Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2003
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Thursday 19 June 2003 Afternoon 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) (i) The core temperature of a human fetus is approximately 0.5 °C higher than that of its mother. Explain what causes this higher body temperature.

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(3 marks)

(ii) Under the same environmental conditions, a newborn human infant is more susceptible to heat loss than an older child. Suggest **two** reasons for this.

1 .....

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2 .....

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(2 marks)

(b) Protein is essential for growth. Different proteins, however, have different nutritive values. One method of measuring protein quality is to calculate its biological value from the equation:

$$\text{Biological value} = \frac{\text{Amount of protein used in maintenance and growth}}{\text{Amount of protein digested and absorbed}}$$

In order to do this, the following quantities are measured:

I = nitrogen intake
F = nitrogen in faeces
U = nitrogen in urine

Use the letters **I**, **F** and/or **U** to show how each of the following is calculated:

(i) the amount of protein digested and absorbed;

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(1 mark)

(ii) the amount of protein used in maintenance and growth.

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(1 mark)

(c) When food passes through the gut, only a certain amount of the protein it contains is digested. The rest passes out of the body in the faeces. The digestibility coefficient is one way of measuring this.

$$\text{Digestibility coefficient} = \frac{\text{Nitrogen intake} - \text{Nitrogen in faeces}}{\text{Nitrogen intake}}$$

(i) Explain why nitrogen intake is a useful measure of protein intake.

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(2 marks)

(ii) Other than protein in the food which has not been digested, give **two** sources of protein in faeces.

1 .....

2 .....

(2 marks)

(iii) A lot of the protein in a vegetarian diet comes from cereals and vegetables. Use your knowledge of plant cells to explain why the digestibility coefficient for protein in vegetarian diets is lower than that for diets in which most of the protein comes from meat.

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(3 marks)

QUESTION 1 CONTINUES ON THE NEXT PAGE

(d) The table shows how protein requirement varies with age.

Age / years	Sex	Mean body mass / kg	Estimated protein requirement / g day^{-1}
11 – 14	Male	43.0	33.8
15 – 18		64.5	46.1
50 +		71.0	42.6
11 – 14	Female	43.8	33.1
15 – 18		55.5	37.1
50 +		62.0	37.2

(i) Explain the difference in the estimated protein requirements for males and females between 15 and 18 years of age.

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(2 marks)

(ii) In people of 50 years and over, protein is used entirely for maintenance. Explain how dietary protein is essential for maintenance of the oxygen-carrying capacity of the blood.

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(2 marks)

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(iii) It has been suggested that maintenance requirements for protein are approximately the same for males and for females. Do you agree with this statement? Use suitable calculations from figures in the table to support your answer.

(2 marks)

20

TURN OVER FOR THE NEXT QUESTION

2 Read the following passage.

The name "antibiotic" was originally used to describe one of the many different substances produced by microorganisms, which kill other microorganisms or stop them from multiplying. These properties make antibiotics very useful in medicine. All antibiotics function by interfering with specific cell components or by disrupting cell metabolism. Not surprisingly, microbial inhibition is brought about by a variety of routes.

The most widely used antibiotics are the penicillins. These substances are chemically similar to each other in that they are all based on a ring-shaped nucleus to which various side-chains are attached. Penicillins inhibit the last stage in the synthesis of peptidoglycan which is the main component of bacterial cell walls. As a result, water enters the bacterial cell and causes it to burst.

Another, rather more diverse, group of antibiotics affects nucleic acids. None of the antibiotics which bind to DNA is useful in controlling disease caused by bacteria because they are incapable of distinguishing between the DNA found in different types of cell. Any selectivity that does exist usually results from other factors such as the permeability of cells to drug molecules. Some of these antibiotics interfere with DNA synthesis by binding specifically to enzymes involved in the polymerisation process.

A third group interferes specifically with ribosome function. The mechanism of protein synthesis is essentially the same in all cells but there is a difference in the type of ribosome that a cell contains. Chloramphenicol and tetracycline are two antibiotics which affect ribosomes. They function in different ways. Chloramphenicol is a broad-spectrum antibiotic which inhibits the formation of peptide bonds. Tetracycline appears to prevent the binding of the tRNA-amino acid complex to the acceptor site of the ribosome. It may be more effective against bacterial cells than against mammalian cells because bacterial cells concentrate tetracycline. This results in a high concentration of tetracycline inside the cell, as much as thirty times that of the concentration outside.

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

(a) Explain why it is not surprising that microbial inhibition is brought about by a variety of routes (lines 4-5).

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(1 mark)

(b) Explain the meaning of the term *nucleus* as used in the passage (line 7).

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(1 mark)

(c) (i) Explain why bacterial cells burst when they are treated with penicillin (lines 9-10).

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(3 marks)

(ii) Plant cells are similar to bacterial cells in that they are also surrounded by cell walls. Explain why plant cells would not burst if they were treated with penicillin.

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(1 mark)

(d) (i) Explain why none of the antibiotics which bind to DNA is useful in controlling disease caused by bacteria (lines 11-12).

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(2 marks)

(ii) Explain how antibiotics which bind specifically to enzymes involved in the polymerisation process interfere with DNA synthesis (lines 15-16).

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(2 marks)

QUESTION 2 CONTINUES ON THE NEXT PAGE

(e) Broad-spectrum antibiotics (line 20) are effective against many different microorganisms. Suggest why chloramphenicol

(i) is effective against many different microorganisms;

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(2 marks)

(ii) does not prevent protein synthesis in mammalian cells.

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(1 mark)

(f) (i) By what mechanism would you expect tetracycline to enter cells? Give a reason for your answer.

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(1 mark)

(ii) In terms of the structure of a plasma membrane, suggest why tetracycline does not reach high concentrations in mammalian cells.

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(1 mark)

15

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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** The structure and functions of carbohydrates *(25 marks)*

OR **B** Cycles in biology *(25 marks)*

END OF QUESTIONS