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

M03/460/S(2)

ENVIRONMENTAL SYSTEMS
STANDARD LEVEL
PAPER 2

Candidate number

Wednesday 7 May 2003 (afternoon)

1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

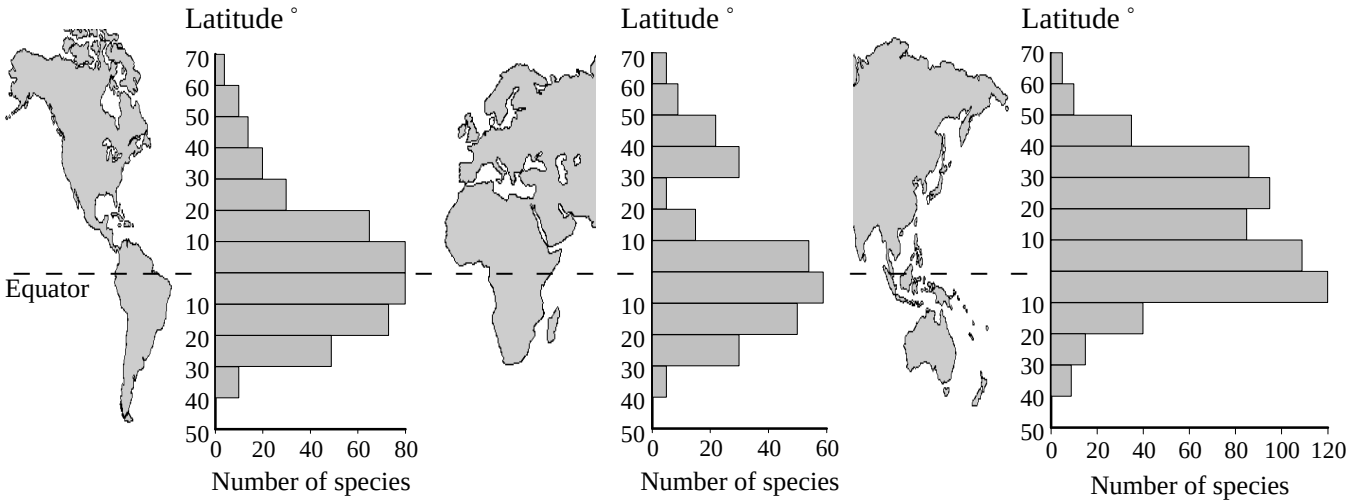
- Write your candidate number in the box above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your candidate number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the 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 shows the global distribution of various species of swallow tail butterfly in three regions of the world: the Americas, Europe and Africa, and East Asia and Australia.

In each case the histogram shows the number of species found plotted against latitude.



[Source: Adapted from Collins and Morris, 1985, *Threatened Swallow Tail Butterflies of the World*, IUCN Red Data Book]

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

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(b) Describe the distribution of swallow tail butterfly species shown in the figure above and suggest a reason for this distribution. *[3]*

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(This question continues on the following page)

(Question 1 continued)

(c) From the figure opposite determine

(i) between which latitudes the highest global number of species is found. *[1]*

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(ii) the range of the number of species in the Americas. *[1]*

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(d) For a **named** species in an ecosystem you have studied, state and explain how **one** biotic factor may have influenced that species' abundance. *[3]*

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2. The following table shows the human population ($\times 10^6$) of six countries for the years 1960 and 2000.

	Population ($\times 10^6$)	
	1960	**2000**
Australia	10	19
Brazil	72	172
China	650	1 273
Nigeria	42	126
United Kingdom	52	59
United States	181	285

[Source: Population Reference Bureau, www.prb.org]

(a) From the data above, determine

(i) in which country the population has increased by the greatest number. *[1]*

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(ii) the **percentage** of population growth in Nigeria. *[1]*

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(b) Outline factors that have affected human population growth in **either** Nigeria **or** China. *[3]*

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(Question 2 continued)

(c) (i) Define the term *sustainability*. *[1]*

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(ii) State **two** factors that may affect the human carrying capacity of a country. *[2]*

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(d) State whether the human population of a city is an open system, a closed system or an isolated system. Explain your answer. *[3]*

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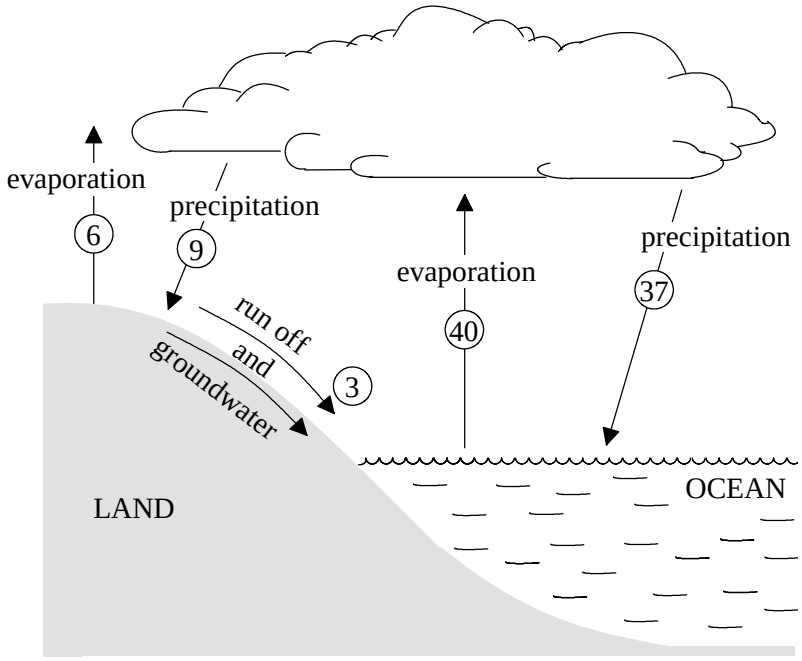
3. The diagram below shows the hydrological cycle. (All figures are in 10^{13} m^3 yr^{-1}.)



[Source: Adapted from Frank Press and Raymond Siever, (1978), *Earth*, Freeman and Company, page 140]

(a) (i) Construct a flow diagram to show the inputs and outputs of the ocean storage. *[2]*

(ii) Calculate the total annual volume of water output from the land surface. *[1]*

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(Question 3 continued)

(b) State and explain how a **named** human activity affects the hydrological cycle. *[3]*

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(c) Recent estimates suggest that 7 % of the world's topsoil is lost each year.

(i) State **two** processes that may cause loss of soil. *[2]*

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(ii) State **two** measures that can be used to conserve soil. *[2]*

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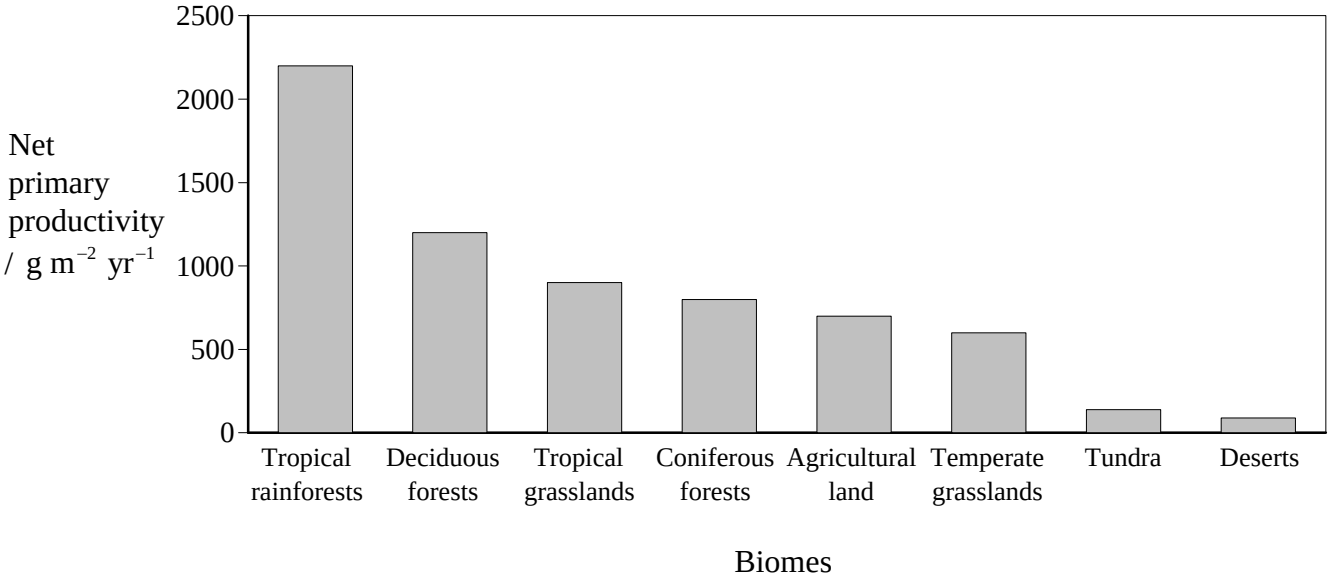
SECTION B

*Answer **one** question. Write your answers on the answer sheets provided. Write your candidate 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.

4. The graph below shows net primary productivity (NPP) of eight major biomes.



[Source: Adapted from D Waugh, *Geography An Integrated Approach*, 1990, Thomas Nelson & Sons, Ltd.]

(a) (i) Compare, and give reasons for, the differences in net primary productivity between any **two** biomes named in the graph. *[4]*

(ii) State **two** of the main factors which influence productivity. *[2]*

(b) Explain, with the aid of a diagram, the transfers and transformations of energy as it flows through an ecosystem. *[7]*

(c) Compare the structure and distribution of tropical rainforests and tundra. *[4]*

Expression of ideas *[3]*

5. The seaward boundary of a remote island ecosystem is defined as the high tide level. The island has no human inhabitants. It has vegetation of low forest. Colonies of seabirds breed on the island, obtaining their food from the surrounding ocean.

(a) Describe, with the aid of one or more diagrams, the inputs, outputs, flows and storages of matter and energy in this ecosystem. *[7]*

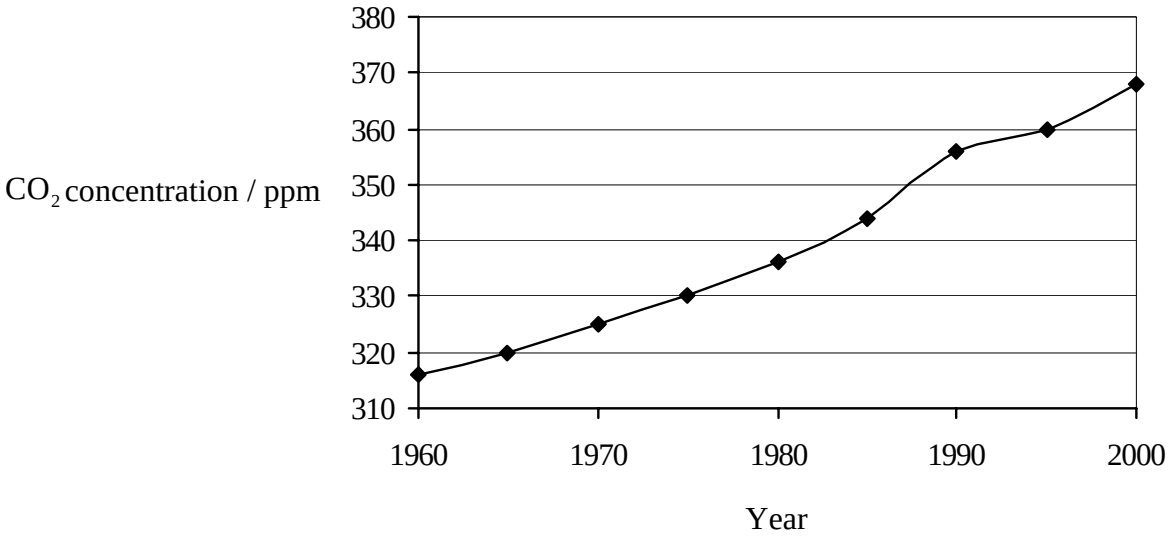
(b) Explain, with an example, how negative feedback might keep the number of seabirds breeding on the island approximately constant. *[4]*

(c) Suggest what changes might occur in the island ecosystem if

- a species of large ground-living herbivore *(e.g.* goat) were to be introduced to the island.
- a predator (*e.g.* feral cat) were to be introduced to the island. *[6]*

Expression of ideas *[3]*

6. The graph below shows the mean concentrations of CO_2 in the atmosphere between 1960 and 2000.



[Source: Adapted from G T Miller, *Environmental Science*, Brooks/Cole, 2001]

(a) Describe and explain these data. *[6]*

(b) Discuss the effect that increases in CO_2 levels might have on the environment. *[6]*

(c) Outline ways by which emissions of CO_2 may be reduced. *[5]*

Expression of ideas *[3]*