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ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 3

Thursday 7 May 2009 (morning)

1 hour

Candidate session number

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all the questions from Option A and all the questions from either Option B, Option C or Option D in the spaces provided.
- You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letter of the Option answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

0116

Option A — Analysing Ecosystems

The compulsory question below relates to the detailed study of ecosystems.

A1. A population of meadow voles in an area of woodland was sampled using small mammal traps over a period of four days. On each occasion any unmarked individuals were marked and all the voles from the capture were then released. The following table represents the data obtained on each of the four days.

Meadow vole

[Scale: approximately one-third actual size. Linda Gray, © ASAB, reprinted with permission]

[Source: Association for the Study of Animal Behaviour (1998) *Scent Marking by Male Meadow Voles*. www.asab.icapb.ed.ac.uk]

	Total catch	**Number in catch already marked**
Day 1	8	0
Day 2	19	0
Day 3	10	2
Day 4	23	8

[Source: Data 2.3, p. 67 from ECOLOGICAL METHODOLOGY, 2/e by Charles J Krebs. Copyright © 1999 by Addison-Wesley Educational Publishers, Inc. Reprinted by permission of Pearson Education, Inc.]

(a) Using these data, estimate the population size of the voles on day four. Show your working. *[3]*

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(This question continues on the following page)

(Question A1 continued)

(b) State **two** factors that should be considered in designing a method for marking the voles. *[2]*

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A2. The following table describes some characteristics of four animal species.

	Three pairs of legs?	**Life cycle includes a larval stage?**	**Size?**	**Head?**	**Compound eyes?**
Species A	No	Yes	Large	Not distinct	Yes
Species B	No	No	Small	Distinct	Yes
Species C	No	Yes	Small	Not distinct	No
Species D	Yes	No	Large	Distinct	Yes

(a) Using **three** characteristics described in the table that are appropriate, construct a key that could be used **in the field** to reliably distinguish the four species. *[4]*

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(This question continues on the following page)

(Question A2 continued)

(b) For **one** of the characteristics you did **not** use in your key, explain why it would **not** have been appropriate in the key you designed. *[1]*

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A3. The diagram below shows the zones of vegetation occurring at different altitudes on San Francisco Peaks, Arizona, USA.

DIAGRAM REMOVED FOR COPYRIGHT REASONS

(a) Identify **one** abiotic factor stating how it may vary between two locations in this region, and describe a method by which you could test your suggestion. *[3]*

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(Question A3 continued)

(b) Describe a method by which you could compare the net primary productivity of a species of small ground plant found in the two locations that you identified in part (a). *[5]*

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(c) Explain **two** assumptions that must be made in order to use the data gained from this method to compare the productivity of the plant in the two locations. *[2]*

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Option B — Impacts of Resource Exploitation

B1. The following table provides data from rice-farming systems in the USA and the Philippines in South East Asia for a period of one year.

	USA		Philippines	
	Quantity / ha^{-1}	**Energy / MJ ha^{-1}**	**Quantity / ha^{-1}**	**Energy / MJ ha^{-1}**
Inputs:				
Human labour	17 hrs	33	576 hrs	1276
Animal labour			272 hrs	3998
Use of machinery		32 145		174
Fertilizer	382.0 kg	18 178	5.6 kg	357
Seed	157.0 kg	4787	108.0 kg	1678
Pesticides	13.4 kg	5503	0.6 kg	183
TOTAL		60 646		7667
Output:				
Grain per unit area	6160.0 kg	93 915	1654.0 kg	25 217

[Source: compiled from data in *Food, Energy & Society*, Pimentel, D. & Pimentel, M. (1979) Edward Arnold, London]

(a) State **two** uses of machinery in the USA that may account for the difference in energy input compared with the Philippines. *[2]*

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(b) Suggest **two** reasons for the difference in energy inputs for "seed" in the two countries. *[2]*

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(c) Identify **two** farming strategies that may have contributed to the higher productivity of rice in the USA. *[2]*

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(This question continues on the following page)

(Question B1 continued)

(d) Describe how **one** of the strategies identified in part (c) may lead to significant environmental impact. *[2]*

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(e) Calculate the efficiency of each farming system in terms of energy stored in grain, per unit of input energy. *[2]*

USA: . . . . . .

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Philippines: . . . . . .

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(f) Explain how this difference in efficiency will affect the ecological footprint of a country. *[2]*

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(g) Other than food production, identify **two** factors that may affect the size of a country's ecological footprint and state the influence each has. *[2]*

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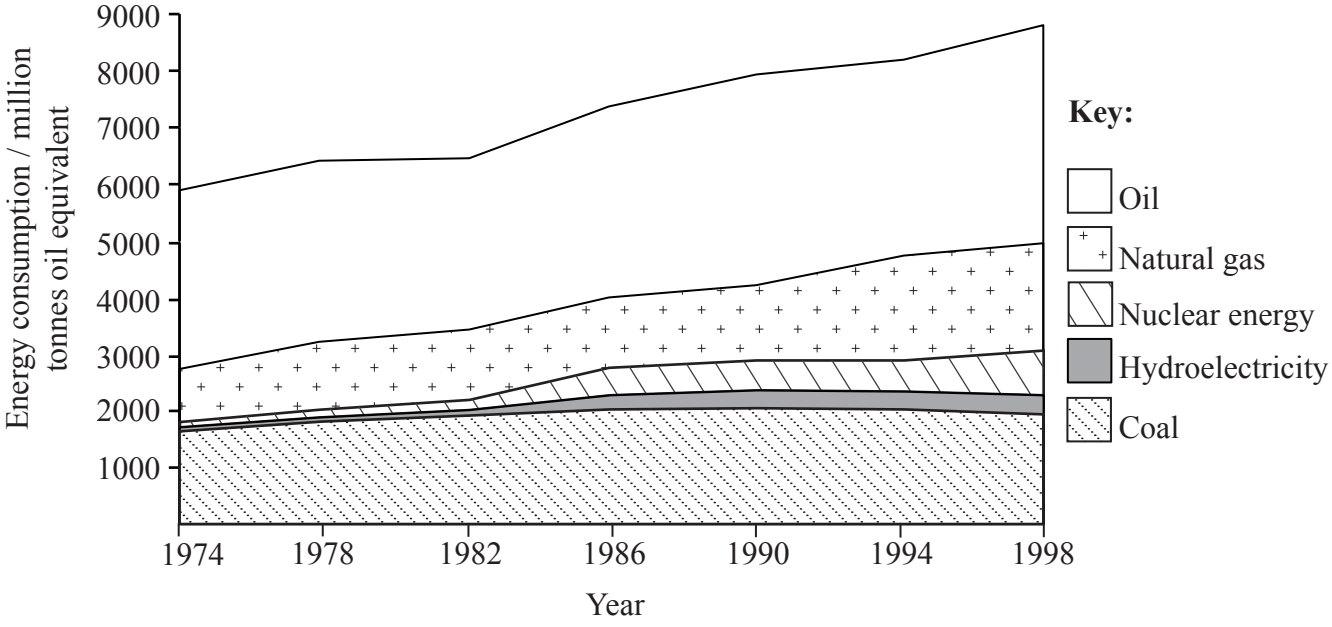
B2. The following diagram represents global energy consumption from various sources over the period 1974–1998.



[Source: adapted from *BP Amoco Statistical Review of World Energy*, 1999]

(a) Identify the general trends in the consumption of fossil fuels shown in these data, and discuss their significance in the overall environmental impact of global energy consumption. *[3]*

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(b) Describe factors that may be limiting the growth of nuclear and hydroelectric power in supplying global consumption. *[3]*

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Option C — Conservation and Biodiversity

C1. The following table gives the number of recorded animal extinctions in different taxonomic groups occurring on islands and continents from 1600–1989.

TABLE REMOVED FOR COPYRIGHT REASONS

(a) Suggest **two** reasons for the difference between the total number of extinctions for molluscs (mostly snails) and the total for mammals over this period. *[2]*

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(b) Calculate the proportion of extinctions on islands as a percentage of all recorded extinctions, and give **two** possible reasons for the difference in this percentage compared with the percentage recorded on continents. *[3]*

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(Question C1 continued)

The pie chart below is an analysis of all the known causes of these extinctions.

IMAGE REMOVED FOR COPYRIGHT REASONS

(c) (i) Explain how introduced species may have contributed to the recorded extinctions. *[2]*

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(ii) State **one** cause of extinction that may have come into the "other" category in these data. *[1]*

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(d) Explain the evolutionary mechanisms that give rise to new species, and how these frequently lead to the appearance of island species that are found nowhere else. *[4]*

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(Question C1 continued)

(e) Protected areas have frequently been compared to "islands" in terms of the threats and limitations that contribute to their vulnerability and significance. With reference to this statement, discuss the challenges and successes involved in the conservation of a **named** protected area you have studied. *[5]*

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(f) Compare the role that governmental and non-governmental organizations can play to support the kind of conservation project that you have described above. *[3]*

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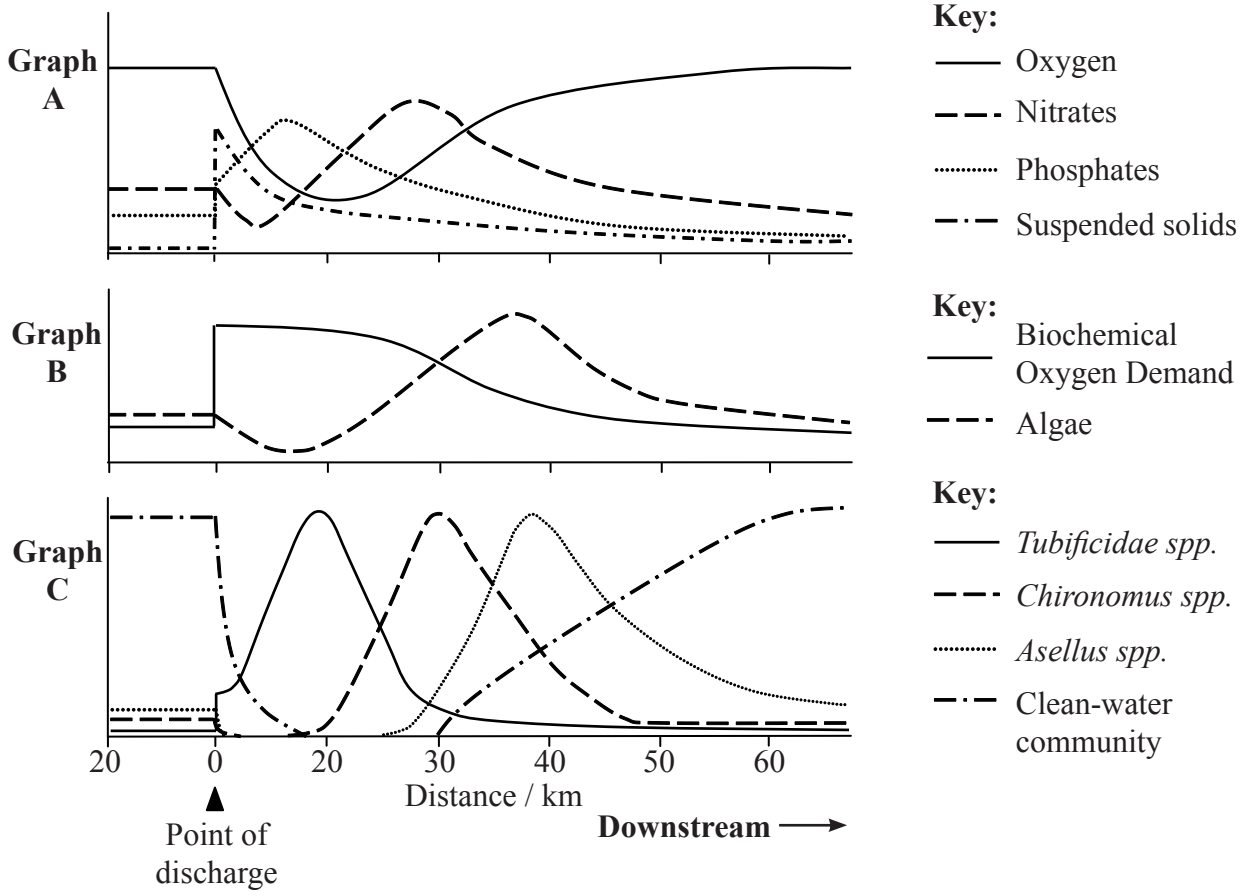
Option D — Pollution Management

D1. The following graphs show variations in the abiotic and biotic components of a river, upstream and downstream from a point of sewage discharge.



[Source: adapted from various sources]

(a) Distinguish *point source pollution* from *non-point source pollution*. *[2]*

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(b) Define *Biochemical Oxygen Demand (BOD)* and describe how it is measured. *[3]*

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(Question D1 continued)

(c) Describe a method by which the data for **one** of the factors in Graph A might have been obtained. *[3]*

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(d) Identify where in the river the system is likely to be eutrophic. Justify your answer from the data. *[2]*

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The effect of sewage pollution in a river can be measured by sampling its animal community. The samples can then be evaluated using a biotic index in which a high score represents relatively unpolluted water.

(e) Identify which of the groups of organisms represented in Graph C would contribute the **lowest** score to such a biotic index if they were found in a sample. Justify your answer. *[3]*

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(This question continues on the following page)

(Question D1 continued)

(f) Apart from the presence of specific groups of organisms, identify **one** other feature of the sample that may influence the biotic index score and explain how it is affected by the presence of pollution. *[2]*

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D2. The following table gives the potential savings in recycling certain resources. The potential saving for a resource represents the reduction in the environmental cost of their disposal and replacement achieved by recycling them instead.

Environmental cost	**Potential saving / %**		
	Aluminium	**Glass**	**Paper**
Energy used	93	18	48
Atmospheric pollution	95	20	74
Aquatic pollution	97	0	35

[Source: adapted from UNEP (1991) *Environmental Data Report* Third edition, Blackwell, Oxford]

With reference to these data, and from what you have studied, evaluate the effectiveness of recycling as a strategy of pollution management. *[5]*

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