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

M06/4/ENVSY/SP2/ENG/TZ0/XX

22066411

ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 2

Thursday 4 May 2006 (afternoon)

1 hour 15 minutes

Candidate session number

0	0							

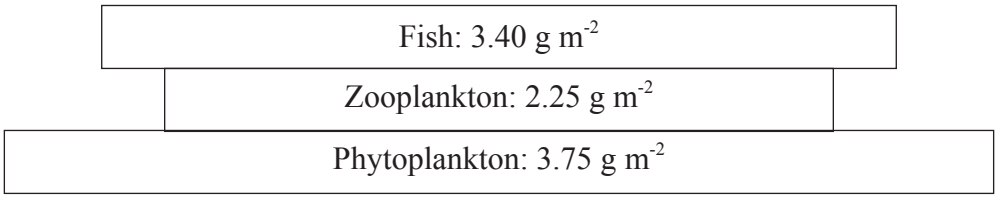
INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write 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 numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

SECTION A

*Answer **all** the questions in the spaces provided.*

1. The figure below represents a pyramid of biomass for a food chain in an aquatic ecosystem.



(a) Suggest **two** reasons why the biomass of fish may be greater than the biomass of zooplankton. *[2]*

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(Question 1 continued)

(b) The productivity: biomass ratio (P:B) represents the annual net productivity per unit of biomass. For example, from the P:B ratios given below it can be seen that each gram of fish biomass produces 2.2 g of new biomass annually.

Using the data in (a) and the P:B ratios below, calculate the productivity for each trophic level and plot a pyramid of productivity on the axes below. *[3]*

Trophic Level	**P:B ratio/yr^{-1}**
Fish	2.2
Zooplankton	14.0
Phytoplankton	60.0

Fish: . . . . . .

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Zooplankton: . . . . . .

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Phytoplankton: . . . . . .

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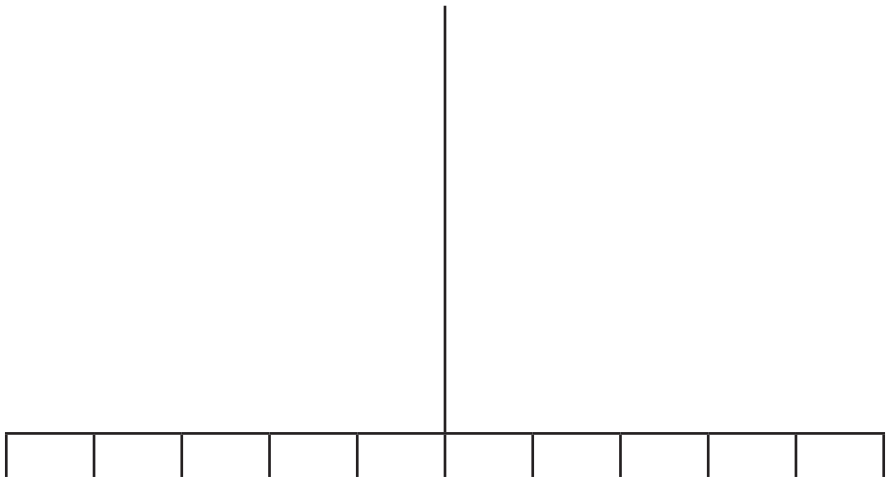

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(Question 1 continued)

(c) If the fish population were considered a resource for human consumption, identify the numerical **values** that would represent the natural capital and the natural income for this resource. *[2]*

Natural capital: . . . . . .

Natural income: . . . . . .

(d) State the **two** factors that would need to be measured in order to estimate the gross productivity of the fish population in g m^{-2} yr^{-1}. *[2]*

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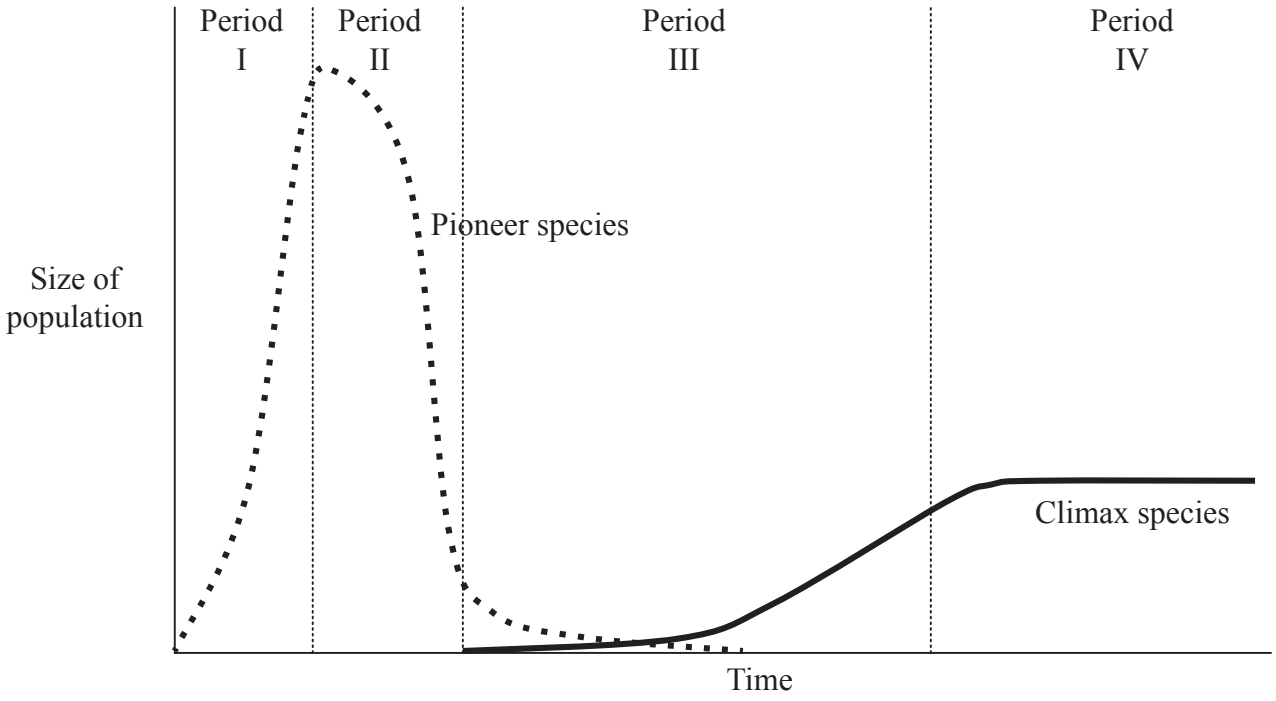
2. The graph below represents changes in the size of populations of a pioneer species and a climax species during a process of succession.

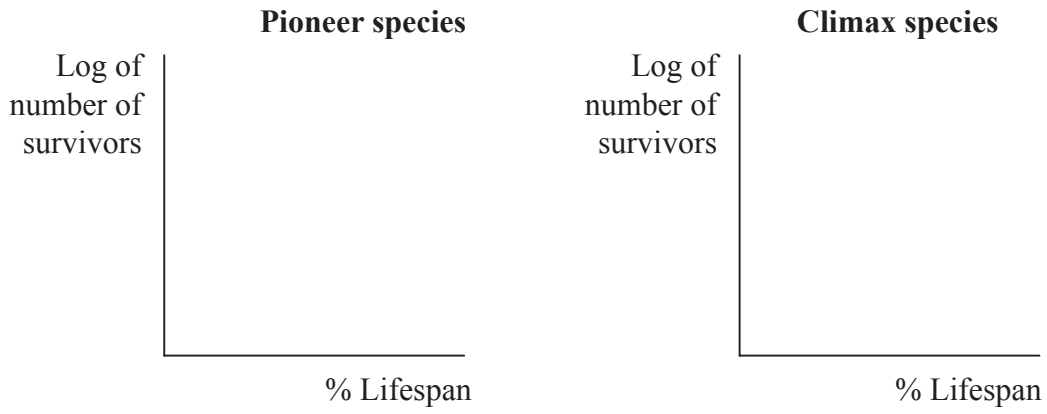


(a) For the pioneer species during periods I and II and the climax species during periods III and IV, state whether positive or negative feedback mechanisms are most significantly affecting their population dynamics. *[2]*

Pioneer species, I . . . . . Climax species, III . . . . . .

Pioneer species, II . . . . . Climax species, IV . . . . . .

(b) Sketch on the axes below the shape of the survivorship curves you would expect for each of these species. *[2]*



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(Question 2 continued)

(c) Compare the strategies these two species are likely to have in terms of specific growth rate, parental care and competitive advantage. *[3]*

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3. Convection cells occur in both the atmosphere and the lithosphere, and involve the following six phenomena:

Heating	Rising matter	Increase in density
Cooling	Falling matter	Decrease in density

(a) In the space below, arrange these phenomena in a flow diagram to show the correct order of events occurring in a convection cell cycle. *[2]*

(b) Explain how the convection cells in the **lithosphere** have influenced biodiversity on the planet. *[4]*

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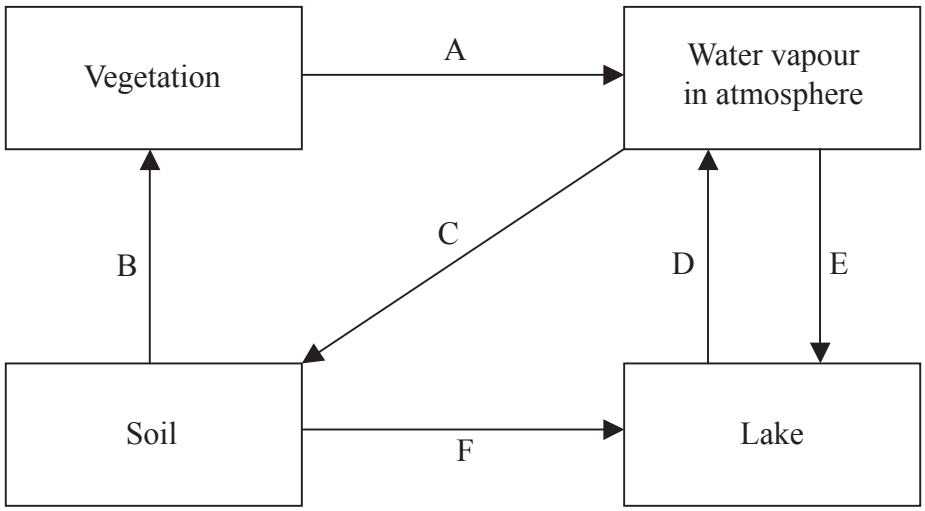
4. The diagram below represents certain flows in the hydrological cycle.



(a) State the transformation process and the transfer process involved in flow E. *[2]*

Transformation: . . . . . .

Transfer: . . . . . .

(b) Identify **two** flows on the diagram which may be increased most directly by an increased input of CO_2 into the atmosphere. Explain your answer. *[4]*

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(c) Explain how the mineral content within the soil may be affected by an increase in atmospheric sulfur oxides. *[2]*

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SECTION B

*Answer **one** question. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

Each essay question is marked out of a total of 20 marks of which 3 are allocated to the expression and development of ideas as follows:

0 No expression of relevant ideas.
1 Expression and development of relevant ideas is limited.
2 Ideas are relevant, satisfactorily expressed and reasonably well developed.
3 Ideas are relevant, very well expressed and well developed.

5. The following tables show predicted changes in the population between the years 2000 and 2050 for two different countries.

Ethiopia	Population (in thousands)	Percentage of the population in urban areas
Year 2000	65 590	14.9
Year 2050	170 987	28.4

Austria	Population (in thousands)	Percentage of the population in urban areas
Year 2000	8 102	65.8
Year 2050	7 376	72.3

(a) Using calculations and sketches where appropriate, compare the percentage growth, age/sex pyramids and position on the demographic transition model you would expect for these two populations over the period 2000-2050. *[7]*

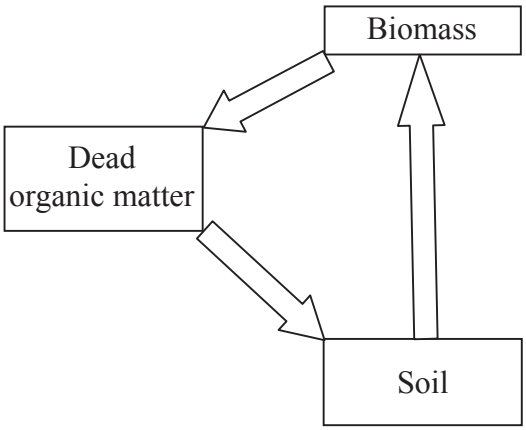
(b) For **each** country, suggest **three** factors that might affect their population size and outline how they could lead to the **predicted** changes between the years 2000 and 2050. *[6]*

(c) Suggest **two** examples of natural capital that have "ecological value", and describe how they might be affected by changes predicted in the urban populations of these countries. *[4]*

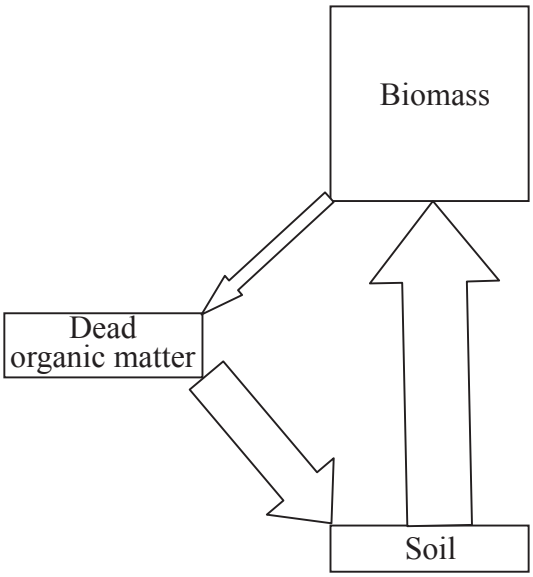
Expression of ideas [3]

6. The following diagrams represent the major nutrient flows and storages in two different ecosystems. The size of the boxes and width of the arrows are proportional to the size of the storages and flows they represent.

Temperate Forest



Tropical Rainforest



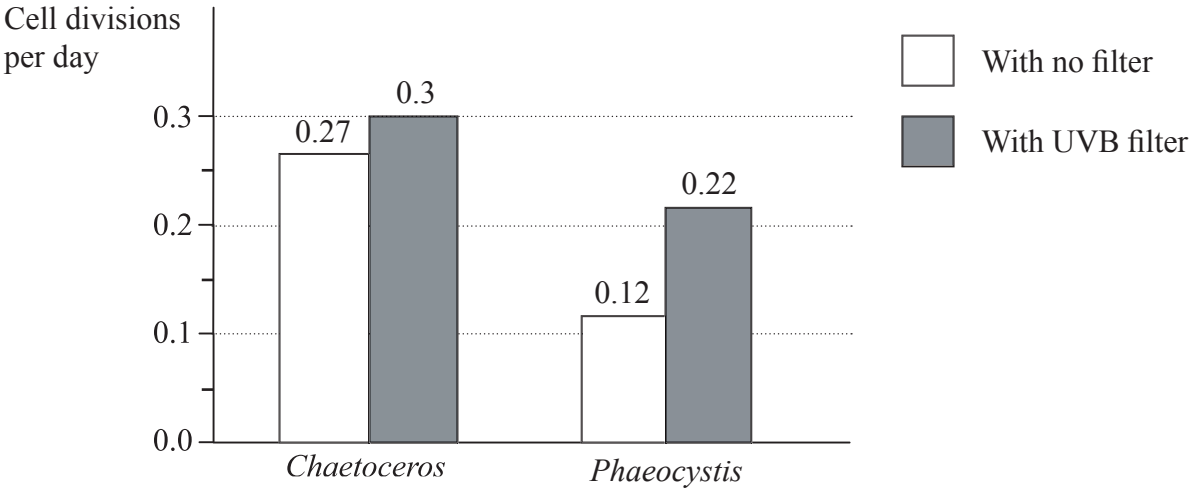
(a) Suggest how the differences in the size of comparable storages of the two ecosystems can be explained in terms of their different climates. *[7]*

(b) From the information provided in these flow diagrams, outline the state of equilibrium in each system and justify your answer. *[4]*

(c) Draw a labelled flow diagram showing the flows and storages of inorganic nitrogen that normally occur within soil. Show on your diagram how these flows provide a link between the storages of dead organic matter and biomass. *[6]*

Expression of ideas [3]

7. A study was carried out on two kinds of single-celled phytoplankton (*Chaetoceros* and *Phaeocystis*) which are both commonly found in an Antarctic marine ecosystem. Populations of each were divided into two groups, one group receiving full sunlight, and one receiving sunlight through a filter that blocked out ultraviolet B (UVB) radiation. The population growth of each group was measured in cell divisions per day. The results of the study are shown in the graph below.



[Source: Adapted from R C Smith *et al,* (1992) *Science*, **255**, pages 952-959]

(a) Using calculations where appropriate, outline the conclusions that can be drawn from these data regarding the growth rate and relative impact of UVB on these two kinds of phytoplankton. *[5]*

(b) With reference to the data, describe the possible impacts of ozone depletion on the Antarctic marine ecosystem, and the significance of these impacts for the wider environment. *[7]*

(c) Evaluate the success and limitations of international agreements in reducing the phenomenon of ozone depletion. *[5]*

Expression of ideas [3]