



22076411

**ENVIRONMENTAL SYSTEMS  
STANDARD LEVEL  
PAPER 2**

Monday 14 May 2007 (afternoon)

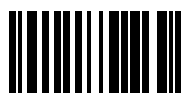
1 hour 15 minutes

Candidate session number

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**INSTRUCTIONS TO CANDIDATES**

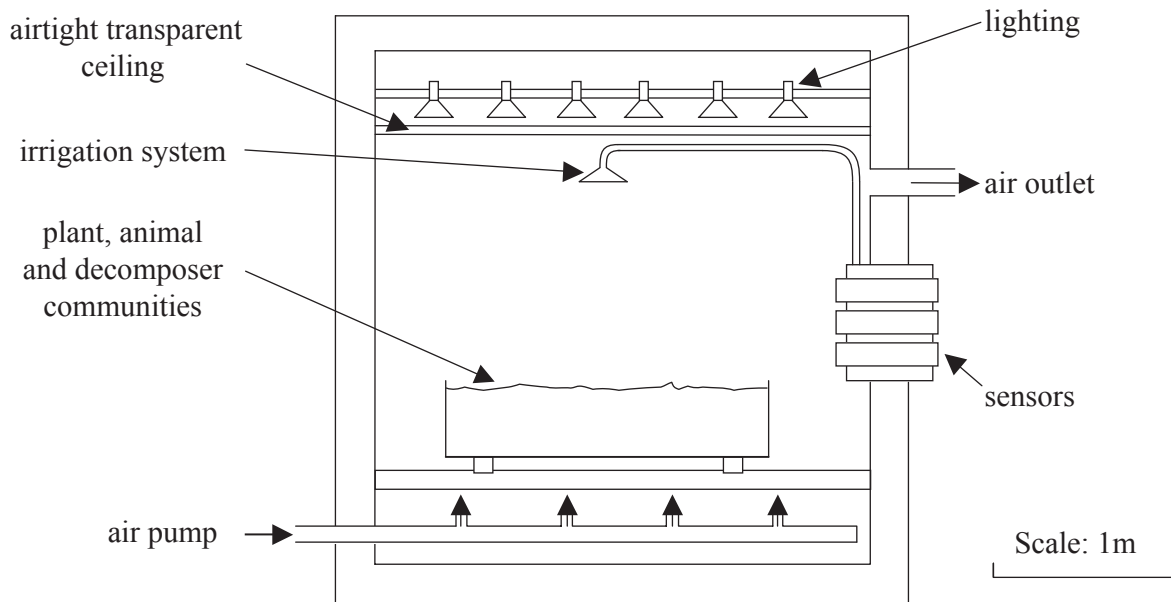
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, 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 following is a schematic diagram of an “ecotron”. This is a walk-in chamber with computer controlled climatic conditions for studying small communities representative of natural ecosystems.



[Source: modified from NERC www.cpb.bio.ic.ac.uk/ecotron/ecotron.html]

- (a) State whether this is an open, closed or isolated system. Give **one** reason for your answer. [1]

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- (b) Identify and explain **two** ways in which the inputs to the system would differ from the outputs while communities are growing within the ecotron. [4]

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*(Question 1 continued)*

- (c) If a fall in temperature of the system is detected by the sensors, mechanisms will be automatically initiated to increase the temperature. State which kind of feedback this demonstrates. [1]

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- (d) (i) Outline how the second law of thermodynamics can explain the pyramid shape associated with most food chains including that found in the ecotron. [2]

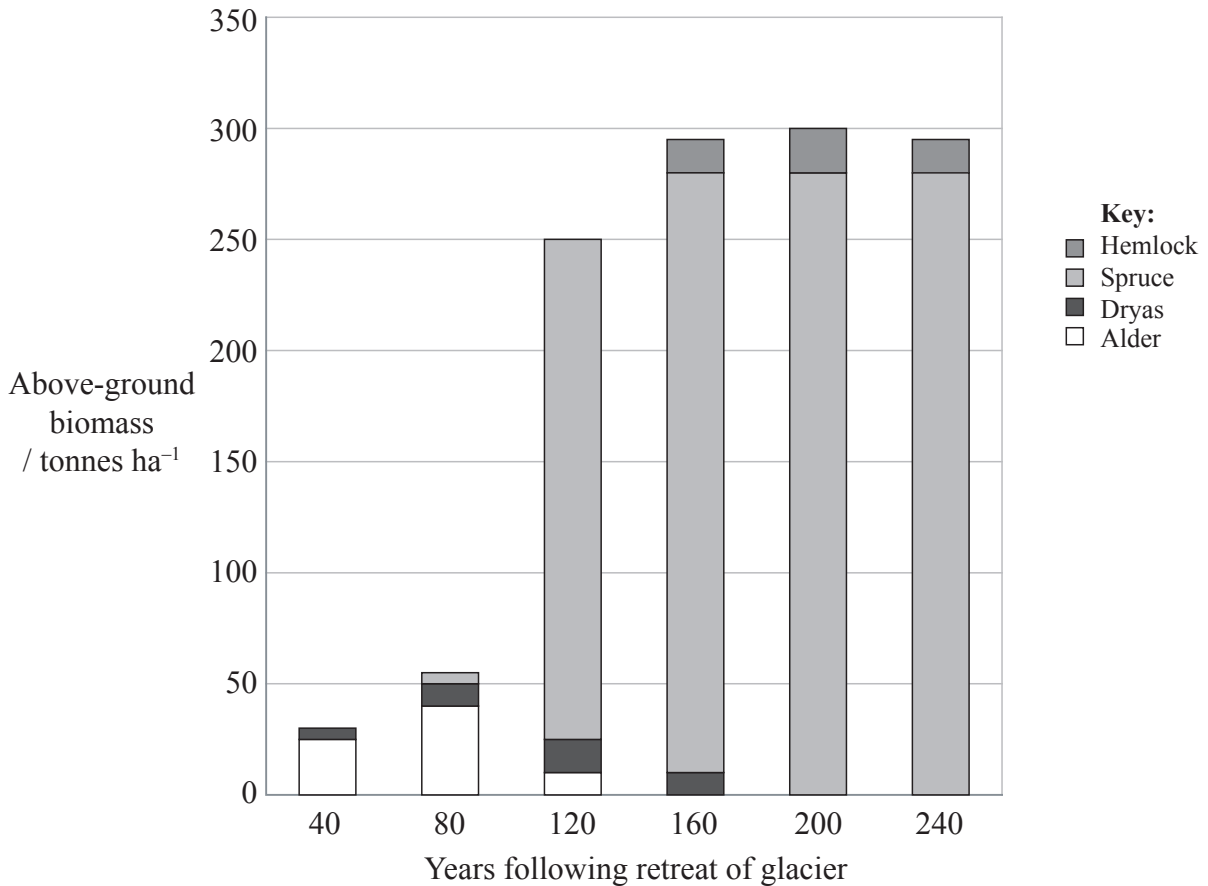
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- (ii) In this context, explain why food chains studied in the ecotron are generally limited to no more than three trophic levels. [2]

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2. The stacked bar graph below represents the composition of tree species every 40 years during primary succession from bare rock exposed by a retreating glacier at Glacier Bay, Alaska.



[Source: modified from R Bardgett, (2001) Plant Succession, *Biological Sciences Review*, (14) 2]

- (a) Calculate the mean growth rate of the Spruce in tonnes ha<sup>-1</sup> yr<sup>-1</sup> for each of the following periods:
  - (i) between 80-120 years..... [1]
  - (ii) between 200-240 years..... [1]
- (b) Suggest **two** reasons for the change of growth rate in the Spruce during this process of succession. [2]

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(Question 2 continued)

- (c) Alder is a pioneer species. Suggest how its reproductive strategy may be appropriate to fulfil this role. [2]

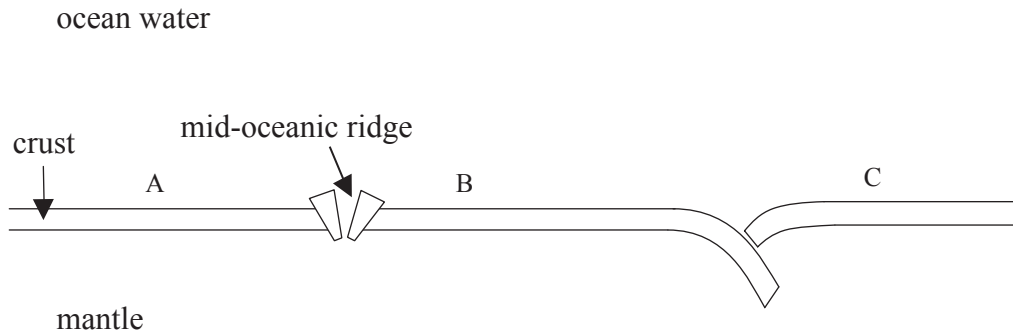
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- (d) Alder possesses root nodules containing nitrogen-fixing bacteria. State what is meant by the term *nitrogen fixation*, and explain the significance that this would have during the early stages of succession. [2]

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3. The diagram below shows three tectonic plates: A, B and C.



(a) By means of arrows, indicate on the diagram the flow of material beneath the crust and the direction of movement of plates A and B. [3]

(b) Describe **two** ways in which the processes involved in these movements may cause exchange of material or energy between the lithosphere and the ocean. [2]

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(c) State the process occurring at the margins of plate B and C, and explain **one** way in which this may have contributed to habitat diversity in that region. [2]

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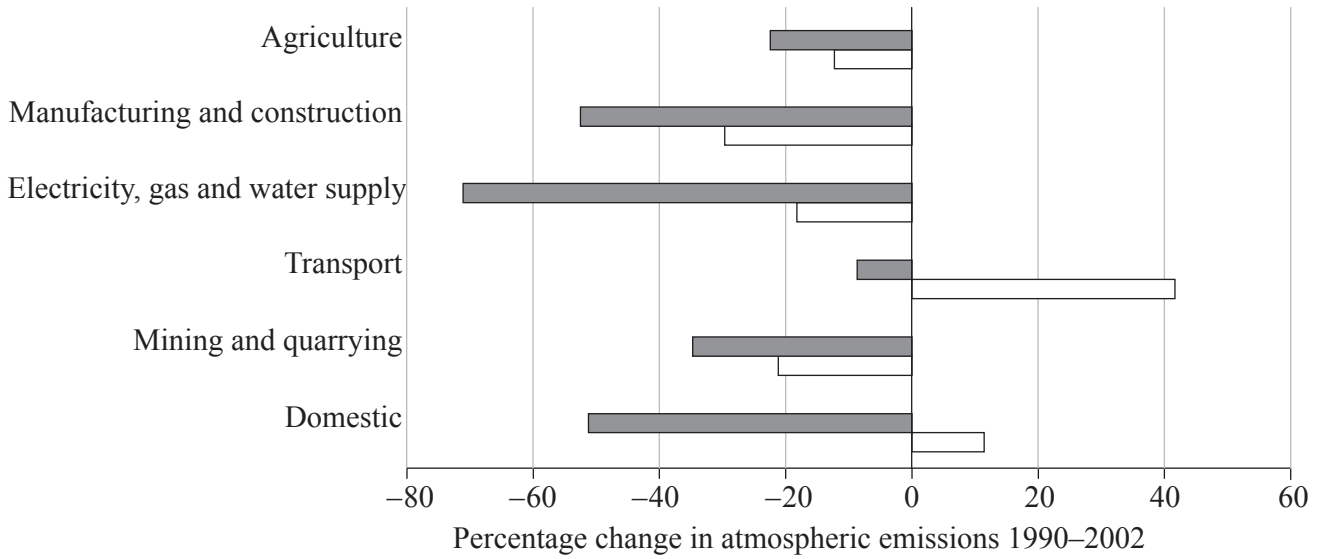
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4. The diagram below shows changes in atmospheric emissions from a variety of human activities in the United Kingdom between 1990 and 2002.



Key: ■ Gases causing acid rain □ Greenhouse gases

[Source: modified from ONS www.statistics.gov.uk/environmentalaccounts]

(a) State the greenhouse gas that has increased to the greatest extent in the atmospheric emissions over this period. [1]

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(b) According to these data, compare the relative success in the reduction of acid rain emissions with the reduction of greenhouse gases, and suggest a reason for this difference. [2]

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(c) With reference to **named** activities shown in the chart, suggest **two** different strategies that might have led to a reduction in acid rain emissions. [2]

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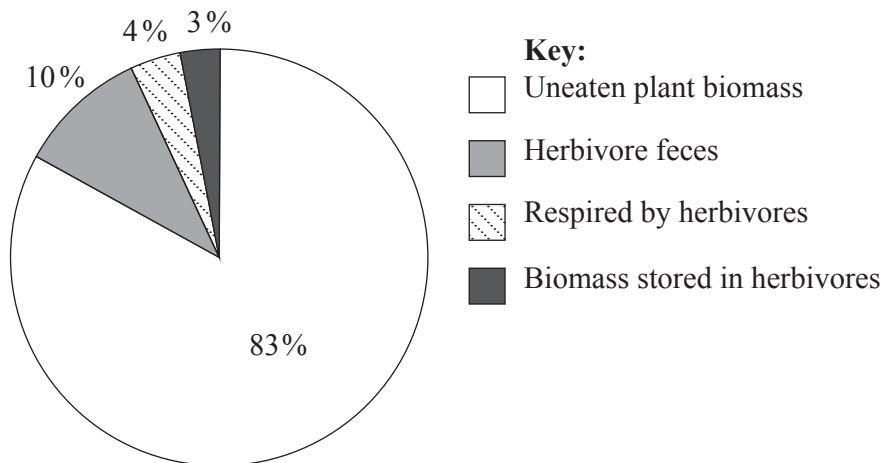
**SECTION B**

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 pie chart below shows what happens to the total biomass of a plant population as part of it is consumed by herbivores.



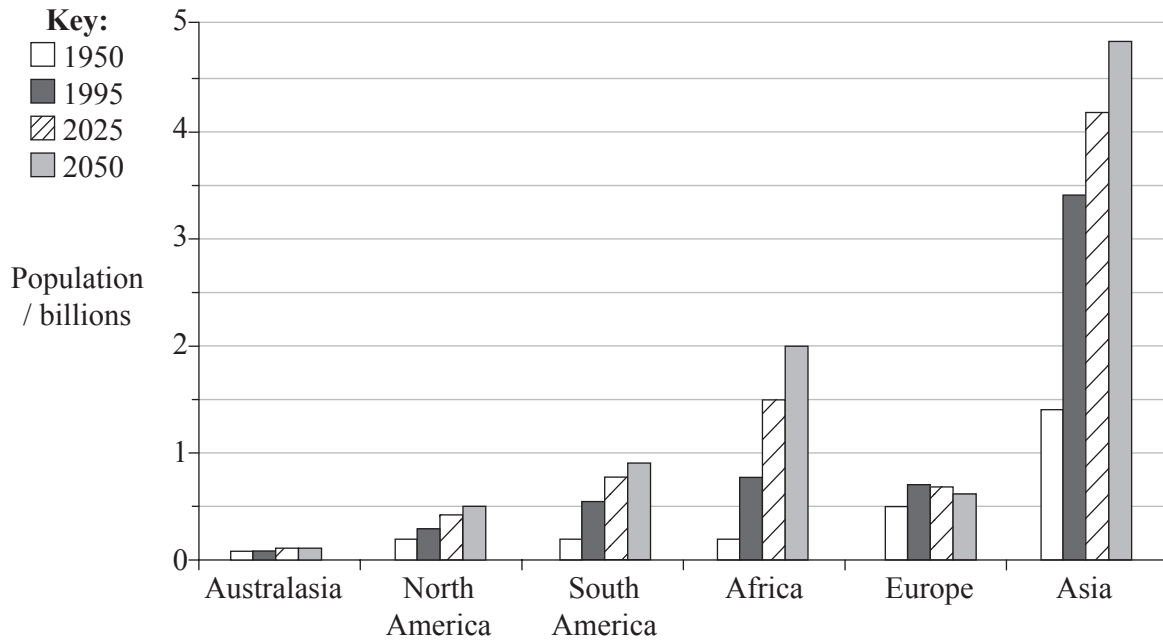
- (a) Use these data to draw a flow diagram showing the flow of energy between the **two** trophic levels. Label all flows, indicating their values. [7]
- (b) With reference to the herbivore population, and using these data as examples, explain what is meant by the terms *gross productivity* and *sustainable yield*. [4]
- (c) Describe those mechanisms that may lead to stability in this interaction between plant and herbivore populations, using sketch graphs or diagrams where appropriate. [6]

Expression of ideas [3]





6. The bar chart below represents the changing distribution of the human population by continent as it has occurred, and is predicted to occur, between 1950 and 2050.



[Source: Modified from M Raw, (2000), *AS/A-level Geography*, Philip Allan]

- (a) Describe the use of models and statistical information that might have been used to make the predictions shown in this chart. [6]
- (b) Calculate the percentage increase predicted for the world population between 1950 and 2050. Show your calculations. [3]
- (c) Discuss the influences that might be responsible for the predicted difference in growth rates that can be seen between Europe and Asia over this period. [8]

*Expression of ideas* [3]



7. The table below provides data relating to the productivity and biomass of two terrestrial and two marine ecosystem types.

Ecosystem type	Mean net primary productivity per unit area / $\text{g m}^{-2} \text{yr}^{-1}$	World net primary productivity / $10^9 \text{tyr}^{-1}$	World biomass / $10^9 \text{t}$
Tropical rainforest	2200	37.4	765
Desert	90	1.6	13
Open ocean	125	41.5	1
Upwelling zones	500	0.2	0.008

[Source: Modified from J Tivy, (1993), *Biogeography – a study of plants in the ecosphere*, Longman]

- (a) With reference to these data, compare the contribution of each ecosystem to global natural capital and natural income. [5]
- (b) Describe the major pattern of atmospheric circulation between 0° and 30° latitude and explain how this influences the mean net primary productivity of the **two** terrestrial ecosystems shown above. [6]
- (c) Explain how atmospheric and oceanic currents give rise to the higher productivity in upwelling zones off the Peruvian coast, and how El Niño phenomena may affect this productivity. [6]

*Expression of ideas* [3]

