

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

For Examiner's Use

General Certificate of Education
 June 2007
 Advanced Level Examination



ENVIRONMENTAL SCIENCE
Unit 4 Biotic Resource Management

ESC4

Tuesday 26 June 2007 1.30 pm to 3.00 pm

You will need no other materials.
 You may use a calculator.

For Examiner's Use			
Question	Mark	Question	Mark
1		5	
2		6	
3			
4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English, clear presentation and appropriate use of specialist vocabulary. Question 6 should be answered in continuous prose. Quality of Written Communication will be assessed in this answer.
- This unit assesses your understanding of the relationship between the different aspects of Environmental Science.

There are no questions printed on this page

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

- 1 Complete the table by putting ticks to indicate whether the statements are true or false.

Statement	True	False
Sensible management of a fishery would involve harvesting at just below the maximum sustainable yield		
Farmers using biological control may try to maintain a small but permanent population of the pest		
Vegetative propagation of potatoes produces potatoes which are physically identical to each other and to the parent		
Commercial conifer plantations have a more complex structure than ancient woodlands		
Energy ratio = $\frac{\text{output or yield}}{\text{input}}$ If farming system A has an energy ratio of 0.91 and system B has an energy ratio of 0.89, system A is more efficient		

(5 marks)

5

Turn over for the next question

- 2 (a) Organic farmers often plant chicory as a soil improver. It has very deep roots and its root mass is two to three times greater than the mass of stems and leaves.

Outline the process by which the use of chicory can increase the nutrient content of the surface layer of soils.

.....

.....

.....

.....

.....

.....

(3 marks)

- (b) Farmyard manure is also used to improve soils. Suggest **two** ways, other than by increasing the nutrient content, in which manure may improve soils.

1

.....

2

.....

(2 marks)

- (c) The table shows typical losses of nitrogen and phosphorus from manure heaps stacked in a farmyard.

Loss as a percentage of original nutrient content				
Summer			Winter	
Nutrient	In solution	As gas	In solution	As gas
Nitrogen	<1	10–50	1–3	1–5
Phosphorus	<1	–	2–10	–

Suggest **one** way in which these losses could be reduced.

.....

.....

(1 mark)

(d) Explain how stacking manure outdoors may:

(i) lead to acid rain

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

(2 marks)

(ii) reduce aquatic biodiversity.

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

(2 marks)

10

Turn over for the next question

- 3 Scientists investigated the profitability and sustainability of different weed control techniques in papaya orchards. Papaya is an important tropical fruit.

Papaya



Source: *Olivier Asselin*

Intercropping with papaya



Source: Dr R. S. Misra, Principal Investigator, Seed Production Programme, RC of CTCRI, Bhubaneswar is thankfully acknowledged.
www.geocities.com/rsmisra2000/images

Four plots were set up. The weed control techniques were as follows:

- Plot 1: Hand weeding
- Plot 2: Spraying with herbicide
- Plot 3: Intercropping with pumpkin
- Plot 4: Intercropping with groundnut

The results are shown in the table.

Technique	Days to achieve 50 % flowering	Weed dry mass / g m ⁻¹	Fruit yield / t ha ⁻¹	Costs / \$ ha ⁻¹	Income / \$ ha ⁻¹
Hand weeding	176	419	66.60	30	350
Spraying with herbicide	141	125	94.50	85	556
Intercropping with pumpkin	155	223	80.40	47	440
Intercropping with groundnut	156	365	83.10	45	419

- (a) (i) Which technique was the most profitable?

.....
(1 mark)

- (ii) Suggest how intercropping helps to control weeds.

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

(3 marks)

- (b) The scientists then considered the energy subsidies of each weed control technique and gave each technique a sustainability rating.

Technique	Sustainability rating 0 = totally unsustainable 1 = totally sustainable
Hand weeding	0.8
Spraying with herbicide	0.2
Intercropping with pumpkin	0.4
Intercropping with groundnut	0.4

- (i) What is meant by the term *energy subsidy*?

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

(2 marks)

(ii) Suggest why the use of herbicide was rated at 0.2.

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

(2 marks)

(c) The scientists concluded that integrated control was best.

What is meant by *integrated control*?

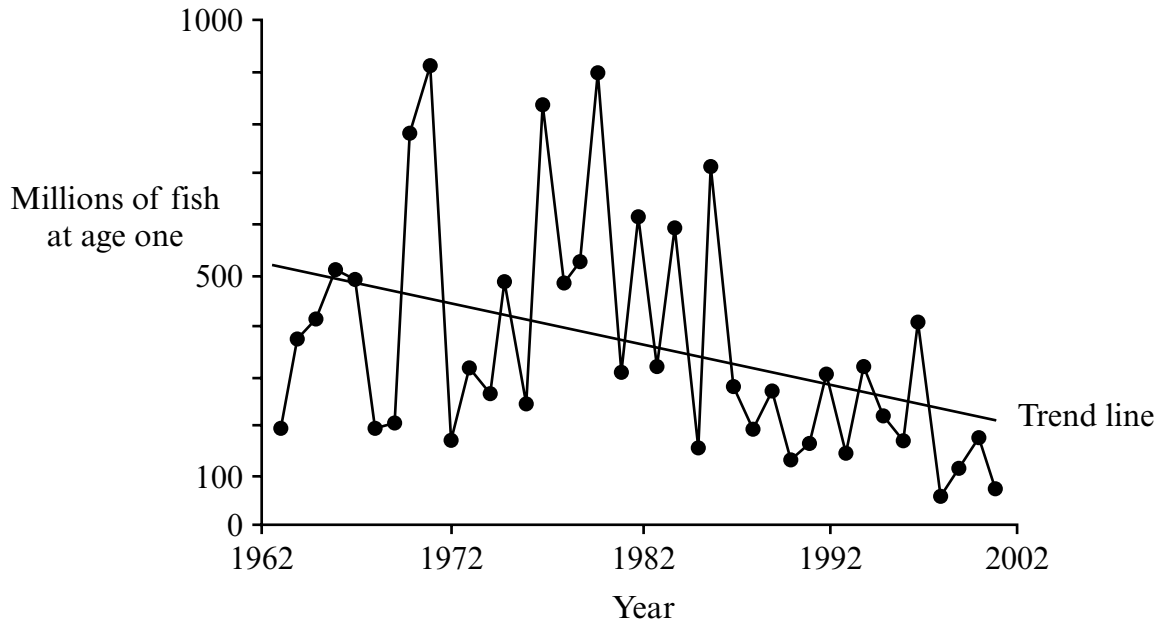
.....
.....
.....
.....

(2 marks)

10

Turn over for the next question

- 4 (a) The graph shows estimates of the population of one-year-old cod in the North Sea. Cod reach sexual maturity at four years.



What is the significance of this trend in terms of fisheries management?

.....

(1 mark)

- (b) Between 2000 and 2003, cod quotas were reduced annually, mesh sizes were increased and closed areas were introduced.

Outline the principle behind:

- (i) the reduced quotas

.....

(1 mark)

- (ii) an increase in mesh size

.....

(1 mark)

- (iii) the introduction of closed areas.

.....

(1 mark)

- (c) Scientists estimate that the minimum sustainable biomass for cod in the North Sea is 150 000 tonnes. Quotas were set that would result in the stock of mature cod increasing by 30 % per year towards this target biomass.

State **two** pieces of population data that the scientists would need to know to set such quotas.

1

.....

2

.....

(2 marks)

- (d) Fish farms may help to reduce pressure on wild fish stocks.

Outline **four** ways by which fish farms provide a controlled environment in order to maximise productivity.

1

.....

2

.....

3

.....

4

.....

(4 marks)

10

Turn over for the next question

- 5 There is increasing pressure on Brazil to stop all unsustainable development in the Amazon forests. Brazil argues that it is economically essential that development continues.

The table shows one estimate of the average value of one hectare of forest.

Function / component	Monetary value / \$ ha ⁻¹
Timber extraction	175
Food production	920
Ecotourism	200
Carbon storage	10 000
Genetic resource	21
Hydrological protection	3 000
Soil protection	8 000

- (a) Explain fully the reasons for the high values of:

(i) *carbon storage*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

(ii) *soil protection.*

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

(5 marks)

(b) Critics suggest that the figure for food production is too high because it does not take account of the rapidly declining yields when crops are grown in cleared areas.

Suggest why yields might decline rapidly.

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

(3 marks)

(c) Outline why forestry is often a very important industry in the early development of tropical countries.

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

(2 marks)

Dotted lines for writing.

