Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2008
Advanced Subsidiary Examination

ENVIRONMENTAL SCIENCE **ESC3**
Unit 3 The Biosphere

Wednesday 16 January 2008 9.00 am to 10.00 am

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

Time allowed: 1 hour

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 60.
- 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.

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

There are no questions printed on this page

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

1 The following is a list of ecological terms.

A Food chain
B Community
C Abiotic
D Quadrat
E Niche
F Population
G Biome
H Ecosystem
I Transect
J Trophic level
K Biomass
L Habitat
M Biotic

Complete the table to give the letter to match the term to the appropriate definition. The first one has been done as an example.

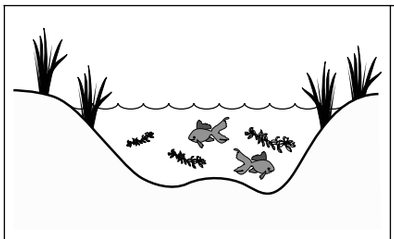
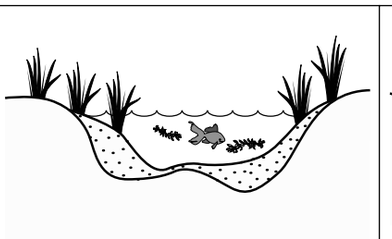
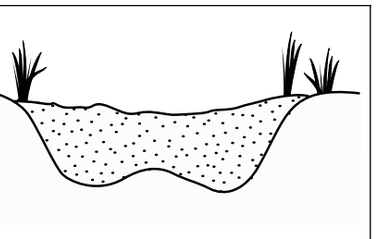
Definition	Letter
The role of an organism in the community	**E**
Non-living factors, such as temperature, that affect the distribution of living organisms	
All the living organisms in a defined area	
The total number of a species living in a defined area	
The place where an organism lives	
A technique for measuring the influence of an environmental gradient on organisms	

(5 marks)

5

Turn over ➤

2 The diagram shows stages in the development of a small garden pond over a 10-year period.

		
1995	**2000**	**2005**
A hole is dug and lined with a waterproof liner. New plants are placed in the pond, including oxygenating pondweed and marginal plants such as irises.	Marginal plants grow and die back in winter. As they rot, the sediment falls to the bottom of the pond.	The pond has filled with sediment and dried up.

(a) Soon after the establishment of the pond, algae (microscopic plants), which were not planted, arrived in the pond.

(i) What term describes an organism that becomes established in a new habitat that did not support life previously?

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(1 mark)

(ii) Suggest a method by which the algae arrived in the pond.

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(1 mark)

(iii) After a time, the algae grew into a thick layer on the surface of the pond. Explain how this might affect the plants growing in the water under the layer of algae.

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(2 marks)

(b) Describe the seral stages that might take place after 2005.

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(4 marks)

(c) Explain why the conservation of ponds is important for species diversity.

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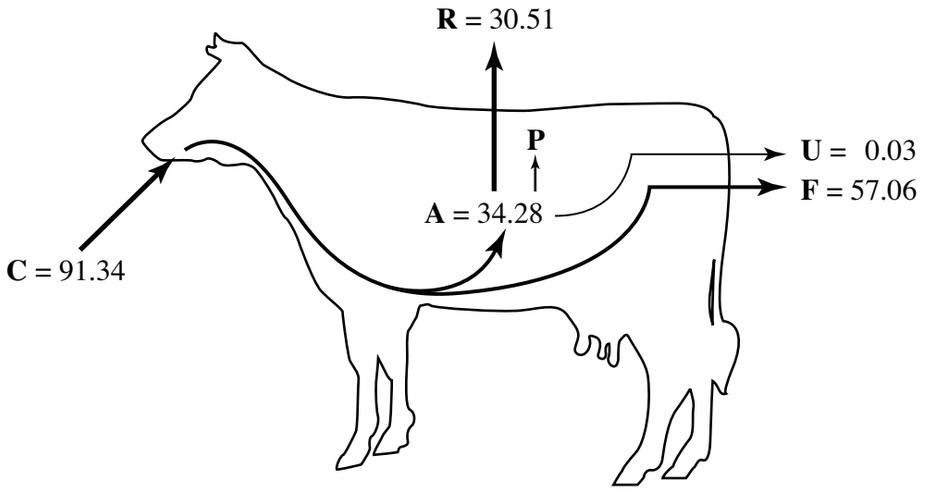
(2 marks)

10

Turn over for the next question

3 The diagram shows the transfer of energy through a cow. The figures are in kJ $\times 10^6$ year^{-1}.



Key: **A** = energy absorbed from the gut
C = energy consumed in food
F = energy lost in faeces
P = energy used in the production of new tissue
R = energy lost by respiration
U = energy lost in urine

(a) (i) Complete the equation for the energy used in the production of new tissue. Use only the letters **C**, **F**, **R** and **U**.

P = ...

(1 mark)

(ii) Calculate the value of **P**.
Show your working.

P = ... kJ $\times 10^6$ year^{-1}

(1 mark)

(b) Explain why keeping cows indoors leads to more efficient growth.

.....

.....

(1 mark)

(c) Cows feed on grass. Give the name of the trophic level of the cow.

.....

(1 mark)

(d) Using random quadrat sampling, a student decided to investigate the effect of trampling and grazing by cows on plant diversity in grassland.

(i) Describe how you would place the quadrats in order to achieve a random distribution.

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(2 marks)

(ii) The table shows data gathered on plant species, excluding grasses, in the grazed area.

Species	Number of plants in sample
Common ragwort *(Senecio jacobaea)*	6
Great plantain *(Plantago major)*	3
Dandelion *(Taraxacum officinale)*	1
Hawkbit *(Leontodon taraxacoides)*	5
Dock *(Rumex obtusifolius)*	8
White clover *(Trifolium repens)*	2

Use the data in the table and the equation below to calculate the index of diversity **(D)** for the site. Show your working.

$$\mathbf{D = \frac{N(N-1)}{\Sigma n(n-1)}}$$

Where
N = total number of organisms of all species
n = total number of organisms of a particular species
Σ = the sum of

Answer .....

(2 marks)

(iii) Explain the advantage of calculating an index of diversity rather than just recording the number of different species present.

.....

.....

(1 mark)

Question 3 continues on the next page

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(iv) Suggest **one** reason why grasses were excluded from the survey.

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(1 mark)

10

4 Water is essential for the existence of life on Earth.

(a) Explain why each of the following properties of water aids the survival of living organisms.

(i) High specific heat capacity

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(1 mark)

(ii) Expansion on freezing

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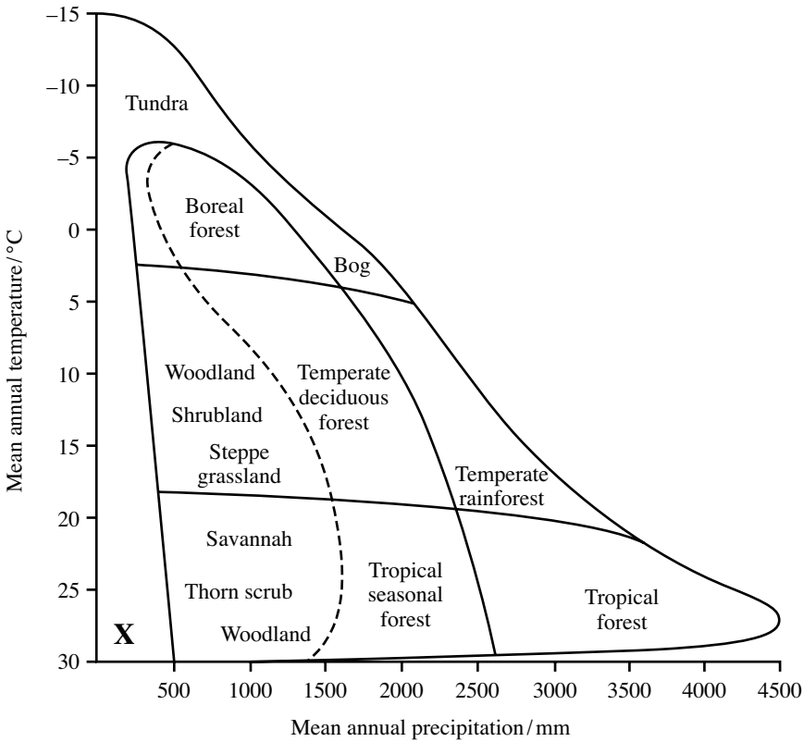
(2 marks)

(b) The diagram shows the distribution of major biomes in relation to the mean annual precipitation and the mean annual temperature.



Source A

Use the diagram to:

(i) state the maximum mean annual precipitation for the temperate deciduous forest biome

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(1 mark)

(ii) state the range of mean annual temperature for the boreal forest biome

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(1 mark)

(iii) suggest the name of the biome found at **X**.

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(1 mark)

(c) Explain why the conservation of tropical forests is of global importance.

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(4 marks)

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Turn over for the next question

5 The Common dormouse *(Muscardinus avellanarius)* is a small animal found in deciduous woodlands and hedgerows. It is a nocturnal species that feeds on flowers, pollen, fruits, insects and nuts. Its numbers are in decline and it has become extinct in several English counties in the past 100 years.

Photograph: Richard Genn

(a) Suggest **three** possible reasons why dormouse numbers are declining.

1 .....

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2 .....

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3 .....

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(3 marks)

(b) Dormice are being bred in captivity and released to increase wild populations.

(i) Describe **two** problems that may prevent successful captive breeding of some species.

1 .....

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2 .....

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(2 marks)

(ii) Give **three** reasons why captive bred animals often fail to survive when they are released into the wild.

1 .....

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2 .....

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3 .....

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(3 marks)

(c) Outline **one** example of how British or European legislation is used to conserve the habitat of threatened species such as the dormouse.

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(2 marks)

10

Turn over for the next question

6 (a) The Banded snail *(Cepaea nemoralis)* is found in areas of grassland.

Describe how the population size of these snails could be estimated, using the mark-release-recapture method.

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(5 marks)

(b) Discuss how abiotic and biotic factors regulate the population size of small herbivorous mammals, such as rabbits, living in grassland.

Quality of Written Communication will be assessed in this answer.

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(10 marks)

15

END OF QUESTIONS

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Question 4 (b) Source A: A KIDD, *Managing Ecosystems*, Hodder Arnold, 1999