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

ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 3

Friday 17 November 2006 (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.

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14 pages

Option A — Analysing Ecosystems

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

A1.   A group of students sampled the animals in a local ecosystem. Their results are shown below. The numbers of individuals captured from each species is indicated in brackets next to each diagram.

P (6)   **Q** (1)   **R** (4)

S (8)

T (2)

U (2)   **V** (3)   **W** (1)
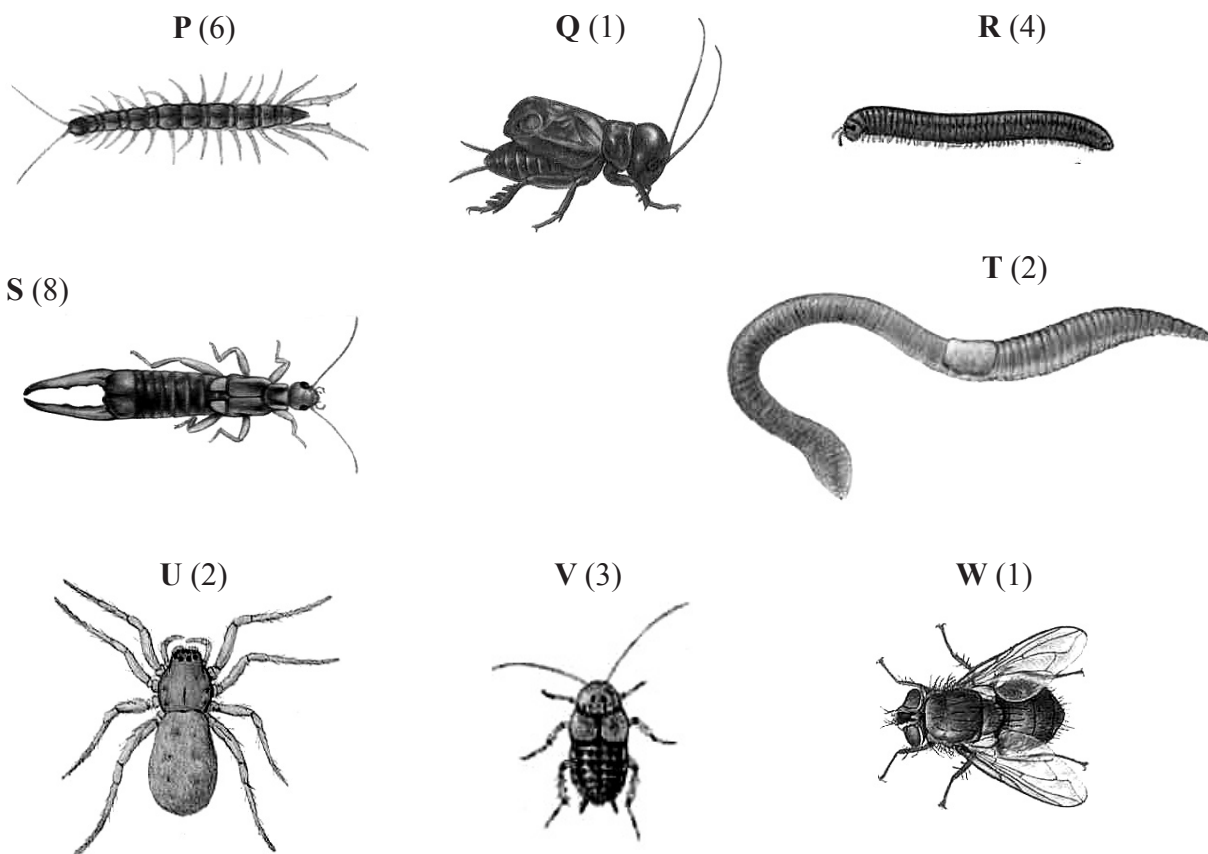
Organisms are not shown to scale

[Source: Lyneborg. L. (1973) *Dune and Moorland Life,* Blandford Press]

(a)   Simpson's diversity index is calculated using:

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

where N is the total number of organisms of all the species found and n is the number of each species.

Calculate a value for D. Show your working.   *[2]*

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(This question continues on the following page)

(Question A1 continued)

(b)   The students used a key to help with the identification of the organisms. Suggest **two** different visible features that would be suitable for use in the key.   *[2]*

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The next day the students sampled a similar ecosystem at a site 2 km away. The Simpson's diversity index for the second ecosystem was found to be much lower.

(c)   (i)   State an abiotic factor that might affect the diversity of two similar ecosystems at different sites.   *[1]*

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(ii)   Explain why differences in the abiotic factor named in (i) might affect diversity between two sites.   *[2]*

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(iii)   Describe how you would measure and compare the abiotic factor named in (i) at each site.   *[3]*

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(This question continues on the following page)

(Question A1 continued)

To estimate the population of animal S, the students marked the eight individuals that they found and returned them to the ecosystem. One week later, the students caught 20 individuals of animal S, of which five were marked.

(d) (i) State the name of this method of estimating a population. *[1]*

....

(ii) Estimate the size of the population of animal S. *[1]*

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....

(iii) Suggest **one** reason why the estimate might be unreliable. *[1]*

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....

(iv) Explain why brightly coloured paint should not be used to mark the animals. *[1]*

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(This question continues on the following page)

(Question A1 continued)

Animal R feeds on plants. The students kept six individuals of animal R for a month in the laboratory to measure their productivity.

(e) (i) Explain why the mass of food given to the animals and the mass of feces produced must be measured. *[2]*

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(ii) Explain why samples of the food and feces should be dried before weighing. *[1]*

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(iii) Outline how the **energy** absorbed by the animals from their food can be calculated from the dry masses of food and feces. *[2]*

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(iv) Show how you would calculate net productivity from measurements of the masses of the animals at the beginning and end of the experiment. *[1]*

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Option B — Impacts of Resource Exploitation

B1. The table below provides data on population and resource use for some countries in South-East Asia.

Country	Land area / 10^6 ha	Population / millions	Area of arable and permanent cropland / 10^6 ha	Ecological footprint / ha *per capita*
Indonesia	182.6	231	33.5	1.48
Malaysia	32.9	23	7.6	3.68
Philippines	29.8	85	10.1	1.42
Thailand	51.2	62	18.0	2.70
Vietnam	32.5	81	7.4	0.95

[Source: Nationmaster (2004), www.nationmaster.com]

(a) (i) State the meaning of the term *per capita*. *[1]*

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(ii) Identify the country in the table with the lowest population density (people per hectare). *[1]*

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(iii) Calculate the percentage of the land used for crops in Thailand. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(b)   (i)   Outline the difference between ecological footprint and carrying capacity for a
            human population.   *[1]*

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      (ii) Identify the country in the table with the largest **total** ecological footprint.   *[1]*

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      (iii) Explain why the relative proportions of meat and cereals eaten in a country might
            affect the size of its ecological footprint.   *[2]*

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      (iv) Explain why a country with a large *per capita* footprint is likely to be a developed
            country.   *[3]*

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0714

(Question B1 continued)

(c)   (i)   Explain why generating electricity using hydroelectric power instead of fossil fuels
            might reduce a country's ecological footprint.   *[1]*

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      (ii) State **two** disadvantages of hydroelectric power generation.   *[2]*

            1.   . . . .

                 . . . .

            2.   . . . .

                 . . . .

(d)   (i)   Name a food production system that you have studied and state **three** inputs and
            three outputs.   *[4]*

            Name of a food production system:

            . . . .

            Inputs: . . . .

                      . . . .

                      . . . .

            Outputs: . . . .

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      (ii) Evaluate the environmental sustainability of the food production system named in
            (d) (i) above.   *[3]*

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Option C — Conservation and Biodiversity

C1. The table below provides data on population, land resources and number of bird species for some countries in South-East Asia.

Country	Land area / 10^6 ha	Population / millions	Area of wetlands of international importance / 10^6 ha	Number of known breeding bird species	Percentage of breeding bird species threatened
Indonesia	182.6	231	0.243	929	7.39
Malaysia	32.9	23	0.038	254	7.28
Philippines	29.8	85	0.068	404	34.18
Thailand	51.2	62	0.132	285	6.01
Vietnam	32.5	81	0.012	262	6.54

[Source: Nationmaster (2004), www.nationmaster.com]

(a) Suggest **one** reason why conserving wetlands is important for conserving breeding bird species. *[1]*

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(b) State which country has the highest **number** of threatened breeding bird species. *[1]*

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(c) Calculate the percentage of land covered by wetlands of international importance in Thailand. *[1]*

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(d) Outline how human activities may change a wetland ecosystem and thus reduce its biodiversity. *[3]*

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0914

Turn over

C2. (a)   Forest reserves A and B shown in the diagram below, have been designed to conserve threatened species. Both reserves have the same area.

Reserve A –
surrounded by
sustainably managed forest

Reserve B –
surrounded by cropland
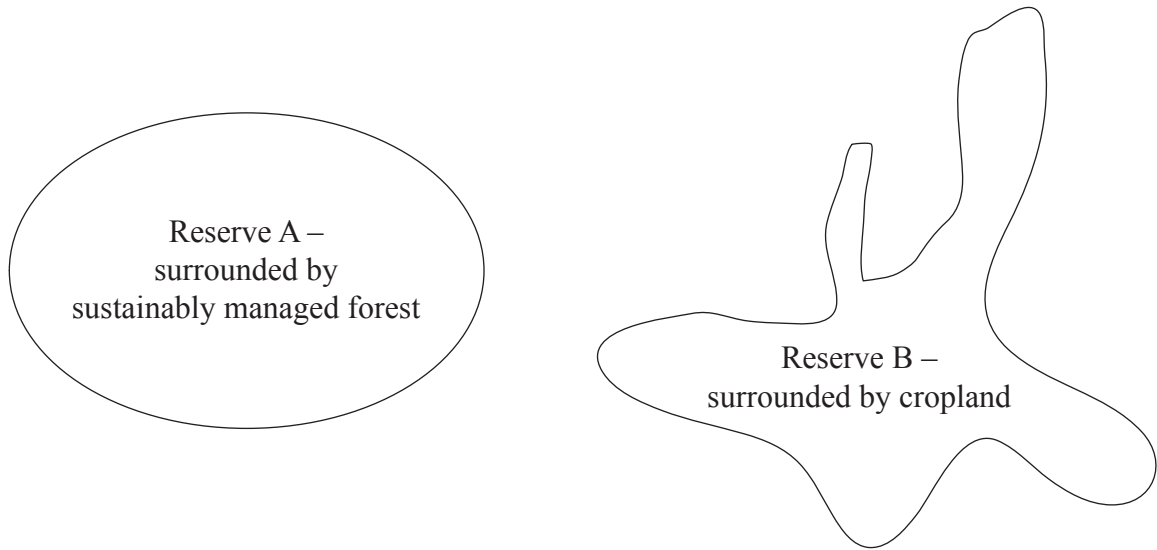
Evaluate the likely effectiveness of the reserves in conserving species, with reference to their shape and the management of surrounding land.   *[4]*

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1014

(Question C2 continued)

(b) (i) State **four** categories used to define the conservation status of species in the *Red Data Books*. *[2]*

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(ii) For a **named** species with a small declining population, outline **three** possible reasons why the population is decreasing. *[3]*

Name of species: . . . .

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2. . . . .

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3. . . . .

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(iii) Predict the possible effects on the ecosystem if the species named in (ii) were to disappear. *[3]*

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(c) Explain how CITES helps to protect threatened species. *[2]*

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1114

Turn over

Option D — Pollution Management

D1. The table below provides data on pollution for some countries in East and South-East Asia.

Country	Total BOD / tonnes day^{-1} in 1980	Total BOD / tonnes day^{-1} in 1993	% BOD from the paper industry / tonnes day^{-1} in 1993	% BOD from the food industry / tonnes day^{-1} in 1993
Indonesia	214	537	7.8	58.9
Malaysia	77	136	14.3	31.8
Philippines	182	182	8.1	52.9
Thailand	214	257	7.6	46.4
Korean Republic	282	359	15.4	25.8

[Source: adapted from www.worldbank.org/NIPR and www.nationmaster.com]

(a)   Define the term *biochemical oxygen demand* (BOD).   *[1]*

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(b)   Identify which country has shown the greatest increase in BOD per day between 1980 and 1993.   *[1]*

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(c)   Calculate the percentage change in total BOD in Thailand between 1980 and 1993.   *[1]*

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(d)   Suggest **two** other sources, apart from the paper and food industries, that are likely to contribute significantly to BOD.   *[2]*

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(e)   Suggest why the BOD from most of the countries in the table increased between 1980 and 1993.   *[2]*

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D2. (a) State the term used to describe lakes and rivers containing high levels of nutrients. *[1]*

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(b) Describe the changes in an aquatic ecosystem produced by high inputs of phosphates and nitrates. *[3]*

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(c) State and evaluate **two** methods of reducing excessive inputs of phosphates and nitrates to an aquatic ecosystem. *[4]*

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1314

D3. (a) Outline **three** possible environmental impacts of a **named** industrial pollutant such as radioactive waste, oil or heavy metals. *[3]*

Name of industrial pollutant: . . . .

Environmental impacts: . . . .

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(b) Suggest ways in which ecosystems damaged by the industrial pollutant named in (a) above can be restored. *[2]*

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