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Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2006
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Friday 23 June 2006 1.30 pm to 3.15 pm

For this paper you must have:
- a ruler with millimetre measurements

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 but note that **Question 3** offers a choice of essays. **Question 3** should be answered in continuous prose.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Use accurate scientific terminology in all your answers.

Information
- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- This unit assesses your understanding of the relationship between the different aspects of biology.
- You are reminded of the need for good English and clear presentation in your answers.
- Quality of Written Communication will be assessed in the answer to **Question 3**.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
Total (Column 1) →			
Total (Column 2) →			
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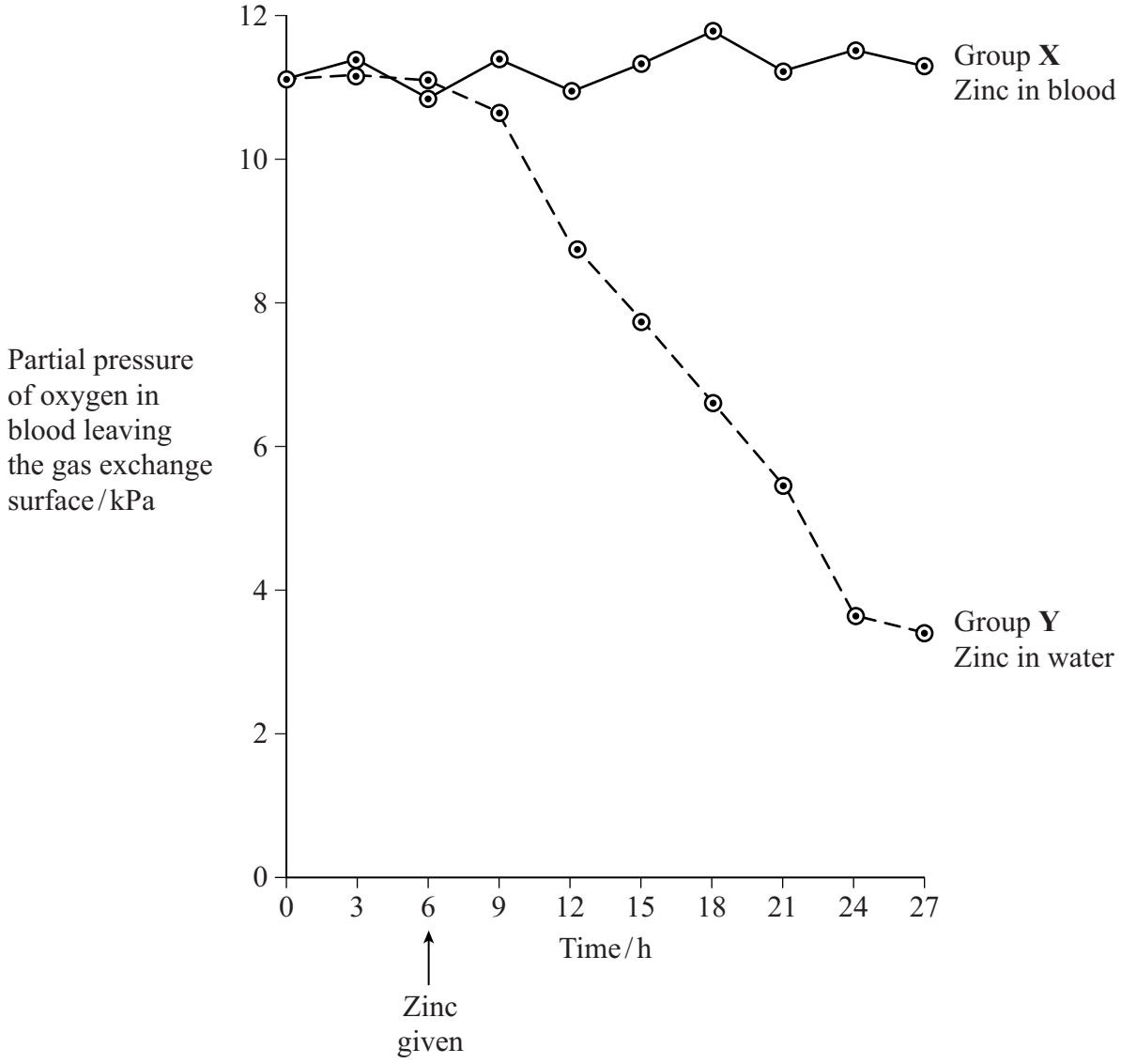
Examiner's Initials			

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

1 Ions of metals such as zinc often pollute rivers. The effect of zinc ions on gas exchange and respiration in fish was investigated. Fish were kept in tanks of water in a laboratory.

The fish in one group (**X**) had a solution of a zinc compound injected directly into their blood and were then put in a tank of zinc-free water.
A second group (**Y**) was not injected but had the solution of the zinc compound added to the water in the tank.

The partial pressure of oxygen in the blood of both groups of fish was then monitored.
The results are shown in the graph.



(a) During this investigation, air was bubbled through the water in the tanks. Explain why this helped to ensure that the results of the investigation were reliable.

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(1 mark)

(b) The results from the two groups were compared using a statistical test.

(i) Suggest a null hypothesis that could be tested.

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(1 mark)

(ii) Explain why it is important to use a statistical test in analysing the results of this investigation.

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(2 marks)

(c) Two suggestions were made to explain the results shown in the graph.

A Zinc ions reduce the rate at which oxygen is taken up from the water and passes into the blood.

B Zinc ions reduce the ability of haemoglobin to transport oxygen.

Which of these suggestions is the more likely? Explain the evidence from the graph that supports your answer.

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(2 marks)

(d) During the investigation, the pH of the blood was also monitored. It decreased in group **Y**. Suggest an explanation for this decrease in pH.

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(3 marks)

Question 1 continues on the next page

(e) Shrews are small mammals. Shrews and the small animals on which they feed were collected at different distances from an oil refinery. The concentrations of copper and cadmium ions in their bodies were measured. The results are shown in the table.

	Concentration of ions / µg g^{-1}					
	Copper			Cadmium		
	10 km from refinery	1 km from refinery	Around refinery	10 km from refinery	1 km from refinery	Around refinery
Food	52	104	652	2	16	48
Shrews	16	19	17	3	22	71

(i) It has been suggested that mammals such as shrews control the concentration of copper ions in their bodies but cannot control the concentration of cadmium ions. Do you agree with this suggestion? Use suitable calculations to support your answer.

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(2 marks)

(ii) Suggest what happens to most of the copper ions eaten by the shrews.

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(1 mark)

(iii) Explain the difference in cadmium ion concentration between the shrews and their food.

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(2 marks)

(f) Yorkshire fog is a species of grass. Two varieties of Yorkshire fog were studied. One variety was tolerant to arsenic, while the other variety was not. In a series of investigations, it was found that

- Arsenic-tolerant plants grow in soil which contains a high concentration of arsenic.
- Arsenic-tolerant plants growing in soil containing high concentrations of arsenic and phosphorus-containing compounds have very low concentrations of arsenic in their cells. They also have low concentrations of phosphates in their cells. Arsenic and phosphorus are chemically similar.
- Plants that are not tolerant to arsenic grow poorly in soil which has a high concentration of both arsenic and phosphorus-containing compounds.
- Tolerance to arsenic in Yorkshire fog is caused by a single gene with the allele, **a**, for tolerance recessive to the allele, **A**, for non-tolerance.

(i) What caused the allele for tolerance to first arise?

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(1 mark)

(ii) Give **two** functions of phosphates in cells.

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(2 marks)

(iii) Arsenic-tolerant Yorkshire fog plants are very rare in areas with low concentrations of arsenic in the soil even where the soil has a high concentration of phosphate. Explain why they are unable to compete in these conditions with plants that are not tolerant to arsenic.

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(3 marks)

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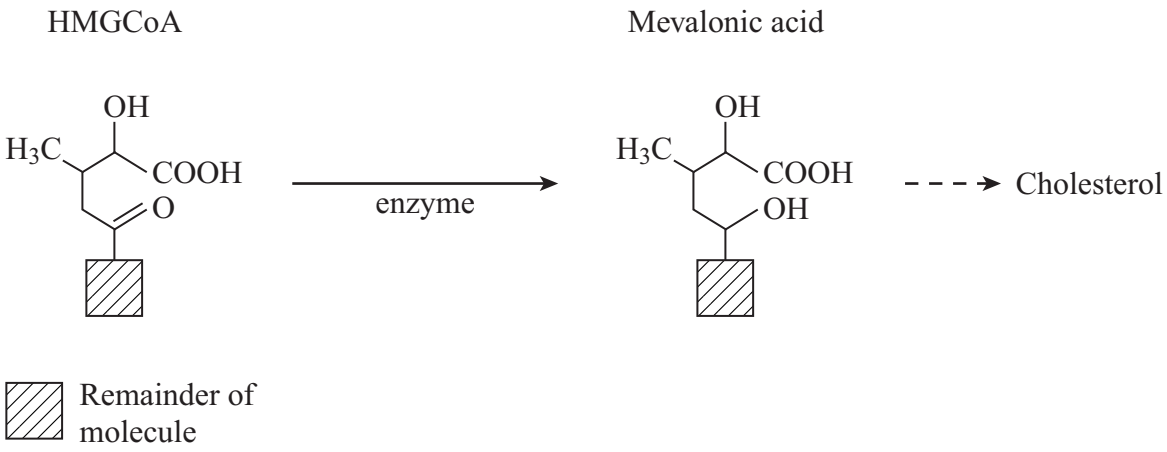
2 Read the following passage.

Cholesterol is a lipid. It is an important component of cell membranes and it is the starting point for the synthesis of a number of sex hormones. About half of our daily cholesterol requirement is absorbed from the gut. The remainder is synthesised in the liver. The pathway by which it is synthesised is shown in **Figure 1**.

Figure 1



5 Because cholesterol is not soluble in water, it cannot be transported in solution in the blood. Instead it is transported combined with other substances such as low-density lipoprotein (LDL).

Cells which take up cholesterol have areas on their plasma membranes called coated pits. Receptor proteins are located round these pits. These receptor proteins bind to
10 LDLs. The membrane then engulfs the LDL particles and forms a vesicle, which is taken into the cytoplasm of the cell. Here the vesicles fuse with lysosomes and the cholesterol is released. Some enters the nucleus of the cell where it shuts down the genes responsible for synthesising LDL receptors.

Unfortunately, high blood cholesterol concentration is linked to an increased risk of
15 heart attacks and strokes. Blood cholesterol concentration may be reduced by a suitable diet but there is also a group of drugs which lower cholesterol concentration. These are the statins and they work by inhibiting the enzyme which catalyses the reaction shown in **Figure 1**.

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

(a) Cholesterol is converted to oestrogen in the ovaries. It reaches the ovaries in the ovarian artery. List the arteries and veins involved in taking cholesterol from the site of its synthesis to the ovarian artery.

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(2 marks)

(b) (i) Name the process by which cholesterol enters a cell.

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(1 mark)

(ii) Describe the role of lysosomes in releasing cholesterol in the cytoplasm of a cell.

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(2 marks)

(c) Familial hypercholesterolaemia (FH) is a genetic disease in which cells do not take up cholesterol from the blood. As a result, people with the disease have a high blood cholesterol concentration and are very likely to have a heart attack. Suggest how possession of the alleles for FH results in a high blood cholesterol concentration.

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(3 marks)

Question 2 continues on the next page

(d) Explain how negative feedback is involved in maintaining the concentration of cholesterol inside a cell below a certain maximum.

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(3 marks)

(e) (i) What is the evidence from **Figure 1** that the enzyme which converts HMGCoA to mevalonic acid is a reductase?

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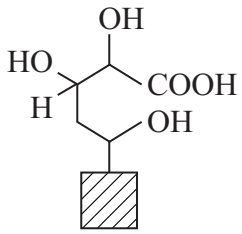
(1 mark)

(ii) Compactin is an example of a statin. Its molecular structure is shown in **Figure 2**.

Figure 2



Explain how compactin lowers blood cholesterol concentration.

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(3 marks)

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Answer **Question 3** in continuous prose.
Quality of Written Communication will be assessed in the answer.

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** Polymers have different structures. They also have different functions. Describe how the structures of different polymers are related to their functions. *(25 marks)*

OR **B** Heat and many different substances are transferred within the body and between the body and the environment. Explain how surface area is linked to this transfer. *(25 marks)*

END OF QUESTIONS

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END OF QUESTIONS

For Examiner's use only

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