IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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M07/4/ENVSY/SP3/ENG/TZ0/XX+

22076412

ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 3

Tuesday 15 May 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.

0114

Option A — Analysing Ecosystems

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

A1. The table below gives the mean dry weight biomass for the primary producers in certain ecosystems.

Ecosystem	Biomass / kg m^{-2}
Tropical rainforest	45.0
Deciduous forest	35.0
Boreal (coniferous) forest	30.0
Grassland	6.0
Tundra	0.6
Desert	0.2
Freshwater Lake	0.1

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

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(ii) For **one** of the ecosystems listed above, describe and evaluate a method for obtaining such dry weight biomass data. *[4]*

Selected ecosystem . . . . . .

Method . . . . . .

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(This question continues on the following page)

(Question A1 continued)

(iii) Name **one** abiotic factor important in the ecosystem you have selected, and describe how you would study its variation over time. *[3]*

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The table below gives the number of individuals of four species of trees in two small patches of Australian forest.

Tree species	Area A	Area B
Allocasurina huegelina	4	1
Banksia grandis	5	8
Eucalyptus calophylla	7	9
Acacia saligna	4	2

(b) (i) Using the formula for Simpson's diversity index

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

calculate which of area A or area B has the higher diversity index. Show your working. *[3]*

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(This question continues on the following page)

(Question A1 continued)

(ii) Name **one** environmental factor that might explain this difference. *[1]*

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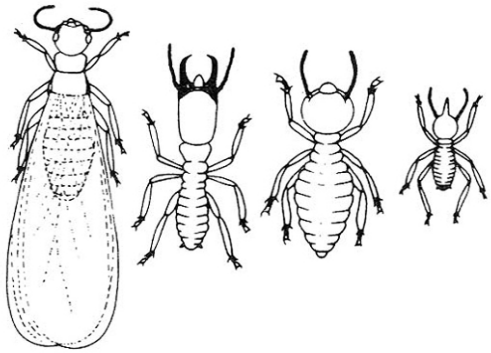
The sketch below shows four types of termite found in Australia. (Termites are burrowing, colonial insects.)



[Source: *Some termites from Western Australia*, 1989. Reprinted with the permission of the Western Australian Gould League Inc.]

(c) (i) List **three** characteristics displayed by the organisms illustrated above that might be used to construct a key to assist in identifying termites from the same part of Australia. *[2]*

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(ii) Name **two** methods, other than the use of a key, that you might use to identify an insect you had not seen before. *[2]*

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(This question continues on the following page)

(Question A1 continued)

(iii) Bearing in mind that termites live in colonies of many thousands of individuals, and that these colonies sometimes form large mounds (see photograph below), suggest how you might estimate the number of termites on five hectares of land. Evaluate your methods. *[4]*

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[Source: Ajay Narendra, "Monstrous termite mounds, Litchfield", from "Crossing Tropic of Capricorn"; http://www.travelblog.org/Australasia/Australia/Northern-Territory/Darwin/blog-6798.html]

Option B — Impacts of Resource Exploitation

B1. (a) A European country is planning to restart building nuclear power stations after a period of twenty years in which no nuclear plants were constructed. List **four** advantages and **four** disadvantages of this change in policy. *[4]*

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(b) The table below gives the nitrogenous fertilizer consumption for three regions for certain years.

	Consumption of N-fertilizer in thousands of tonnes of Nitrogen				
Region	**1961**	**1971**	**1981**	**1991**	**2001**
Western Europe	3639	7371	10426	10069	9356
Australasia	40	137	286	504	1332
Africa	136	722	1278	1239	1433

[Source: modified from http://www.fertilizer.org/ifa/statistics/ifadata/dataline]

State the region in which the N-fertilizer consumption has increased most between 1961 and 2001:

(i) by absolute amount.

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as a percentage. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(ii) Calculate the percentage that N-fertilizer consumption increased between 1961 and 1991 in Australasia. Show your working. *[2]*

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(iii) Describe and explain the changes in fertilizer consumption for the three regions over the period 1961–2001. *[4]*

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(c) State **two** outputs that might result from the increased use of fertilizer on a farm in a developed country. *[2]*

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(This question continues on the following page)

(Question B1 continued)

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

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(ii) Describe and explain the probable differences between the ecological footprint of a subsistence farmer in Africa and a commercial farmer in Australasia or Western Europe. *[5]*

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Option C — Conservation and Biodiversity

C1. (a) (i) Distinguish between *genetic diversity* and *habitat diversity*. *[2]*

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(ii) Describe and explain how the diversity of an ecosystem might be expected to change throughout ecological succession. *[4]*

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(iii) In December 1834 Charles Darwin visited a very small island off the coast of South America. He noted that "there were many wild goats" on this island, but that in colour and appearance they were surprisingly similar to each other. Explain why the population might have shown this degree of similarity. *[3]*

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(This question continues on the following page)

(Question C1 continued)

The table below gives an index of the genetic diversity (the higher the number the higher the diversity) for the buffalo populations of four reserves in South Africa, together with the size of each reserve, and the size of the buffalo population in each.

Reserve	Area / hectares	Buffalo population	Index of genetic diversity
Kruger National Park	1 945 500	30 000	0.72
Umfolozi	47 753	8400	0.54
St Lucia	38 826	175	0.45
Addo Elephant Park	9000	85	0.48

[Source: modified from O'Ryan *et al.*, (1998), *Animal Conservation*, **2**, pages 85–94,]

(iv) Describe and explain relationships evident in the table amongst area, population and genetic diversity. *[5]*

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(v) Discuss how data of this sort are important in decision-making on the size of national parks and reserves. *[2]*

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(This question continues on the following page)

(Question C1 continued)

(b) Identify **four** factors that can lead to the loss of biological diversity in an area, giving an example of each. *[4]*

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Option D — Pollution Management

D1. (a) Define the term *pollution*. *[1]*

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The table below gives the BOD and approximate number of fecal coliform bacteria (organisms often associated with sewage) at a number of sampling points along a river in southern Europe. Sampling point 1 is closest to the source of the river, point 5 is closest to the mouth of the river.

Sample point	BOD / $mg\,L^{-1}$	Number of fecal coliform bacteria / colony forming units per litre
1	1.8	3000
2	2.4	6500
3	15.0	18 000
4	19.3	22 000
5	2.0	2500

[Source: modified from Vitali *et al.*, (1997), *Environment International*, **23** (3), pages 337–347]

(b) (i) Define what is meant by *BOD*. *[2]*

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(ii) Describe and explain how BOD and the number of bacteria change downstream. *[5]*

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(Question D1 continued)

(iii) Apart from BOD and bacteria numbers, list **four** characteristics that might distinguish the water at sample point 4 from that found at point 1. *[4]*

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(c) Explain and evaluate strategies to prevent the release of a **named** industrial waste into the environment. (Your example must **not** be any of the oxides of carbon, nitrogen or sulfur.) *[5]*

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(This question continues on the following page)

(Question D1 continued)

(d) Give **three** examples of how the alteration of human activities that produce pollutants can reduce the impact of pollution on the environment. *[3]*

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