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Centre Number						Candidate Number					
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General Certificate of Education  
 January 2003  
 Advanced Level Examination



**BIOLOGY (SPECIFICATION A)  
 Unit 8 (Written Synoptic)**

**BYA8/W**

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			
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Total (Column 1)	→		
Total (Column 2)	→		
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Examiner's Initials			

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

- 1** Plaice are fish which lay very large numbers of eggs. When the young plaice hatch from these eggs, they are very small and have a permeable body surface. **Table 1** shows some of the results of an investigation of surface area to body mass ratio and gas exchange in young plaice.

Length/mm	Surface area in relation to body mass/mm <sup>2</sup> mg <sup>-1</sup>	
	body surface	gills
5	39.8	0.02
10	17.4	0.05
15	7.2	0.16
20	3.1	0.24

**Table 1**

- (a) Describe how the ratio of body surface area to body mass changes as the fish increases in length.

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(2 marks)

- (b) It would **not** be possible to draw valid conclusions from **Table 1** about how the surface area to volume ratio of a young plaice changes as it increases in length. Explain why.

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(1 mark)

- (c) As a plaice increases in length, its total oxygen uptake increases.

- (i) Explain why larger plaice need more oxygen than smaller plaice.

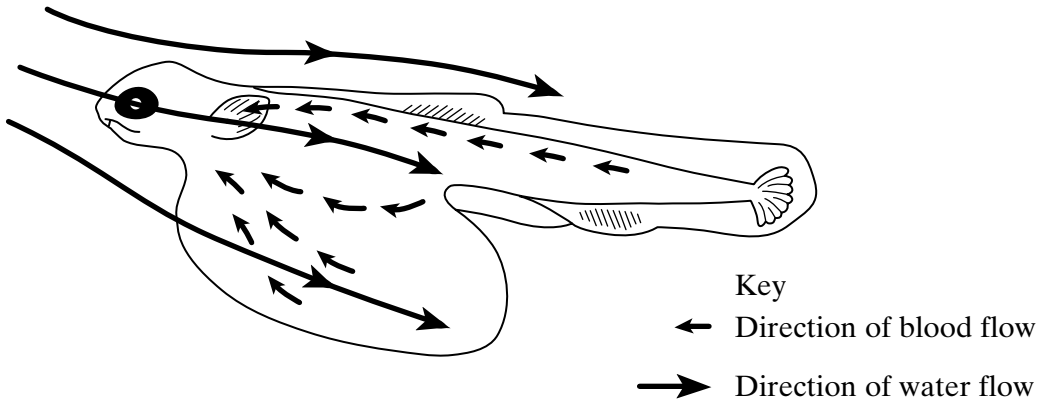
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(2 marks)

- (ii) Suggest how the different sites of gas exchange change in importance as the plaice increases in length.

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- (d) **Figure 1** shows a newly-hatched plaice. The arrows show the direction of blood flow in the blood vessels near the body surface, and the direction of water flow over the fish.



**Figure 1**

- (i) Explain how the directions of water and blood flow help to ensure efficient uptake of oxygen.

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(3 marks)

- (ii) Young plaice have periods when they swim and periods when they lie still in the water. They increase the frequency of the periods of swimming when the percentage saturation of water with oxygen falls below 60%. Explain how this behaviour helps to increase oxygen uptake.

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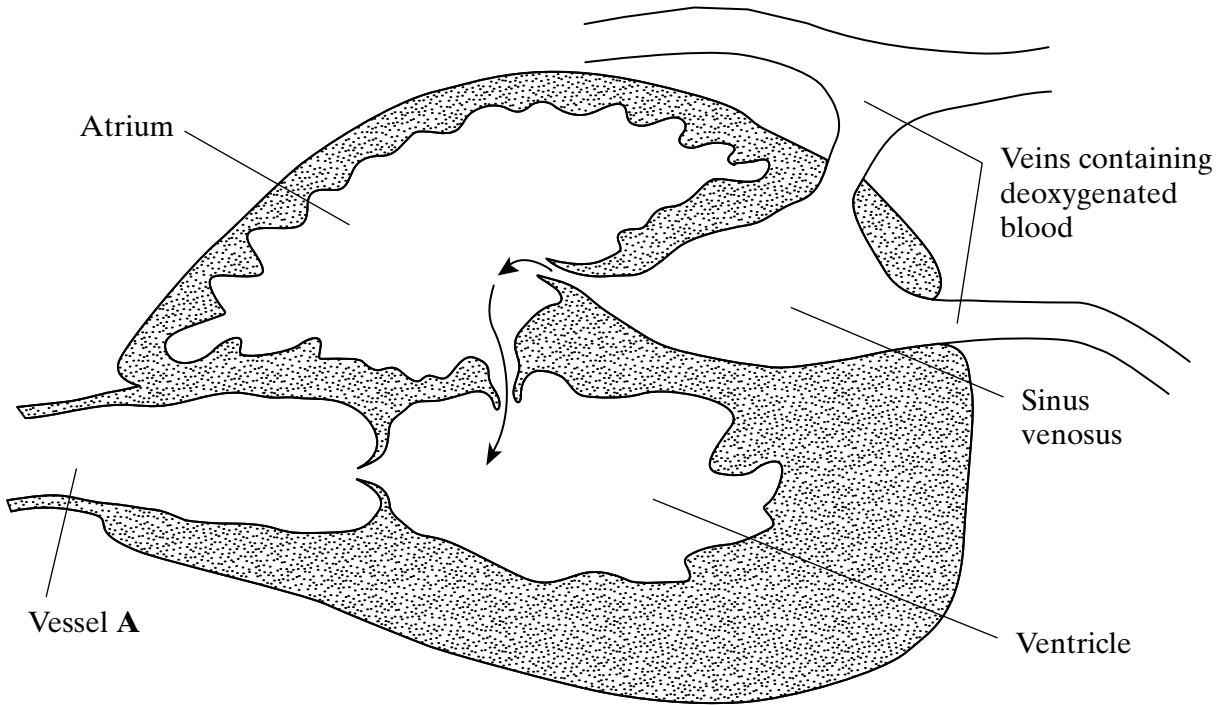
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(2 marks)

**QUESTION 1 CONTINUES ON THE NEXT PAGE**

**Figure 2** shows a section through the heart of a fish. In a fish, the heart has one atrium and one ventricle.



**Figure 2**

- (e) (i) What is the evidence in the diagram that blood can only flow in the direction shown by the arrows?

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*(1 mark)*

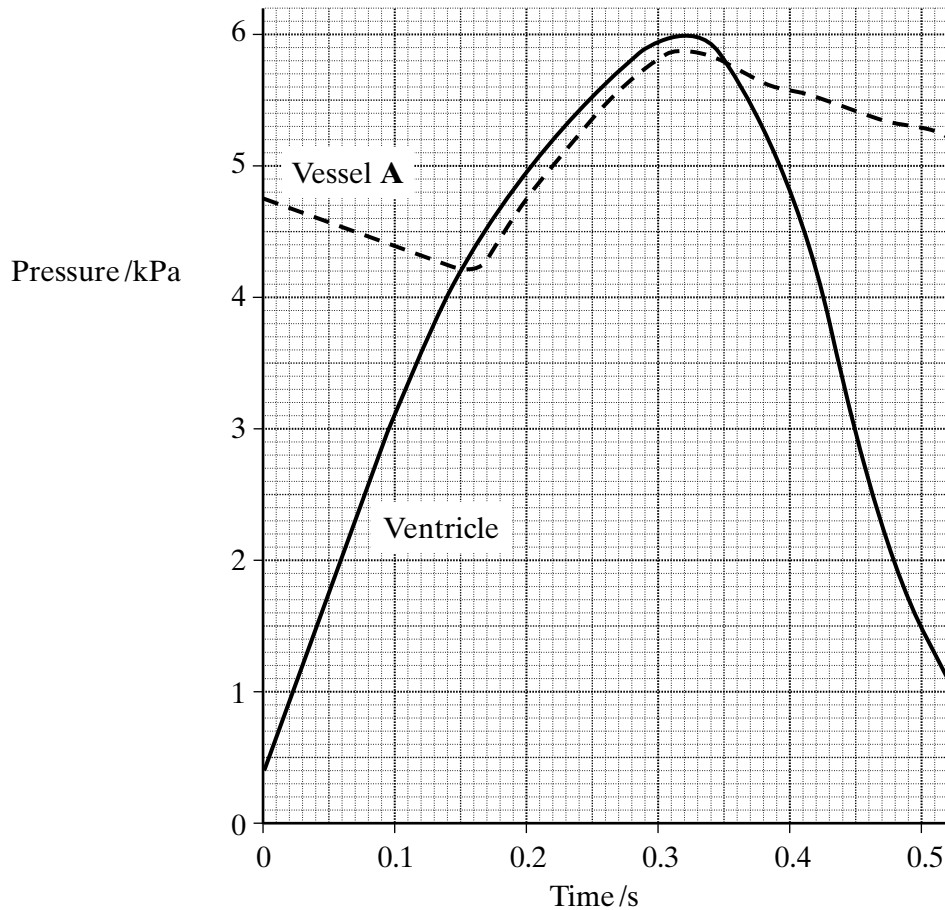
- (ii) When the sinus venosus contracts, some blood flows back into the veins. Explain why.

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*(2 marks)*

- (iii) To which organ does blood in vessel **A** flow first?

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*(1 mark)*

- (f) The graph in **Figure 3** shows some pressure changes which take place in this heart during part of a cardiac cycle.



**Figure 3**

For how long during this cycle will blood be flowing out of the ventricle? Use evidence from the graph to explain your answer.

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(2 marks)

**QUESTION 1 CONTINUES ON THE NEXT PAGE**

- (g) Stroke volume and heart rate change as an animal becomes more active. **Table 2** shows how they change in a fish and in a mammal.

<b>Animal</b>	<b>Feature</b>	<b>At rest</b>	<b>Active</b>
Fish	Heart rate/beats minute <sup>-1</sup>	38	51
	Stroke volume/cm <sup>3</sup>	0.46	1.03
Mammal	Heart rate/beats minute <sup>-1</sup>	143	321
	Stroke volume/cm <sup>3</sup>	2.29	2.86

**Table 2**

Describe how the way in which cardiac output is increased with exercise in a fish differs from the way in which it is increased in a mammal. Use suitable calculations based on the data in **Table 2** to support your answer.

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(3 marks)

2 Read the following passage.

In spite of the ability of animals to eat them, green plants dominate the landscape. Part of the reason for this is that most plants, not just the ones we regard as poisonous, contain toxins. These toxins are found in different amounts in different parts of the plant.

5 Many different substances act as toxins. The simplest are the non-protein amino acids. These substances are chemically similar to the twenty amino acids normally found in proteins. Thus  $\beta$ -cyanoalanine,  $\text{NCCH}_2\text{CHNH}_2\text{COOH}$ , is clearly similar to alanine,  $\text{CH}_3\text{CHNH}_2\text{COOH}$ . When non-protein amino acids are eaten, they are incorporated into proteins. This results in the formation of unnatural enzymes that do not function properly. Plants which make these non-protein amino acids, however, do not synthesise faulty enzymes. Investigations with lily of the valley have shown why. This plant produces large amounts of azetidine 2-carboxylic acid (ACA). This substance is a non-protein amino acid very similar to the amino acid proline. In the lily of the valley, the enzyme which links proline to tRNA does not bind to azetidine 2-carboxylic acid.

15 Another group of toxins has been called the “sugar-shaped weapons of plants” and they inhibit enzymes involved in carbohydrate metabolism. One of these is a substance called swainsonine. It is toxic to cattle and affects the nervous system. This effect results from the build-up of mannose-based sugars because the animal’s mannosidase enzymes cannot break them down.

20 Fortunately, many toxic compounds can be made harmless. In mammals, the liver plays an important part in this. Poisonous substances are converted into products which are relatively harmless. These products are excreted either in bile or urine. Molecular size is often the factor determining the final route of elimination from the body. Only the smaller molecules are removed in the urine. The selective ability of primary consumers to overcome the chemical defences of plants is reflected in the pattern of feeding we see today.

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

(a)  $\beta$ -cyanoalanine (line 6) is a non-protein amino acid. Explain why  $\beta$ -cyanoalanine is

(i) an amino acid;

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(2 marks)

(ii) called a non-protein amino acid.

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(1 mark)

(b) (i) Explain why enzymes which contain non-protein amino acids cannot function properly.

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(3 marks)

(ii) Explain why enzymes which do not function properly are not synthesised in lily of the valley.

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(2 marks)

(c) Would you expect swainsonine (line 16) 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)

(d) (i) Explain why some of the products in bile (line 21) are described as excretory products.

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(1 mark)

**QUESTION 2 CONTINUES ON THE NEXT PAGE**



(ii) Suggest why only small molecules are removed in the urine.

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(2 marks)

(e) Explain **one** way in which the information in the passage can help to explain why different species of primary consumer have different ecological niches.

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(2 marks)

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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** How bacteria affect human lives (25 marks)

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

**END OF QUESTIONS**

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