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

M03/460/S(3)

ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 3

Candidate number

Thursday 8 May 2003 (morning)

1 hour

INSTRUCTIONS TO CANDIDATES

- Write your candidate number in the box above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your candidate 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 letters of the Options 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.

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Option A – Analysing ecosystems

A1. (a) The lizard population of an island was studied as follows.

During a three-day period 50 lizards were captured, marked and then released. Two weeks later, on a second visit to the island, another 50 lizards were captured, of which 20 were already marked from the previous visit.

Assuming that there have been no deaths or hatchings, determine the approximate lizard population of the island. *[1]*

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(b) Outline and evaluate a method for estimating the abundance of a named plant species in a named ecosystem. *[3]*

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(c) Explain why abundance of organisms might be of importance in estimating the diversity of an ecosystem. *[2]*

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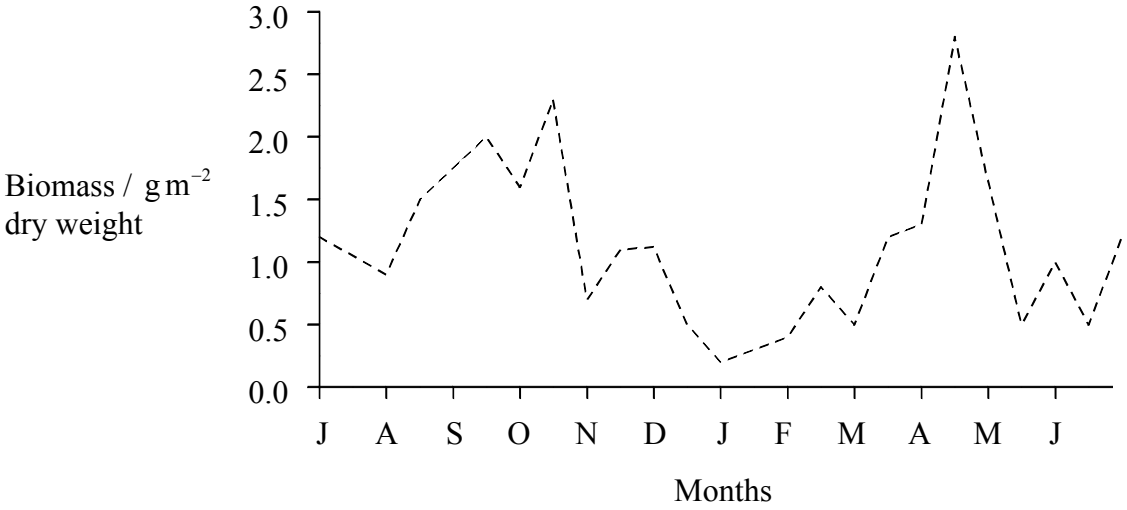
A2. The graph below shows the variation in insect biomass (measured in $g\,m^{-2}$ dry weight) over the period of a year, in a shrubland ecosystem, on the west coast of South America. Note that the months along the horizontal axis commence in July, which is winter in the southern hemisphere.



[Source: Cody *et al*, (1977), *Convergent Evolution in the Consumer Organisms in the Mediterranean, Chile and California*, Dowden, Hutchinson and Ross.]

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

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(b) Explain why the term *dry weight* is used. *[1]*

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(c) Describe and explain the shape of the curve on the graph. *[3]*

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(This question continues on the following page)

(Question A2 continued)

(d) Describe and evaluate a method for the estimation of the changes in plant biomass in an ecosystem over a period of a year. *[4]*

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A3. (a) Briefly describe a human activity that might have an effect on the ecosystem you named in A1(b). *[1]*

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(b) Identify an abiotic factor that might change as the result of this human activity, and outline how you would measure these changes. *[4]*

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Option B – Impacts of resource exploitation

B1. The table below shows some statistics relating to the world food production system between 1950 and 1995.

	1950	**1995**
Human population / $\times 10^6$	2555	5732
Cereal production / $\times 10^6$ tonnes	631	1700
Meat production / $\times 10^6$ tonnes	44	192
Fish catch / $\times 10^6$ tonnes	21	109
Fertilizer use / $\times 10^6$ tonnes	14	122
Irrigated area / $\times 10^6$ hectares	94	248

(a) (i) Determine the percentage increase in human population between 1950 and 1995. *[1]*

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(ii) Determine the percentage increase in fertilizer use between 1950 and 1995. *[1]*

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(iii) State **two** reasons for the difference between the percentage increase in the human population and the percentage increase in fertilizer use. *[2]*

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(This question continues on the following page)

(Question B1 continued)

(b) Use the data in the table to explain how inputs and outputs of the world food production system changed between 1950 and 1995. *[4]*

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(c) State and explain the differences in the relative proportions of fish, meat and cereals consumed in developed and developing countries. *[3]*

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B2. List **two** advantages and **two** disadvantages for each of the following sources of energy.

(a) Fossil fuels

(i) Advantages *[1]*

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(ii) Disadvantages *[1]*

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(b) Nuclear power

(i) Advantages *[1]*

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(ii) Disadvantages *[1]*

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(c) State **one** other source of energy and evaluate its sustainability. *[2]*

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B3. (a) Define the term *ecological footprint*. *[1]*

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(b) State **two** differences you would expect between the ecological footprint of a city in a developing country and that of a city in a developed country. *[2]*

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Option C – Conservation and biodiversity

C1. The table below shows the approximate numbers of species that have become extinct since 1600 on continents, on islands and in oceans, compared with the number of species alive today.

Biological group	Total number of living species	Number of extinct species (since 1600)			
		Continents	Islands	Oceans	Total
Mammals	4 000	30	51	2	83
Birds	9 000	21	91	0	113
Reptiles	6 300	1	20	0	21
Fishes	19 100	22	1	0	23
Invertebrates	>1 000 000	49	48	1	98

[Source: R B Pinnock, *Essentials of Conservation*, Sinauer Associates Inc, (1993)]

(a) Calculate the percentage of mammals that have become extinct since 1600. *[1]*

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(b) Use the data in the table to determine which groups of organisms have had the highest and lowest total rates of extinction in relation to the number of living species. *[1]*

(i) Highest total rate of extinction: . . . . . .

(ii) Lowest total rate of extinction: . . . . . .

(c) Suggest **two** reasons for the difference in the rate of extinction between these two groups. *[2]*

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(Question C1 continued)

(d) Explain the differences between the numbers of extinctions on islands and those on continents. *[5]*

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C2. (a) Define the term *species diversity*. *[1]*

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(b) Explain how natural selection may produce new species. *[2]*

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(c) (i) State **two** natural factors that might lead to a loss of biodiversity. *[2]*

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(ii) State **two** types of human activity that might lead to a loss of biodiversity. *[2]*

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C3. Explain how the shape and size of a protected area may influence its success in protecting the organisms and ecosystems within it. *[4]*

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Option D – Pollution management

D1. (a) Distinguish between *point-source* and *non-point-source* pollution. *[1]*

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The data in the table below show the quantities of heavy metals detected in the upstream (closer to the source) and downstream (closer to the mouth) sections of a river. The testing points were about 10 km apart. All data are in ng cm^{-3}.

Heavy metal	**Upstream**	**Downstream**
Chromium	3.2	5.1
Nickel	1.3	2.7
Copper	0.8	6.8
Zinc	9.7	22.1
Cadmium	0.1	0.1
Lead	1.7	3.6

[Source: partly based on Ramessur *et al*., *Environment International* (1998)]

(b) (i) Determine which metal shows the greatest percentage increase in concentration between the upstream and the downstream testing points of the river. *[1]*

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(ii) Determine which metal shows the lowest percentage increase in concentration between the upstream and the downstream testing points of the river. *[1]*

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(Question D1 continued)

(c) Explain the data in the table. *[3]*

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(d) State **two** strategies that might be used to reduce the amount of these pollutants in rivers. *[2]*

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D2. The data in D1 represent a *direct* method of measuring pollution. Pollution of the environment may also be measured *indirectly* using a biotic index. Explain, with an example, how a biotic index is used. *[4]*

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D3. Define the term *biochemical oxygen demand* (BOD) and explain how it is used to assess pollution levels in water. *[3]*

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D4. Describe how you would evaluate the solid waste (garbage) management strategies of your school. *[5]*

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