 10% of CF cases are not identified by screening. Symptoms will show up during the first few years of life.

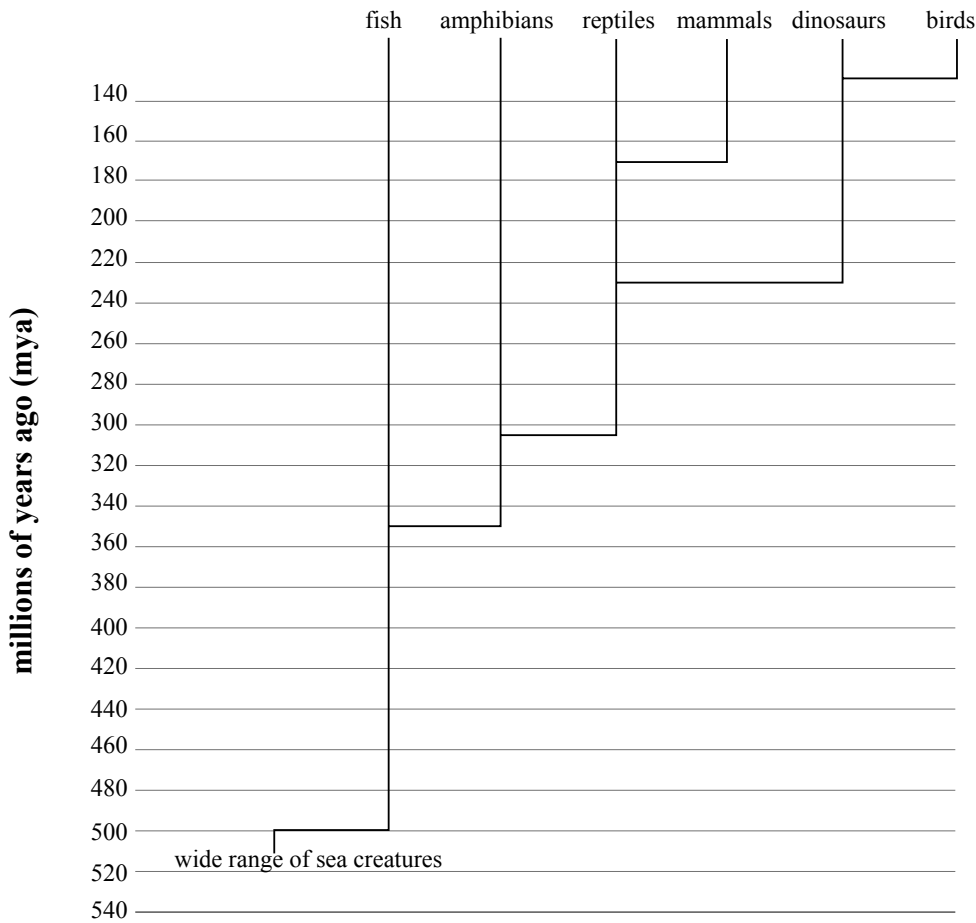


5 When Darwin proposed his theory of evolution by natural selection, one of the most important types of evidence he used to support the idea was the fossil record.

Fossils form when creatures die in particular circumstances that allow their bodies to be preserved as minerals. Fossils are found in different layers of rock. Deeper rock layers are usually older. The age of a fossil can be estimated from the age of the rock layer it is found in.

Figure 5 shows the evolutionary relationship between some important classes of animals. The estimated ages of the oldest fossils for each class are indicated by the horizontal lines on the diagram.

Figure 5
Some evolutionary relationships



5 (a) (i) From the information in **Figure 5** make an estimate of how long it took for the amphibians to evolve from the first fish.

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(1 mark)

5 (a) (ii) Which class of animals is most closely related to mammals according to **Figure 5**?

.....
(1 mark)

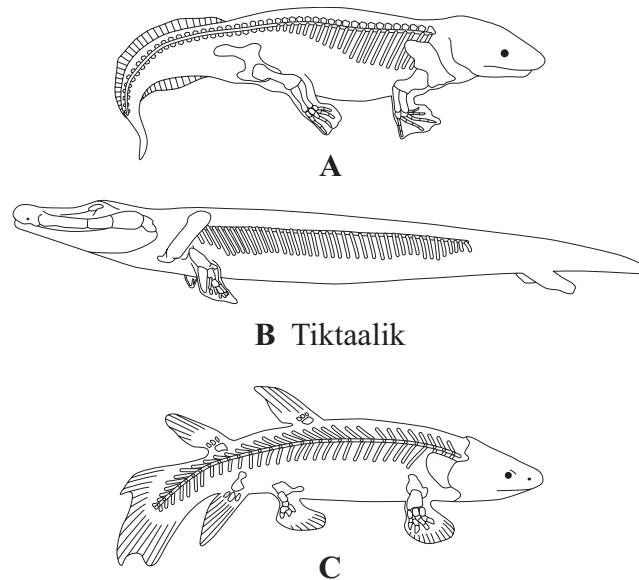


- 5 (b) One important evolutionary change was from fish to amphibians, the first air breathing four-legged animals. Until 20 years ago almost no fossils had been found that were intermediate between the two. Critics of evolution referred to a ‘missing link’. However scientists predicted such intermediates would be found. In what age of rock would they have predicted that intermediates, showing features of both fish and amphibians, should be found?

.....
(1 mark)

- 5 (c) Several such fossils have now been found, exactly as predicted. **Figure 6** shows some of these intermediate forms in order of age, with the oldest at the bottom.

Figure 6
Reconstructions of some fossils intermediate between fish and four-legged air breathing animals



- 5 (c) (i) Use Darwin’s theory of evolution to explain the process by which the four-legged land animal, A, may have evolved, over about 20 million years, from the fish-like creature, C, in the swampy conditions of the time.

.....

(4 marks)

Question 5 continues on the next page

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5 (c) (ii) Tiktaalik was only found in 2004 and aroused great interest. Explain why scientists thought it was a very significant finding.

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(2 marks)

5 (c) (iii) If a mammal fossil were ever to be found in rocks that date from 400 mya this would be strong evidence that our current understanding of evolutionary relationships is incorrect. Explain why.

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(2 marks)

5 (c) (iv) Those who oppose the theory of evolution often claim that gaps in the fossil record are important evidence against the theory. Explain why this is not a valid conclusion.

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(2 marks)

END OF QUESTIONS

13

