

**INTERNATIONAL BACCALAUREATE****ENVIRONMENTAL SYSTEMS**

Subsidiary Level

Monday 13 May 1996 (afternoon)

Paper 1

1 hour 30 minutes

This examination paper consists of 4 compulsory questions.

The maximum mark for each question is 10.

The maximum mark for this paper is 40.

This examination paper consists of 6 pages.

INSTRUCTIONS TO CANDIDATES

DO NOT open this examination paper until instructed to do so.

Answer ALL questions.

EXAMINATION MATERIALS

Required/Essential:

Millimetre square graph paper

Allowed/Optional:

Electronic calculator (neither programmable nor graphic display calculators are allowed)

A simple translating dictionary for candidates not working in their own language

1. The dogwhelk (*Nucella lapilus*) is a mollusc found on rocky shores in the Northern Atlantic. It is a carnivore feeding on other molluscs and barnacles which live on the shore. In recent years it has been observed that female adult dogwhelks are becoming sterile in waters that have been polluted with a paint that contains tin. This paint, called TBT, is used to keep the hulls of boats clean.

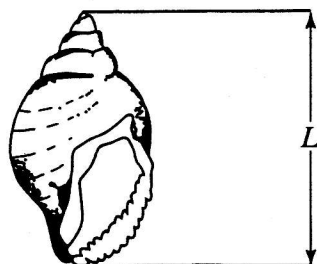


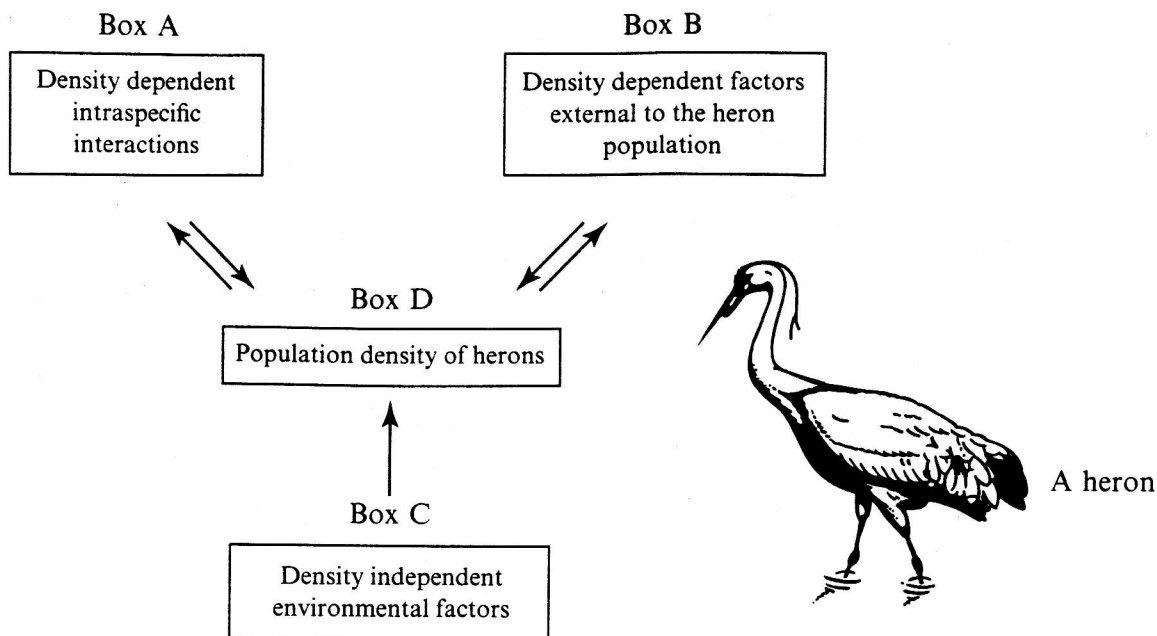
Diagram of shell of *Nucella lapilus* showing how length of shell (L) is measured.

A group of students collected the following data on dogwhelks when sampling their local rocky shore. The shore had been exposed to pollution from TBT from a nearby harbour.

Shell length L (mm)	Frequency (No. of dogwhelks)
0–10	49
11–15	58
16–20	156
21–25	187
26–30	60
31–35	22
36–40	4

- (a) Plot the above data in a suitable form on the graph paper provided. [3 marks]
- (b) Why was shell length measured in this survey? [1 mark]
- (c) Give two possible explanations for the small number of dogwhelks collected with a shell length of 0–10 mm. [2 marks]
- (d) Suggest why so few large dogwhelks (over 36 mm) were observed. [2 marks]
- (e) If TBT affects dogwhelks, why do you think they were the first organisms to show the harmful effect of this paint? [2 marks]

2. Herons (*Ardea cinerea*) are large, wading birds which live in colonies by shallow fresh water. Their main source of food is fish. In Britain, the number of birds in a breeding population of herons was found to be constant from year to year but, after a particularly hard winter, the number of herons decreased. In the years following, the heron population gradually increased to its former level. The diagram below shows some of the relationships between population density and the factors and interactions affecting it.



- (a) Suggest a reason why the heron population fell after a hard winter. [1 mark]
- (b) For density dependent intraspecific interactions (Box A),
- define the term;
 - give one example of this type of interaction;
 - using your example, explain the relationship between the interaction and the population density of herons. [3 marks]
- (c) For density dependent external factors (Box B),
- define the term;
 - give one example of this type of factor;
 - using your example, explain the relationship between the factor and the population density of herons. [3 marks]
- (d) For density independent environmental factors (Box C),
- define the term;
 - give one example of this type of factor;
 - using your example, explain the relationship between the factor and the population density of herons. [3 marks]

3. The diagrams below show the nitrogen budgets over a cultivation cycle for
- a typical saltwater fish farm with salmon, and
 - a mussel long line rearing farm.

Adult salmon eat squid and small fish when not in captivity. In fish farms, salmon are kept in cages suspended under the surface of the water and fed pellets. The composition of fish food pellets is shown below in Table 1.

In long line rearing farms, mussel cultures are suspended on lines beneath rafts in the sea. Mussels are filter feeders, taking microscopic organisms from the seawater.

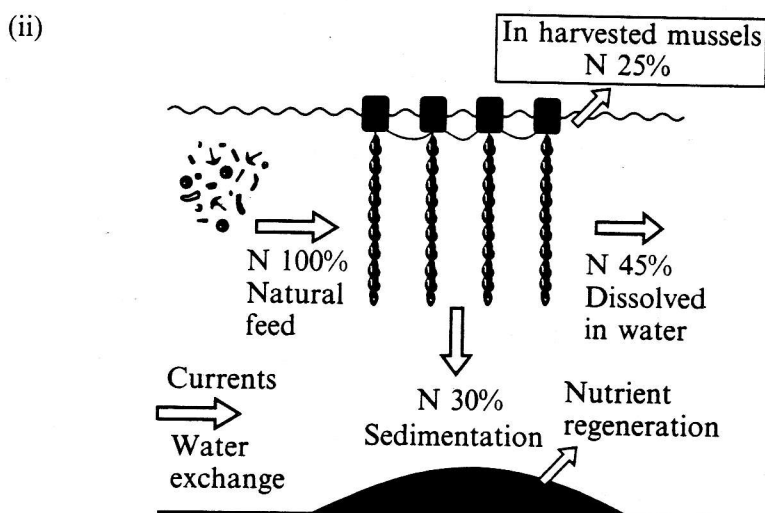
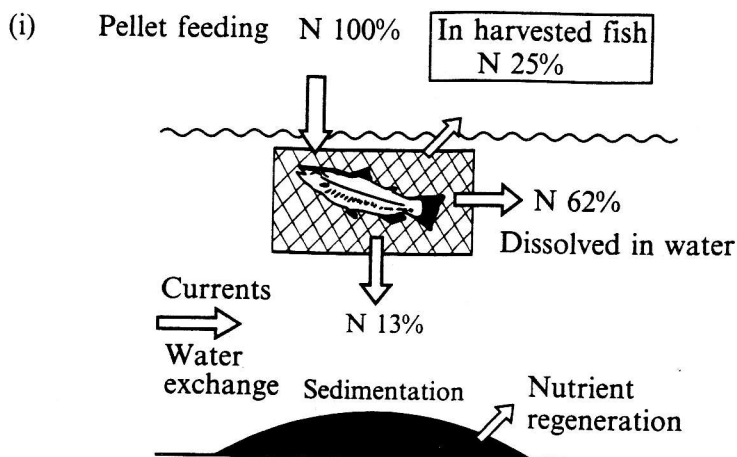
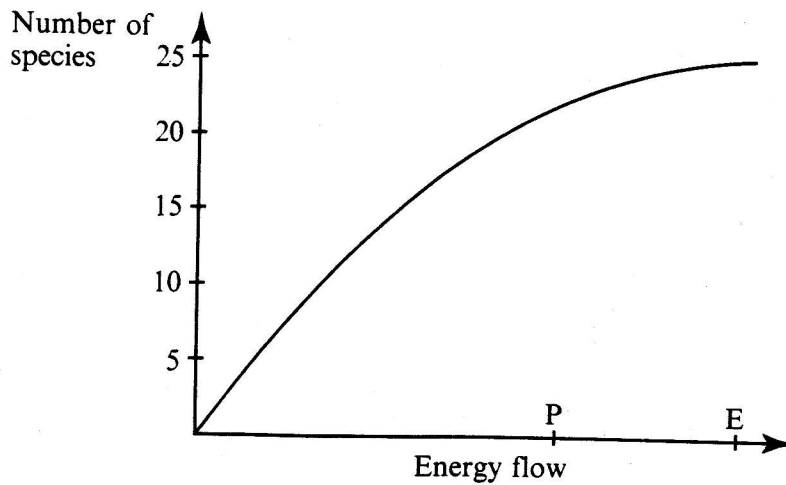


Table 1

Constituent of fish food	Percentage
fish meal	25
dried milk	5
meat and bone meal	15
wheatmeal	30
minerals, vitamins, salt	25

- M20/400/3(1)
- (a) State the main differences between the nutrient budgets of the two farms. [3 marks]
- (b) What is meant by nutrient regeneration? [1 mark]
- (c) Write quantitative equations showing clearly all the inputs and outputs of nitrogen for each farm. [2 marks]
- (d) Compare the economic and environmental costs and benefits, considering only inputs and outputs, of the two farms. [4 marks]

4. A model representing the relationship between total number of species and energy flow through an ecosystem produces the following graph:



E = Energy flow through ecosystem if there were no human impact.

P = Present day energy flow following impact of human activity.

- (a) Explain briefly how energy enters an ecosystem and what is meant by energy flow through the ecosystem. [4 marks]
- (b) Using the graph of the model above, estimate the approximate percentage reduction in number of species predicted as a result of human activity. [1 mark]
- (c) Explain how a reduction in the energy flow through a system may lead to the extinction of some species. [2 marks]
- (d) With brief explanations, give **three** examples of different human activities that may either divert energy from, or prevent energy flow through, natural ecosystems. [3 marks]