IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N07/4/ENVSY/SP3/ENG/TZ0/XX

88076412

ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 3

Monday 5 November 2007 (morning)

1 hour

Candidate session number

0	0							

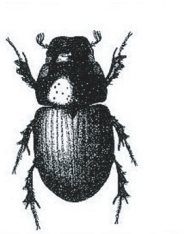
INSTRUCTIONS TO CANDIDATES

- 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.

Option A — Analysing Ecosystems

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

A1. Groups of students studied the species diversity of the beetle fauna found on two upland sites in Europe. The same number of students searched for a similar length of time in each of the two sites. The two sites were of equal area.



Aphodius beetle (enlarged)

[Source: J Bechyně (1956) *Guide to Beetles*, Thames and Hudson, page 111]

The number of individuals of the four species found at each site is given in the table below.

Species	Site A	Site B
Trichius fasciatus	10	20
Aphodius lapponum	5	10
Cincidela campestris	15	8
Stenus geniculatus	10	2

(a) Define the term *biodiversity*. *[1]*

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(This question continues on the following page)

(Question A1 continued)

(b) Calculate the Simpson diversity index (D) for the beetle fauna of the two sites using the formula:

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

where N = total number of individuals
and n = the number of individuals of each species.

Show your working.

(i) Site A: *[2]*

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(ii) Site B: *[2]*

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(iii) State which site has the greater beetle diversity **and** give a possible cause for this difference. *[1]*

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(This question continues on the following page)

(Question A1 continued)

(c) (i) Describe how you might estimate the population of **one** of these beetle species in 0.1 hectare of upland vegetation. *[4]*

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(ii) State two factors that might influence the accuracy of the results you obtain using the method described in (c) (i). *[2]*

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(d) Suggest how you might identify a species of beetle that you had not seen before. *[1]*

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(This question continues on the following page)

(Question A1 continued)

(e) (i) Name and briefly describe an ecosystem you have studied, and name an *abiotic* factor that influences the abundance of organisms within it. *[1]*

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(ii) For the ecosystem and the abiotic factor named in (e) (i), describe how you would measure an environmental gradient. *[4]*

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(iii) Explain how a **named** human activity might affect the abiotic factor in the ecosystem selected in (e) (i). *[2]*

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Option B — Impacts of Resource Exploitation

B1. The table below gives the world production of energy from several sources for selected years.

Energy source	Annual World Production / 10^{18} Joules			Percentage increase 1980–2000
	1980	1990	2000	
Hydroelectric	19.05	23.79	28.63	
Nuclear Power	8.00	21.44	26.94	237%
Geothermal, solar and wind power	0.49	1.67	3.08	529%

[Source: adapted from Energy Information Administration, *International Energy Annual 2002,* US Department of Energy, http://www.eia.doe.gov/iea/contents.html]

(a) Calculate the absolute increase in energy production between 1980 and 2000 for each source. *[1]*

(i) Hydroelectric: . . . . . .

(ii) Nuclear power: . . . . . .

(iii) Geothermal, solar and wind power: . . . . . .

(b) Calculate the percentage increase in hydroelectric energy production between 1980 and 2000. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(c) Describe and explain the data in the table opposite. *[4]*

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(d) Outline **three** disadvantages of hydroelectric power. *[3]*

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(This question continues on the following page)

(Question B1 continued)

(e) (i) Name and briefly describe a food production system (either terrestrial or aquatic) that you have studied. *[3]*

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(ii) Evaluate the sustainability of the system described in (e) (i). *[3]*

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(This question continues on the following page)

(Question B1 continued)

(f) (i) Define the term *ecological footprint*. *[2]*

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(ii) Compare the probable size of the ecological footprint of an inhabitant of a developed country with that of an inhabitant of a less developed country. Explain your answer. *[3]*

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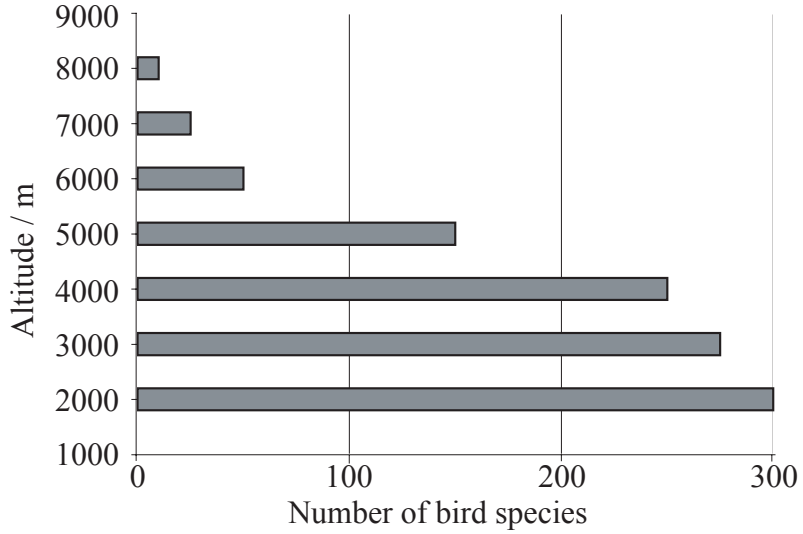
Option C — Conservation and Biodiversity

C1. The bar-graph below shows the number of bird species found at different altitudes in the Himalayan Mountains. These mountains, in northern India, show a transition from tropical forest at the base, to a tundra-like ecosystem at high altitudes.



[Source: G M MacDonald (2003), *Biogeography*: *Space, Time and Life,* John Wiley, page 414]

(a) (i) Define the terms *species diversity* **and** *habitat diversity*. *[2]*

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(ii) Use the data in the graph to state and explain the relationship between species diversity and habitat diversity. *[2]*

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(This question continues on the following page)

(Question C1 continued)

(b) (i) In an African country the proportion of adult female elephants occurring **naturally** without tusks increased from 10.5 % in 1969 to 38.2 % in 1989. Suggest a possible reason for this change. *[2]*

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(ii) Suggest what might happen if a small population of elephants were to be isolated from other elephants for a number of years. *[3]*

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(iii) Explain the purpose of the Convention on the International Trade in Endangered Species (CITES), and state **one** limitation or weakness of the convention. *[2]*

Purpose: . . . . . .

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Weakness: . . . . . .

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(This question continues on the following page)

(Question C1 continued)

(iv) Describe a **named** example of the species-based approach to conservation, and evaluate its success. *[4]*

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(c) "Human activities often simplify ecosystems, making them unstable." Explain this statement. *[5]*

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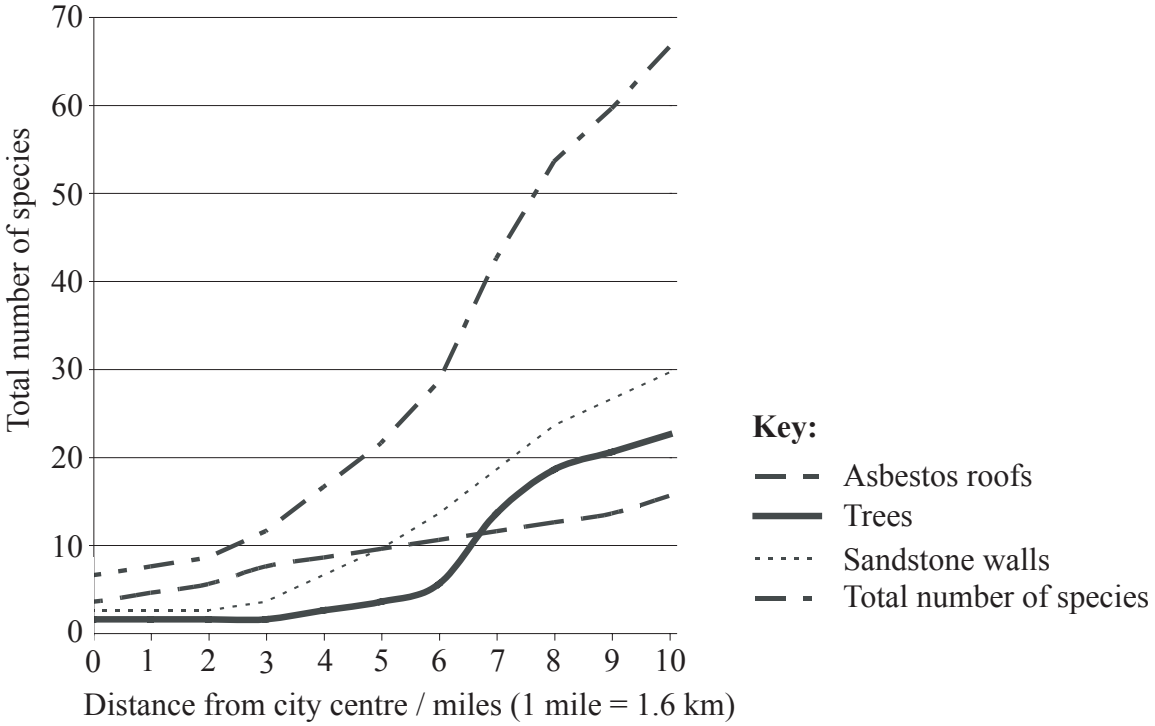
Option D — Pollution Management

D1. The graph below shows the numbers of lichens growing on the top of sandstone walls, on asbestos roofs, and on trees at varying distances from the centre of a European city in 1964.



[Modified from: O Gilbert (2000) *Lichens*, HarperCollins]

(a) Describe and explain the graph. *[5]*

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(This question continues on the following page)

(Question D1 continued)

(b) (i) Define the term *biochemical oxygen demand.* *[1]*

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(ii) Describe how the biochemical oxygen demand is used to assess pollution levels in aquatic ecosystems. *[3]*

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(c) A freshwater lake near your school has become severely eutrophic. Describe **four** ways in which this lake pollution might be prevented in future. *[4]*

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(This question continues on the following page)

(Question D1 continued)

(d) State **three** ways in which a eutrophic lake might be cleaned up and restored. *[3]*

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(e) Evaluate incineration as a method of disposal of solid domestic (municipal) waste. *[4]*

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