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General Certificate of Education  
June 2003  
Advanced Level Examination



**ENVIRONMENTAL SCIENCE**  
**Unit 4 Biotic Resource Management**

**ESC4**

Monday 23 June 2003 Morning Session

**No additional materials are required.**  
You may use a calculator.

Time allowed: 1 hour 30 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.
- Do all rough work in this book. Cross through any work you do not want marked.

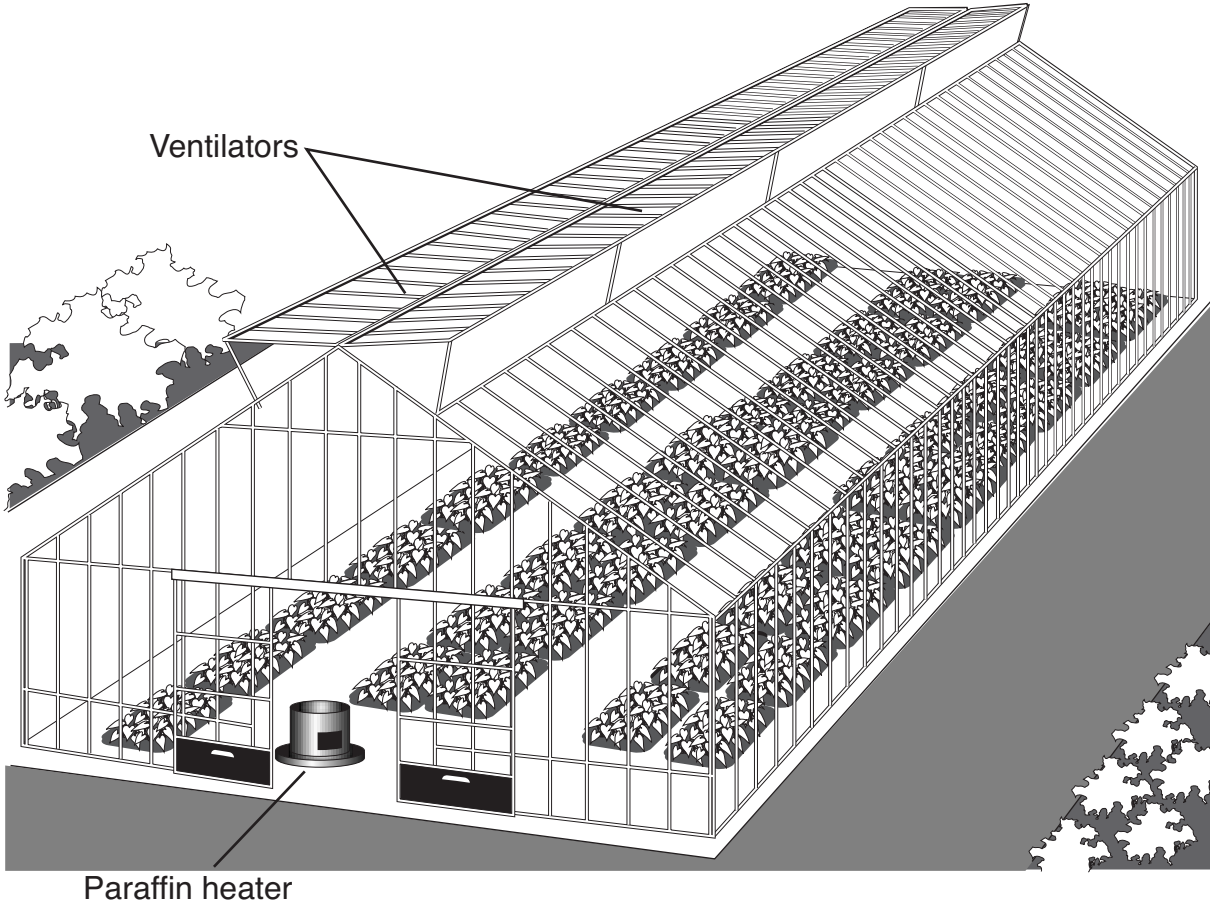
**Information**

- The maximum mark for this paper is 70.
- Mark allocations are shown in brackets.
- You are expected to use a calculator where appropriate.
- 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.
- This unit assesses your understanding of the relationship between the different aspects of Environmental Science.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
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7			
8			
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			

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

1 The diagram shows the production of tomatoes in a glasshouse.



Outline **three** ways in which glasshouse production attempts to control limiting factors.

- 1. ....  
.....
- 2. ....  
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- 3. ....  
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(3 marks)

2 (a) Explain why marine productivity is usually higher on continental shelves than in the deep ocean.

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.....  
(2 marks)

(b) (i) What is El Niño?

.....

.....  
(1 mark)

(ii) What effect does El Niño have on ocean productivity?

.....

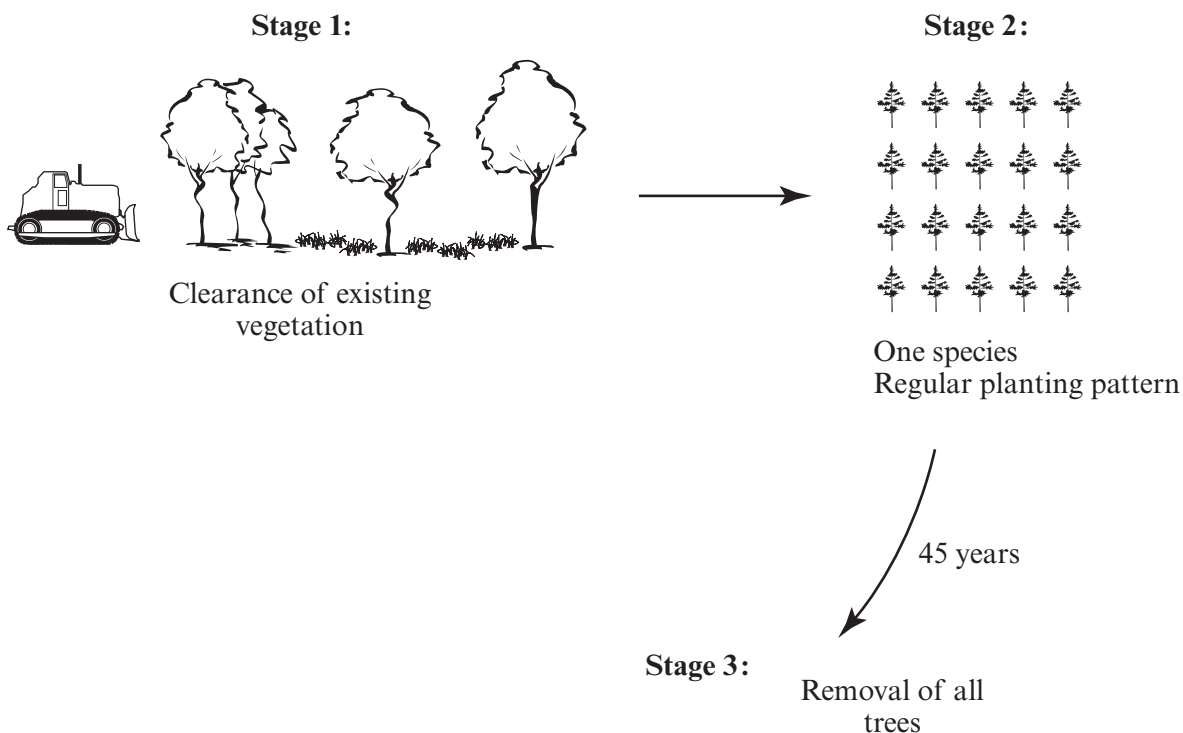
.....  
(2 marks)

5

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

3 The diagram shows stages in the development of a pine tree plantation in Australia.



(a) Outline the advantages of growing trees in plantations.

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.....

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(2 marks)

(b) Explain the impact of **Stage 3** on:

(i) forest hydrology;

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(2 marks)

(ii) soil stability.

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(2 marks)

4 Economists conducted a cost–benefit analysis to evaluate the desirability of a proposed shrimp farm development in mangrove forests in the coastal wetlands of Cambodia. The tables show the expected costs and benefits of the development up to the end of year 1 and up to the end of year 5.

Costs and benefits (000Aus \$) from start of project to the end of year 1					
	Shrimp production	Loss of fuelwood and construction timber	Loss of coastline protection	Habitat loss	Total
Costs	–	321	195	123	639
Benefits	1370	–	–	–	1370

Costs and benefits (000Aus \$) from start of project to the end of year 5					
	Shrimp production	Loss of fuelwood and construction timber	Loss of coastline protection	Habitat loss	Total
Costs	–	2110	4900	5015	12025
Benefits	4190	–	–	–	4190

(a) Suggest **one** factor that determines the monetary value of a habitat such as the mangroves.

.....  
 .....  
 (1 mark)

(b) With reference to the data, state and explain what the cost-benefit analysis suggests about the economic viability of the shrimp farm proposal.

.....  
 .....  
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 .....

(3 marks)

Turn over ►



5 Biotechnology companies are attempting to produce transgenic crops capable of producing vaccines. This may allow children to gain disease protection by, for example, eating a banana.

(a) What is a transgenic crop?

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.....

(2 marks)

(b) Suggest **one** argument:

(i) in favour of this development;

.....  
.....

(1 mark)

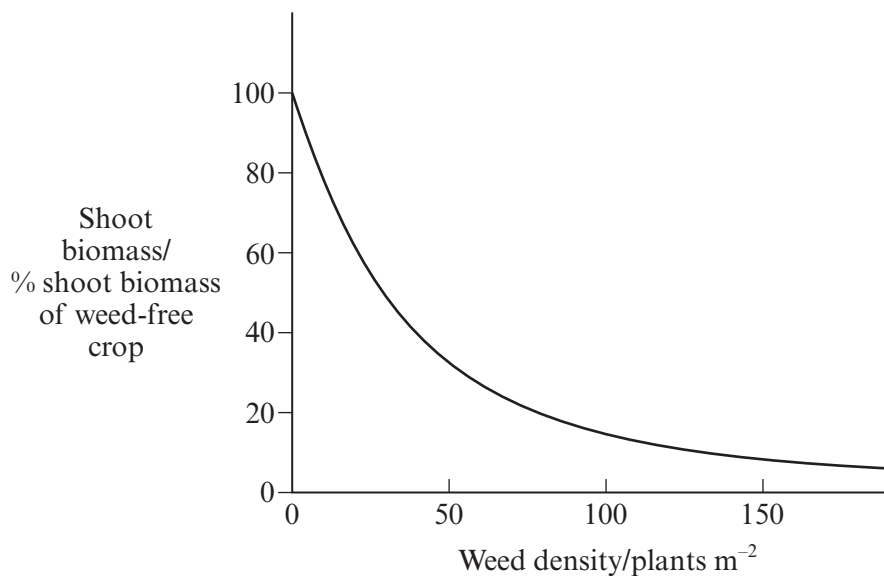
(ii) against this development.

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(1 mark)

$\frac{\quad}{4}$

6 The graph shows the effect of weed density on the shoot biomass of maize.



(a) Describe the relationship shown.

.....  
(1 mark)

(b) Explain the relationship shown.

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.....  
(1 mark)

(c) Suggest **three** useful properties of an efficient pesticide.

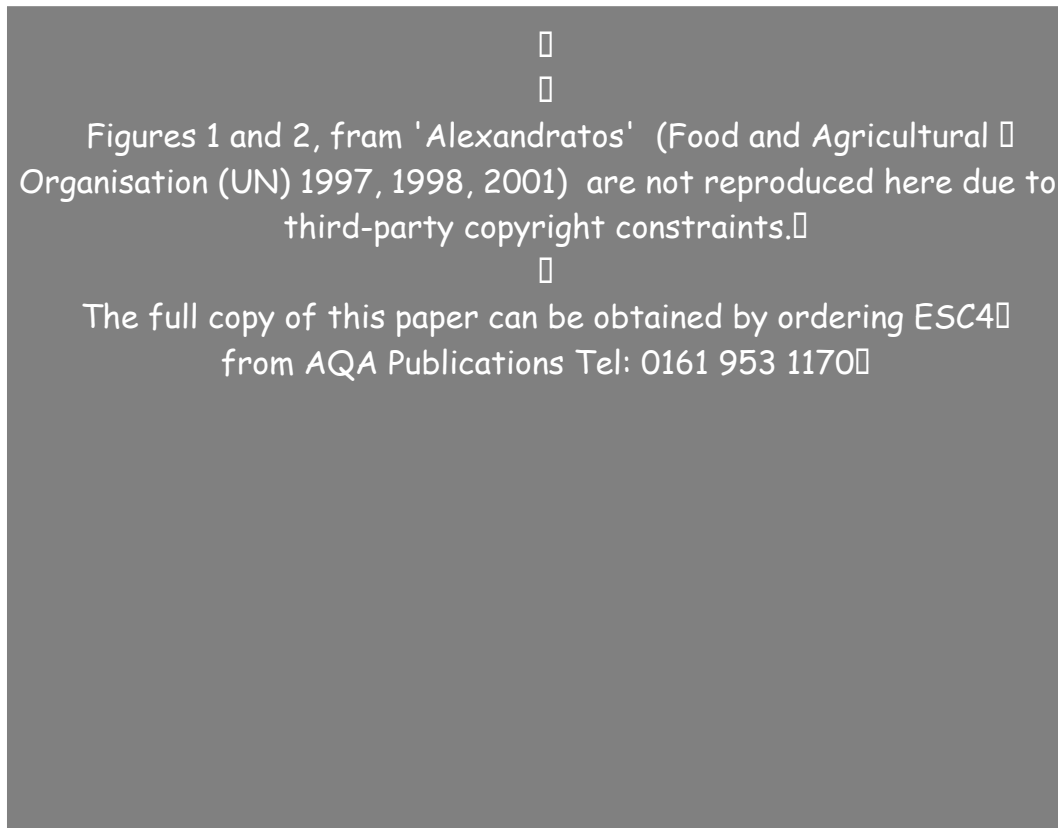
1. ....
  2. ....
  3. ....
- (3 marks)

(d) Suggest **three** advantages of using organic fertilisers instead of artificial fertilisers.

1. ....
  2. ....
  3. ....
- (3 marks)

7 From the beginning of agriculture, the rapid growth in human population has been accompanied by increasing food production. Presently the arable land under cultivation is 1.5 billion hectares and this has to feed the world population of 6 billion. The Food and Agriculture Organisation (FAO) of the United Nations estimates that the maximum total land area that could be cultivated by 2100 is 2 billion hectares when the population is expected to reach 12 billion. The predicted change in per capita arable area may have important implications for air and water quality, soil fertility and biodiversity because the present levels of productivity have been achieved with an enormous energy subsidy.

5



However, the FAO remains optimistic. It points to the huge increases in world grain production over the last 40 years (**Figure 1**) and believes that the recent decline in world production is due to problems in Transition countries that have suffered from serious political upheaval. Sceptics point to the per capita figures (**Figure 2**) suggesting that they are the first global economic indicator that the world is on a demographic path that is environmentally unsustainable. Others blame threats to ecosystem stability and suggest that globally we have reached Maximum Sustainable Yield. Still others point to worldwide recession, emphasising that most developed countries and some developing ones are net food exporters and that many of the latter also devote large areas of land to cash crops. They point to the evidence of grain gluts and the fact that government subsidies are often needed to help sell farm surpluses abroad.

10

15

The fact is that hunger has increased even as food production has increased. In India, for example, over 200 million people are malnourished but India is a net food exporter. So hunger persists in an age of plenty and malnutrition affects both rich and poor countries.

20



- (a) (i) Calculate the expected change in the area of arable land per person between now and 2100 (lines 2–6). Show your working.

Answer .....  
(2 marks)

- (ii) Explain why this change may have important implications (lines 6–8) for:

1. air quality;

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(3 marks)

2. water quality;

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(3 marks)

3. soil quality.

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(3 marks)

**QUESTION 7 CONTINUES ON THE NEXT PAGE**

**Turn over ►**

(b) Explain what is meant by “a demographic path that is environmentally unsustainable . . .”. (lines 13–14).

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(2 marks)

(c) Describe the trends shown in **Figure 2**.

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(3 marks)

(d) What is meant by the term *Maximum Sustainable Yield*? (line 15).

.....  
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(1 mark)

(e) What evidence is there that hunger may be a consequence of political and economic decisions? (lines 9–23).

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(3 marks)

**8** Write an essay on **one** of the following topics. Credit will be given for your understanding of the relationship between different areas of the subject and also for the organisation and presentation of the essay and use of grammar, punctuation and spelling.

**EITHER** (a) Discuss the importance of selective breeding and genetic manipulation of crops and animals. (20 marks)

**OR** (b) Discuss the management of fishing and fish farming. (20 marks)

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**Turn over ▶**