Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

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General Certificate of Education
January 2003
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

HUMAN BIOLOGY (SPECIFICATION A) BYA9/W
Unit 9 (Written Synoptic)

Tuesday 28 January 2003 Morning Session

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

Time allowed: 1 hour 45 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 but note that **Question 3** offers a choice of essays.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.
- This unit assesses your understanding of the relationship between the different aspects of Biology.
- 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
1			
2			
3			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 (a) Caterpillars were fed on diets in which different amino acids were absent. **Figure 1** shows the percentage of caterpillars which survived on these diets for 20 days.

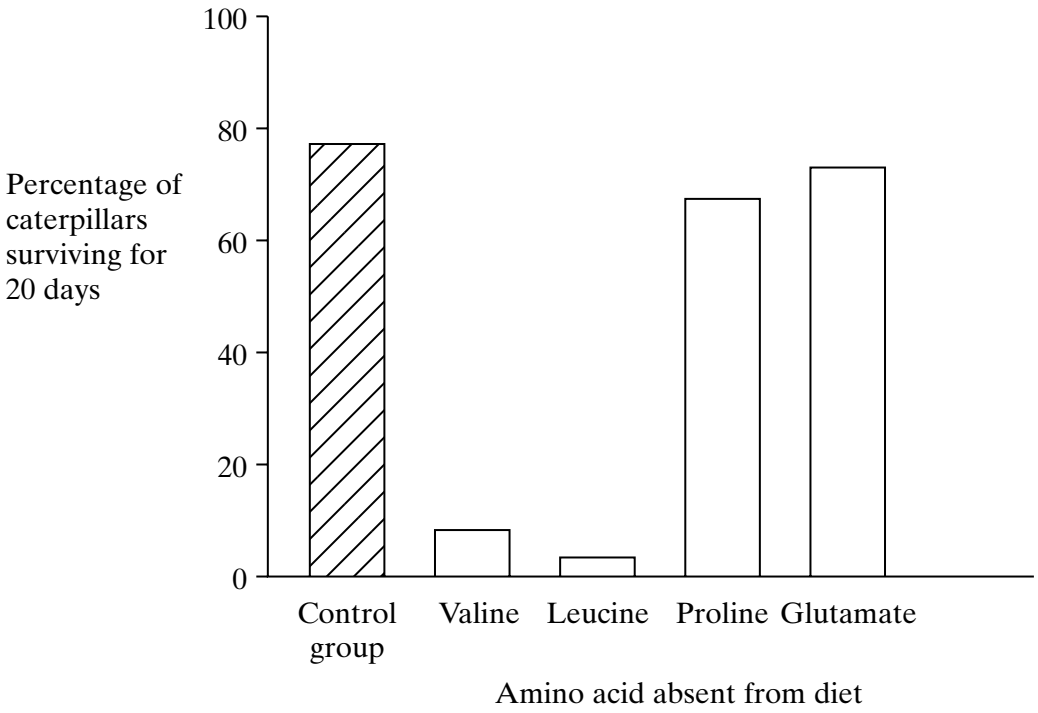

Figure 1

(i) Describe how the control group of caterpillars should have been treated.

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(2 marks)

(ii) In caterpillars, glutamate is a non-essential amino acid. Explain the evidence from **Figure 1** which supports this.

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(2 marks)

The rate of uptake of amino acids by the epithelial cells lining a piece of rat small intestine was investigated. Two experiments were carried out. In experiment **A**, the contents of the intestine were stirred while the measurements were taken. In experiment **B**, the contents of the intestine were not stirred. The table shows the results of these experiments.

Concentration of amino acids in intestine / mmol dm^{-3}	**Rate of uptake of amino acids / arbitrary units**	
	A. Contents stirred	**B. Contents not stirred**
0	0	0
2	5.1	2.9
4	7.8	5.6
6	9.4	6.5
8	10.8	7.2
10	11.1	7.5

(b) (i) In experiment **B**, describe how the rate of uptake changes as the concentration of amino acids in the intestine increases.

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(2 marks)

(ii) It has been suggested that carrier proteins are involved in transporting amino acids from the intestine. Explain how the results of experiment **B** support this suggestion.

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(2 marks)

QUESTION 1 CONTINUES ON THE NEXT PAGE

(c) (i) Explain how mixing the intestine contents increases the rate of absorption of amino acids.

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(2 marks)

(ii) Which tissue, present in the wall of the intestine, mixes the contents of the intestine in a live animal?

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(1 mark)

Figure 2 shows some biochemical pathways involving the amino acid phenylalanine in the human body.

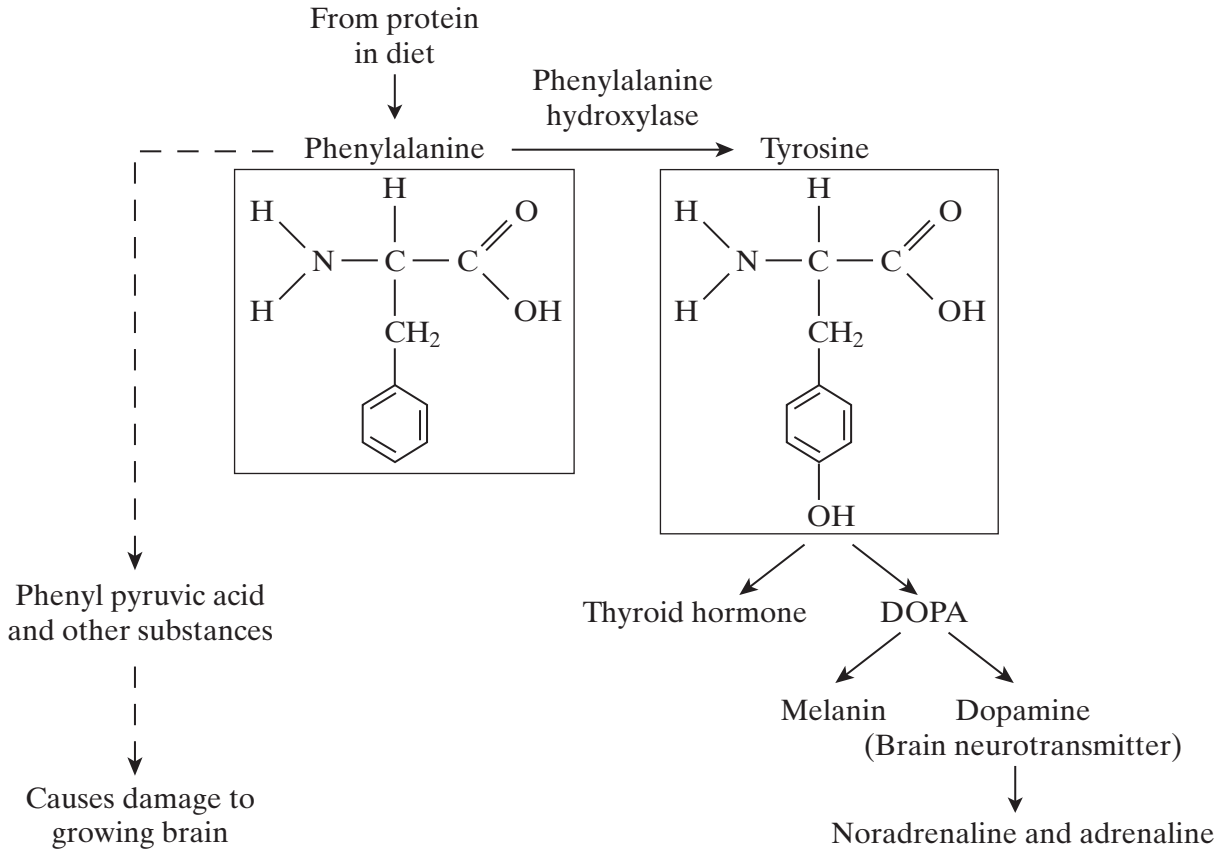

Figure 2

(d) Explain why the enzyme which converts phenylalanine into tyrosine is called phenylalanine hydroxylase.

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(1 mark)

(e) Phenylketonuria is a genetic disease in which the enzyme phenylalanine hydroxylase (PAH) is missing. If untreated, phenylketonuria causes damage to the growing brain. Suggest and explain **one** other sign or symptom of phenylketonuria.

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(3 marks)

(f) Babies who are diagnosed as having phenylketonuria are fed on a special diet that contains only small amounts of phenylalanine and extra tyrosine. This special diet is necessary only until the child reaches the age of about 6 years. After this a normal but low-protein diet is recommended.

(i) Explain why the special diet contains extra tyrosine.

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(2 marks)

(ii) Explain why the special diet is only necessary until the child reaches the age of about 6 years.

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(1 mark)

(g) A woman who has phenylketonuria may have a child who does not have this condition. It is important that a woman with phenylketonuria keeps to the special diet throughout her pregnancy, otherwise her child will be born with brain damage. Explain why.

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(2 marks)

20

2 Read the following passage.

Doctors use the word "drug" to refer to a substance which can be used to treat disease. Although there are more than five thousand different drugs, their action falls into one of three categories.

The first of these involves interfering with how cells work. We will look at an example of one of these drugs. Urate is one of the body's waste products. It is normally produced in small quantities which are excreted in the urine. Urate, however, is not very soluble and this is particularly true at temperatures of 20 °C or less. Gout results from a high concentration of urate in the blood plasma. It is a painful condition produced by urate crystals formed as urate comes out of solution in the toes. Allopurinol is a drug used to treat gout. It has molecules which are chemically very similar to those of hypoxanthine. Hypoxanthine is the substrate of the enzyme xanthine oxidase. Urate is formed from hypoxanthine by the action of this enzyme.

A second group comprises drugs that replace substances which are deficient in the body. The one which is probably most familiar is the protein hormone, insulin. It is injected into patients with diabetes. Most of the insulin we use now is made by genetic engineering. Older preparations were obtained from cattle or pigs. Insulin obtained from cattle, in particular, was strongly antigenic.

The final group contains drugs which kill disease-causing microorganisms. The most familiar drugs in this group are the antibiotics. They act in various ways. Vancomycin, for example, prevents the formation of peptidoglycan, the main substance from which bacterial cell walls are made. It is used in the treatment of a number of bacterial diseases. Streptonigrin is another antibiotic. It breaks down DNA into shorter polynucleotides. Streptonigrin kills bacteria but is more useful as an anti-cancer drug.

Use information in the passage and your own knowledge to answer the following questions.

(a) Urate comes out of solution in the blood and forms crystals (lines 8-9). Explain why urate often first comes out of solution in the toes.

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(2 marks)

(b) Would you expect allopurinol (line 9) to be a competitive or a non-competitive inhibitor? Explain the evidence from the passage which supports your answer.

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(2 marks)

(c) Explain why insulin cannot be taken orally.

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(2 marks)

(d) Insulin obtained from cattle is described as being strongly antigenic (lines 16-17).

(i) What is meant by an *antigen*?

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(1 mark)

(ii) Explain why insulin obtained from cattle is more strongly antigenic than insulin produced by genetic engineering.

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(2 marks)

(e) Bacteria treated with vancomycin swell and burst due to water entering the cells. Explain why.

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(3 marks)

QUESTION 2 CONTINUES ON THE NEXT PAGE

(f) (i) Explain why the genes in a bacterial cell cannot produce proteins if the cell has been treated with streptonigrin.

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(2 marks)

(ii) Streptonigrin can be used as an anti-cancer drug but vancomycin cannot. Give **one** explanation for this.

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(1 mark)

15

3 Write an essay on **one** of the following topics. You should select and use information from different parts of the specification. Credit will be given, not only for the biological content, but also for the selection and use of relevant information, and for the organisation and presentation of the essay.

EITHER **A** How bacteria affect human lives *(25 marks)*

OR **B** The biological importance of water *(25 marks)*

END OF QUESTIONS