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General Certificate of Education
January 2004
Advanced Level Examination



BIOLOGY (SPECIFICATION B)
Unit 6 Section A Applied Ecology

BYB6/A

Tuesday 27 January 2004 9.00 am to 11.15 am

In addition to this paper you will require:

- Section B provided as an insert (enclosed).
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: The total time for Section A and Section B of this paper is 2 hours 15 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 **Section A** in the spaces provided. All working must be shown.
- **Section A** and **Section B** will be marked by different examiners. You must ensure that any supplementary sheets are fastened to the appropriate question paper answer book.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for **Section A** is 50.
- Mark allocations are shown in brackets.
- You are advised to spend 1 hour on **Section A**.
- You are reminded of the need for clear presentation in your answers. All answers should be in good English and should use accurate scientific terminology.
- You are reminded that **Section A** requires you to use your knowledge of Modules 1-5 as well as Module 6 in answering synoptic questions. These questions are indicated by the letter **S**.

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

SECTION A

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

- 1 The vegetation on a large heap of waste from an old mine was investigated. The table shows the results of the measurements of certain factors in 1 m² frame quadrats placed on the south-facing slope.

Quadrat	Angle of slope / °	Vegetation cover / %	Moisture content of soil / %	pH of soil
1	45	60	17.2	5.6
2	30	70	14.6	4.2
3	25	68	20.3	5.2
4	12	100	23.5	7.1
5	7	85	21.0	5.4
6	1	100	21.2	6.8

- (a) Which of the factors measured are abiotic?

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(1 mark)

- (b) Describe how the investigators could obtain the value for vegetation cover in each quadrat.

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(2 marks)

- (c) The correlation between vegetation cover and soil moisture content was tested statistically. These two factors were found to be positively correlated, and $p < 0.05$. Explain what this result means.

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(2 marks)

S (d) At first the waste heap had no plants growing on it. Some of the first plants to colonise it were small herbaceous plants. Explain **one** way in which colonisation by herbaceous plants could change the physical environment.

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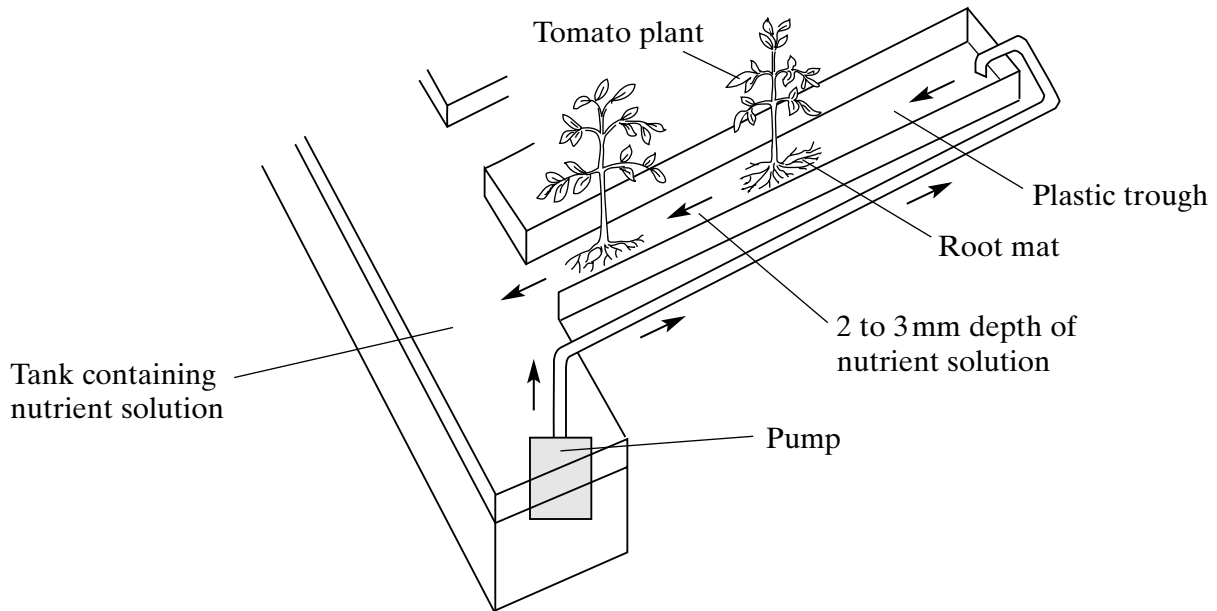
(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

Turn over 

- 2 Tomato growers have increased the yield of fruit from 100 to 400 tonnes per hectare by growing the tomato plants in automatically heated glasshouses and enhancing the carbon dioxide concentration. To control the nutrient supply to the roots, the plants are grown without soil in plastic troughs, as shown in the diagram.



- (a) Explain how enhancing the carbon dioxide concentration helps to increase the yield.

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(2 marks)

- (b) Maintaining a high temperature in a glasshouse in winter, when the light intensity is low, may reduce the yield. Explain how.

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(2 marks)

- S** (c) Tomato fruits have a high percentage of water. When making tomato ketchup, it is more economical to use fruits which have a low percentage of water. Growers can reduce the water content of the fruit by adding sodium chloride to the nutrient solution in the plastic trough.

Explain how adding sodium chloride can reduce the water content of the fruit.

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(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

3 Over a million tonnes of salmon per year are produced in fish farms. The salmon are grown in large cages in sheltered waters, such as off the west coast of Scotland. The cost of these farmed salmon is much lower than that of wild salmon.

(a) Give **two** reasons why farmed salmon are cheaper than wild salmon.

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2

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(2 marks)

S (b) Large amounts of waste food and faeces fall through the bottom of the cages. This results in a much reduced diversity of marine organisms below and around the cages. Explain how the organic matter in the water causes this reduction in diversity.

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(2 marks)

S (c) Farmed salmon are fed on pellets made from small fish. About five tonnes of small fish are required for each tonne of salmon produced. Give **two** reasons why this high ratio is needed.

1

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2

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(2 marks)



4 A popular lake in the United States was affected by large swarms of midges (small biting insects) in the summer. The lake was sprayed with insecticide to kill the midges. The effect of spraying on the following food chain in the lake was investigated.



(a) Shortly after spraying the concentration of insecticide in the water of the lake was $2 \times 10^{-5} \text{ g dm}^{-3}$. After four weeks the concentration in the plant plankton was equivalent to $5 \times 10^{-3} \text{ g dm}^{-3}$.

By how many times was the insecticide concentrated?

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(1 mark)

(b) After a few months the concentration of insecticide in the grebes was more than six times the concentration in the sunfish. Explain why.

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(2 marks)

(c) Another lake, which contained dead trout, was found to be contaminated by waste containing mercury ions.

(i) In an investigation, the lethal concentration of mercury ions for trout was 42 parts per billion over four days. Explain what is meant by *lethal concentration*.

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(1 mark)

S (ii) Explain how heavy metal ions are toxic to animals.

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(3 marks)

Turn over ▶



- 5 (a) How does a systemic herbicide differ from a contact herbicide?

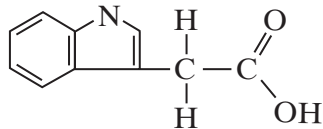
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(1 mark)

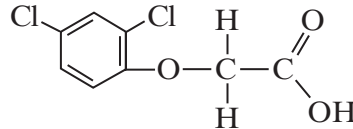
IAA is an auxin which stimulates plant growth. It binds to proteins in cell walls. This changes the arrangement of the cellulose molecules, so the walls are more easily stretched. IAA also lowers the pH around the cells.

2,4-D is a systemic herbicide which has the same effect on cell walls as IAA, but it is less easily broken down in plants.

- S (b) The diagram shows the molecular structures of IAA and 2,4-D.



IAA



2,4-D

Use evidence from the diagram to suggest

- (i) why IAA lowers pH;

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(1 mark)

- (ii) why IAA and 2,4-D have similar effects on cell walls.

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(1 mark)

- (c) When 2,4-D is applied to weeds their growth is very rapid but very distorted. After a short time they die. Suggest **one** explanation for the rapid and distorted growth of weeds when 2,4-D is applied.

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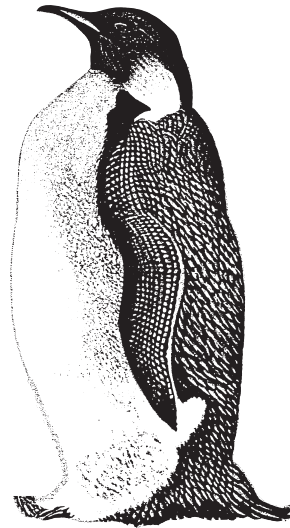
(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

6 Emperor penguins are birds which live in the Antarctic. They cannot fly, but they are very good swimmers and feed on fish from the oceans around the Antarctic continent. To breed they have to leave the sea and move on to the ice. The drawing shows a male emperor penguin.



(a) Like mammals, birds maintain a constant body temperature. The emperor penguin maintains a core body temperature of about 38 °C. On the Antarctic ice the air temperature is often as low as -40 °C.

(i) Use the drawing to suggest how its shape helps the penguin to maintain its core body temperature in such low air temperatures.

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(2 marks)

S (ii) At rest a penguin maintains a constant metabolic rate as the air temperature falls to -10 °C. Below this temperature its metabolic rate increases. Explain why the metabolic rate can stay constant down to -10 °C, but rises when the temperature falls below this.

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(2 marks)

- (b) At the start of winter emperor penguins walk about 100 km from the sea to the permanent ice shelf. Here each female lays a single egg which the male incubates in a pouch above his feet. The females return to the sea, but the males stay at the breeding site and do not feed. Large groups, often more than a thousand birds, huddle close together. They regularly change position within the huddle. When the chicks have developed, after 100 days, their fathers walk the 100km back to the sea so that they can feed again.

When they leave the sea at the start of winter, the males weigh 35 kg and may have up to 20kg of stored fat. Walking uses 7.5 g of fat per km. Research has shown that at the average temperatures on the ice a penguin standing on its own loses 200 g of its stored fat per day. However, when in a huddle only 100 g per day is lost.

- (i) Explain how huddling close together helps to reduce the loss in mass from 200 g to 100 g per day.

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(2 marks)

- (ii) Use the information above to explain why the huddling behaviour is essential to the survival of the male penguins. You should include relevant calculations in your answer.

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(3 marks)



Turn over 

7 The Solomon Islands are situated in the Pacific Ocean. The nearest large land mass is Australia, which is about 1500km away. The biggest islands are mountainous, with large areas of tropical forest and a wide range of habitats. Some islands have a very high species diversity, and many species are endemic, that is they occur only in the Solomon Islands.

The table shows the total number of species on the islands in four vertebrate classes and the percentage which are endemic.

Vertebrate class	Total number of species	Endemic species /%
Mammals	53	36
Birds	223	20
Reptiles	61	16
Amphibians	17	53

(a) How many reptile species are endemic?

..... (1 mark)

S (b) Suggest an explanation for the high proportion of endemic species on the Solomon Islands.

.....

 (3 marks)

