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General Certificate of Education
 June 2004
 Advanced Level Examination



**HUMAN BIOLOGY (SPECIFICATION A)
 Unit 9 (Written Synoptic)**

BYA9/W

Friday 25 June 2004 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
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2			
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Total (Column 1)		→	
Total (Column 2)		→	
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Answer **all** questions in the spaces provided.

- 1** A newly laid chicken's egg contains a zygote and all the substances this zygote needs to develop into a chick, with the exception of oxygen. **Figure 1** shows some of the substances which are absorbed and produced during the development of the chick.

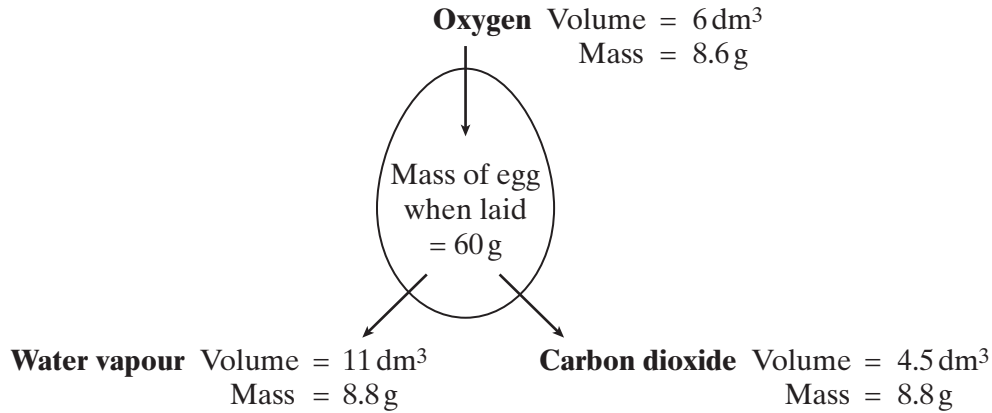


Figure 1

- (a) The values for oxygen in **Figure 1** show the total amount taken up during the development of the chick from zygote to hatching.

- (i) Describe how you would expect the pattern of the rate of oxygen uptake to change during this period.

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- (ii) Explain the change in the rate of oxygen uptake which you have predicted.

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(3 marks)

- (b) (i) The shell surrounding the egg weighs 12 g. As the chick develops, it comes to fill the egg. Calculate the mass of a newly hatched chick.

Answer g
(1 mark)

- (ii) What is the main respiratory substrate of the developing chick? Support your answer with a suitable calculation.

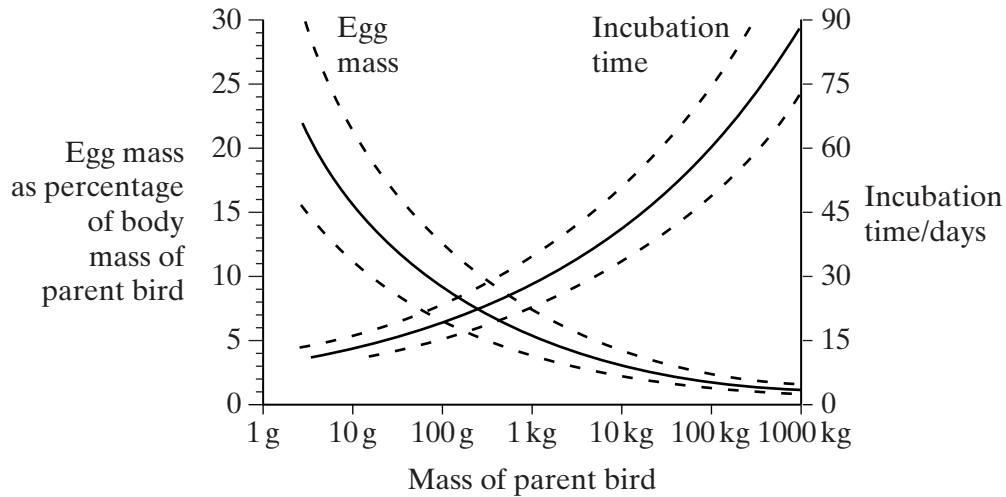
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(3 marks)

QUESTION 1 CONTINUES ON THE NEXT PAGE

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The eggs of different species of bird differ in size and in incubation time. Incubation time is the time between the egg being laid and hatching. The graph shows the relationship between the body mass of the parent bird, egg mass and incubation time. For each curve, the solid line represents the mean value. The dashed lines represent one standard deviation above and below the mean.



(c) What information do the curves showing standard deviation give about egg mass?

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(2 marks)

(d) Suggest an explanation for the relationship between the mass of the parent bird and incubation time. Refer to the size of the newly hatched chick and the length of the cell cycle in your answer.

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(3 marks)

- (e) (i) Calculate the mean mass of an egg from a bird weighing 10 g and from a bird weighing 10 kg. Show your working.

Mass of egg from bird weighing 10 g Mass of egg from bird weighing 10 kg

Answer g Answer g
(2 marks)

- (ii) Suggest an advantage of large size in eggs which have a long incubation time.

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 (1 mark)

Egg shells are perforated by small pores through which exchange of gases takes place. One of these pores is shown in **Figure 2**.

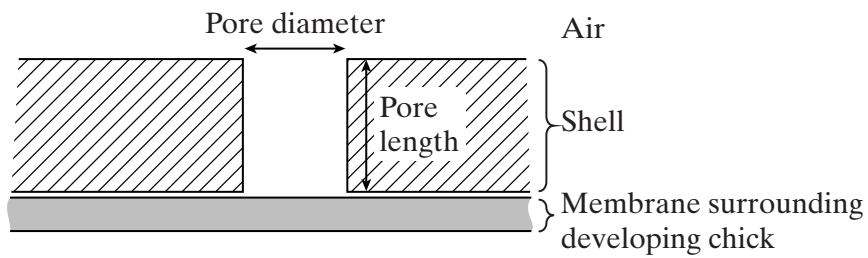


Figure 2

- (f) (i) Use your knowledge of Fick's law to explain how diffusion rate is affected by both the diameter and the length of the pores.

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 (3 marks)

- (ii) Explain why there is an unavoidable loss of water vapour from a developing egg.

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(2 marks)
Turn over ▶

2 Read the following passage.

Vampire bats are unique among mammals. They feed entirely on blood. The bat lands on its victim and uses its teeth to make a small wound in the skin of its host – a cow, horse or, sometimes, a human. It then feeds on the blood which flows from the cut.

- 5 Biologists have often wondered how a vampire bat could obtain its liquid meal without the blood clotting. Clotting is a response to injury. It depends on blood plasma producing an insoluble protein which forms a mesh of fibres that trap red blood cells to form a protective clot. As a defence against this happening in an intact blood vessel, the plasma also contains proteins called plasminogens. Plasminogens are normally inactive but can be converted to active plasmins. Plasmins are able to break down the protein fibres and dissolve blood clots.
- 10 Vampire bats produce a plasminogen activator called desmokinase. Interestingly, desmokinase is an enzyme which only activates the plasminogens of cattle, horses and humans.

- 15 A diet of blood presents considerable problems for a mammal. Blood consists of about 90% water. The remainder is almost entirely protein. There is very little lipid or carbohydrate present. This diet affects a number of aspects of a vampire bat's biology. It has very little by way of fat reserves and this limits the animal's geographical distribution. Its body temperature is maintained at around 37°C. If the temperature of the surroundings falls below 10°C, it is unable to survive. At the other end of the temperature range, its high metabolic rate means that environmental temperatures above 30°C rapidly prove lethal.

- 20 Vampire bats are important vectors of the virus which causes rabies, transferring it from host to host in their saliva. Cases of vampire-borne rabies occur in periodic outbreaks. The progress of an outbreak can be determined by the immune response of the bats. At the beginning of an outbreak, a significant percentage of vampire bats will test positive for the rabies virus but few carry the appropriate antibodies. When the outbreak is receding, the antibody levels will be high but there will be little evidence of the virus.

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

- (a) (i) Name the insoluble protein which forms a mesh of fibres (line 6).

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(1 mark)

- (ii) This insoluble protein is produced from a soluble protein found in the plasma. Explain how injury to blood vessels produces this reaction.

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(2 marks)

(b) It is thought that desmokinase could be useful in preventing myocardial infarction. Explain why.

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(3 marks)

(c) Desmokinase only activates plasminogens from cattle, horses and humans. Explain what causes desmokinase to activate the plasminogens from these animals but not the plasminogens from other species.

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(3 marks)

(d) (i) Explain why vampire bats are unable to survive in environmental temperatures lower than 10°C (lines 16 - 17).

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(1 mark)

(ii) Explain why the high metabolic rate of a vampire bat means that environmental temperatures above 30°C rapidly prove lethal (line 18).

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(2 marks)

QUESTION 2 CONTINUES ON THE NEXT PAGE

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(e) The number of bats testing positive for rabies antibodies changes as an outbreak of rabies progresses (lines 21 - 24). Describe the role of lymphocytes in producing this change.

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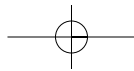
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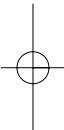
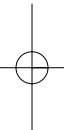
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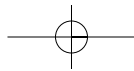
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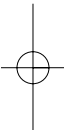
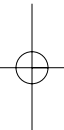
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