BIOLOGY   2805/03

Environmental Biology

| Friday | **23 JUNE 2006** | Afternoon | 1 hour 30 minutes |

Candidates answer on the question paper.
Additional materials:
    Electronic calculator
    Ruler (cm/mm)

Candidate Name		Centre Number	Candidate Number

TIME   1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read each question carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	10	
2	18	
3	17	
4	16	
5	16	
6	13	
TOTAL	90	

This question paper consists of 20 printed pages and an insert.

Registered Charity Number: 1066969   **[Turn over**

Answer **all** the questions.

1 The common limpet, *Patella vulgata*, a type of mollusc, is found on all rocky shores around the UK. It can also be found attached to wharves and groynes in sandy areas.

A group of students carried out an investigation into the shape of common limpets on two different shores. One shore was exposed to wave action, the other was sheltered from the waves. Ten limpets were randomly sampled in each area. The students measured the length and height of the limpets as shown in Fig. 1.1. They then calculated the length to height ratio for each limpet in the sample. This was carried out on both shores. The results of this investigation are shown in Table 1.1.
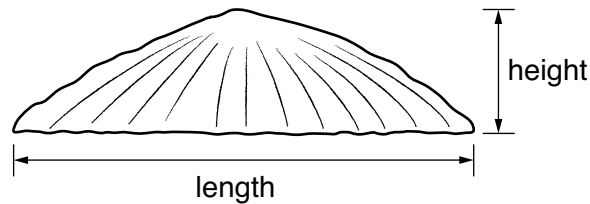
Fig. 1.1

Table 1.1

length: height ratio	
sheltered shore (X)	exposed shore (Y)
1.85	1.58
2.02	1.42
2.84	1.65
2.41	1.63
2.04	1.42
1.78	1.68
1.59	1.35
1.90	1.40
1.86	1.52
2.12	1.46

	sheltered shore (X)	exposed shore (Y)
sample number (*n*)	10	10
mean length : height ratio	2.04	1.51
standard deviation (*s*)	0.364	0.118

(a) Suggest **three** factors, **other than exposure to wave action**, which may influence the shape of the limpets on the two shores.

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(b) Describe how the random sampling of the limpets may have been carried out.

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[Turn over

(c) The *t*-test can be carried out to see whether the means of the two sets of data differ significantly, using the formula below.

$$t = \frac{\bar{x} - \bar{y}}{\sqrt{\dfrac{(s_x)^2}{n_x} + \dfrac{(s_y)^2}{n_y}}}$$

where: $\bar{x}$ equals the mean of sample X (sheltered shore)

$\bar{y}$ equals the mean of sample Y (exposed shore)

s_x is the standard deviation of sample X

s_y is the standard deviation of sample Y

n_x is the number of individual measurements in sample X

n_y is the number of individual measurements in sample Y

The students calculated the value of *t* as 4.38.

Table 1.2 shows critical *t* values at different levels of significance and degrees of freedom.

Table 1.2

		level of significance (*p*)				
		0.10	0.05	0.02	0.01	0.001
degrees of freedom	16	1.74	2.12	2.58	2.92	4.01
	17	1.74	2.11	2.56	2.89	3.96
	18	1.73	2.10	2.55	2.87	3.92
	19	1.72	2.09	2.53	2.86	3.88
	20	1.72	2.08	2.52	2.84	3.85

The null hypothesis for this investigation was:

'There is no significant difference between the length : height ratios of the limpets on the two shores.'

(i) Using the calculated value of t and Table 1.2, state whether you **accept** or **reject** the null hypothesis.

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(ii) Explain how you reached your conclusion.

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[Total: 10]

[Turn over

2 (a) Minamata is a fishing town in Japan. In the early 20th century, a large industrial company, the Chisso Corporation, built a factory near the town. The main products from the factory were fertilisers and plastics. Between 1932 and 1968, the corporation dumped an estimated 27 tonnes of mercury-containing products, such as methylmercury chloride, into Minamata Bay. In the 1950s, people in Minamata noticed that some of them were developing strange symptoms, such as numbness in the limbs, slurred speech and restricted vision. People showing these symptoms were diagnosed as having a degeneration of their nervous systems. Some people had serious brain damage, while others lapsed into unconsciousness or suffered from involuntary movements.

Fig. 2.1 shows the results of a study of mercury concentrations in fish populations in a food chain within the bay.

rudder fish $\longrightarrow$ spotted sardine $\longrightarrow$ wrasse $\longrightarrow$ Japanese sea perch $\longrightarrow$ scorpion fish

    0.1   0.2   0.3   0.4   0.5
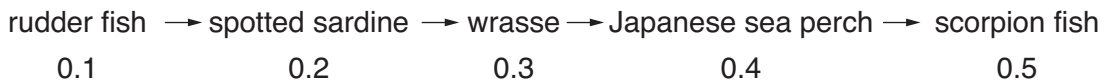
The figures represent concentrations of mercury in mg kg^{-1}.

Fig. 2.1

(i) With reference to Fig. 2.1, describe the changes in concentration of mercury within the food chain.

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(ii) Explain how the changes in mercury concentration have come about in this food chain.

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The use of pesticides has increased considerably since 1945 partly due to the intensification of agriculture.

(b) Outline the different ways in which pesticides may harm the environment.

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[Turn over

(c) In this question, one mark is available for the quality of spelling, punctuation and grammar.

One of the alternatives to the increased use of pesticides is to employ biological pest control. An example of biological pest control is the use of nematode worms to control wax moth larvae. The effectiveness of this can be determined by measuring the percentage survival of the wax moth larvae. The data resulting from such an application are given in Fig. 2.2.

A graph has been removed due to third party copyright restrictions

Details: A graph showing the percentage survival of the wax moth larvae after nematode application

With reference to Fig. 2.2, describe the advantages **and** disadvantages of using biological pest control.

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Quality of Written Communication [1]

[Total: 18]

[Turn over

3   Fig. 3.1 shows some of the stages that have occurred during succession at Glacier Bay in
     Alaska.

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Details: An image showing bare ground, then colonisers, then early succession, then mid
succession and then late succession

Fig. 3.1

(a)   Using the information in Fig. 3.1,

(i)   explain what is meant by the term   succession ;

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(ii)   outline two changes which occur between mid and late succession;

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(iii)   suggest one biotic and one abiotic change which are   not indicated in Fig. 3.1.

biotic ....

abiotic ....[2]

(b)   Fig. 3.2 shows the organic matter (humus) in agricultural top soils in England and Wales in 1980 and in 1995.

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Details: A chart showing the organic matter in agricultural top soils in England and Wales in 1980 and in 1995
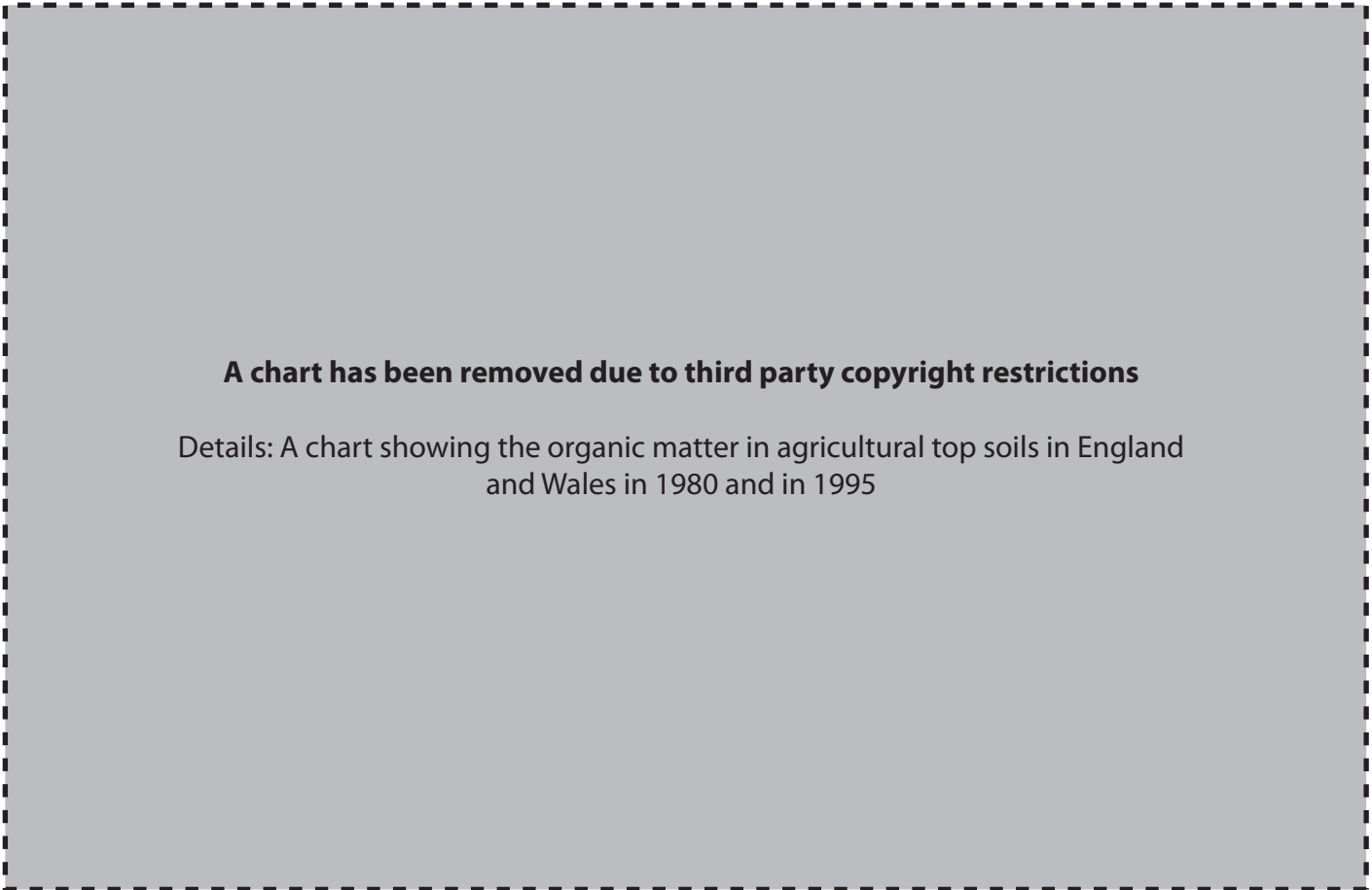
Fig. 3.2

(i)   Outline how the percentage of organic matter in a sample of   dry soil can be estimated.

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(ii)   With reference to Fig. 3.2, describe the changes in top soil composition between 1980 and 1995.

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[Turn over

Natural succession can be affected by agricultural practices. This results in a deflected succession and the creation of a plagioclimax.

(c) State **two** examples of a plagioclimax.

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2 ....[2]

(d) With reference to agricultural practices, explain the process of deflected succession and how a plagioclimax is maintained.

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[Total: 17]

4 The black rhinoceros, *Diceros bicornis*, is an endangered species whose numbers have fallen to approximately 3000 in the past thirty years. For this reason, the species was placed on Appendix I of the Convention on International Trade in Endangered Species (CITES) agreement. Since the black rhinoceros has been placed on the appendix, numbers have stabilised, or even increased, in several countries.

(a) (i) Explain the term *endangered species*.

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(ii) Suggest **two** reasons why the black rhinoceros is endangered.

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2 ....[2]

(b) State **two** ways in which the CITES agreement is helping to save endangered species, such as the black rhinoceros.

1 ....

2 ....[2]

As well as animals, many plant species are also in decline. In 1987, the UK Government created the category of Environmentally Sensitive Areas (ESAs) in England, to aid the protection of plant species and their habitats.

(c) Explain what is meant by an ESA.

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[Turn over

(d) In this question, one mark is available for the quality of use and organisation of scientific terms.

A continuing factor leading to the decline in animal and plant populations is the removal of hedgerows from the British countryside.

Discuss the reasons why hedgerows are being removed **and** why they are of importance to wildlife.

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Quality of Written Communication [1]

[Total: 16]

5 The Canadian Food Inspection Agency (CFIA), regularly monitors fish populations for a variety of contaminants, including polychlorinated biphenyls (PCBs). The World Health Organisation (WHO) has set an international guideline for the maximum concentration of PCBs in fish at 2 mg kg^{-1}.

(a) State **two** sources of PCBs.

1 ....

2 ....[2]

(b) PCBs have been demonstrated to cause a variety of adverse health effects, including cancer.

(i) Explain how substances, such as PCBs, can act as carcinogens.

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(ii) Describe **and** explain **two** possible effects that PCBs can have on vertebrates.

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[Turn over

(c) The great blue heron, *Ardea herodias*, feeds in wetlands and on coasts across the United States and southern Canada. It is a top predator feeding on a varied diet of small fish, frogs, salamanders, lizards, snakes, crawfish, small birds, rodents and insects. The University of British Columbia monitored the concentration of PCBs in the eggs of great blue herons from 1977 to 2000. The results are shown in Fig. 5.1 on the insert.

Comment on the data shown in Fig. 5.1.

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(d) Due to increased demand for fish as a human food source, the numbers of fish have been gradually decreasing. This is putting pressure on top predators such as seals and fish-eating birds, such as the great blue heron.

State **two** ways in which fish stocks can be managed so there are sufficient quantities for both humans and top predators.

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2 ....

....[2]

[Total: 16]

6

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Details: An extract from an article by Urquhart, Chomentowski, Skole and Barber in
The Earth Observatory, NASA in 2001 about deforestation
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(a)   State three reasons for the decline in rain forest.

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2 ....

3 ....[3]

Question 6 continues on page 18

(b) Launched in 1995, the Central African Regional Program for the Environment (CARPE) is a long-term initiative designed to address the issues of deforestation and loss of biodiversity in the Congo Basin forest zone in central Africa. Nine countries are involved with the initiative. Fig. 6.1 shows the relationship between annual deforestation rates and annual population growth for six of these countries.
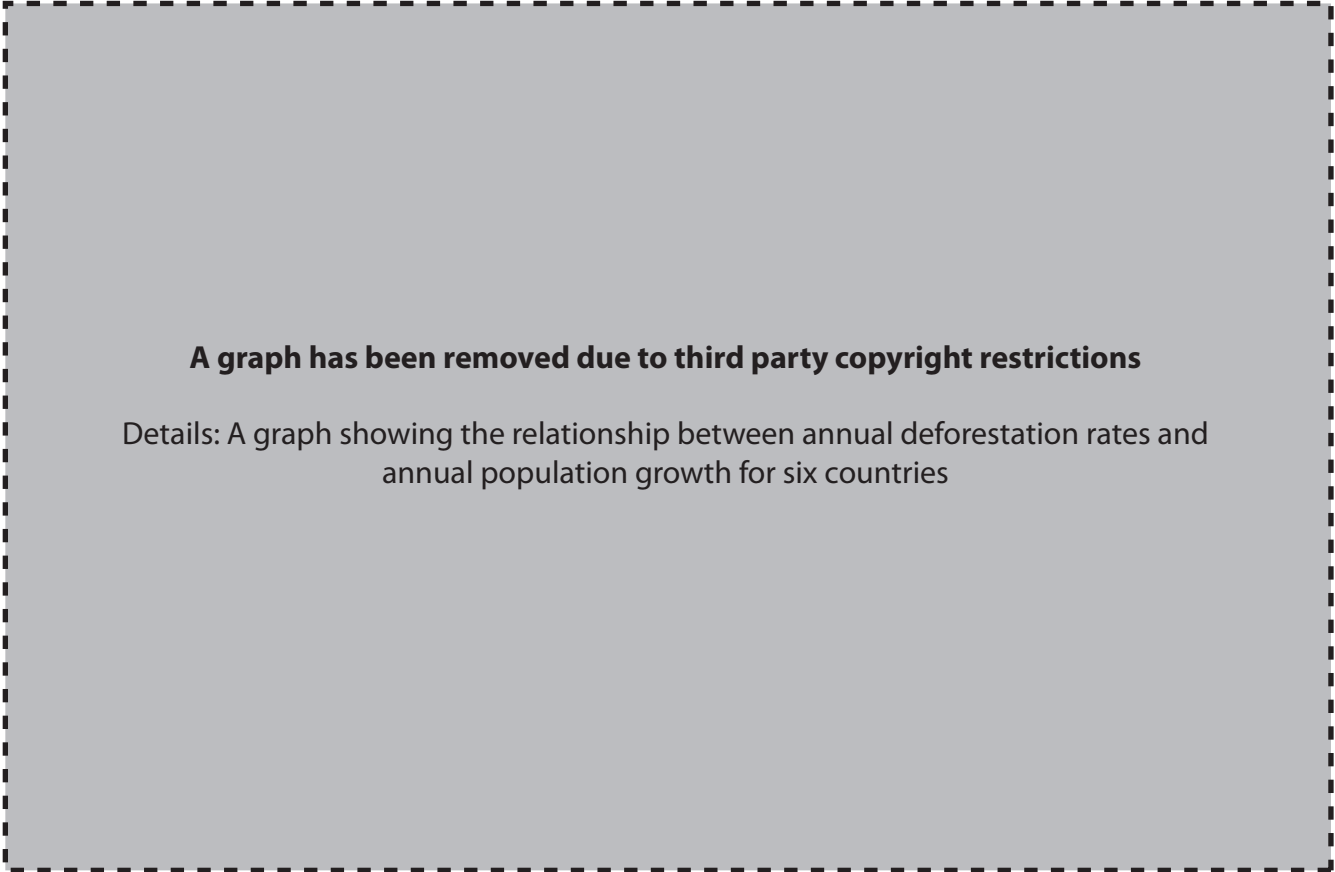
A graph has been removed due to third party copyright restrictions

Details: A graph showing the relationship between annual deforestation rates and annual population growth for six countries

Fig. 6.1

Describe the relationship shown in Fig. 6.1.

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(c) Over half of the species of plants and animals comprising the biodiversity of the Earth are thought to exist in tropical rain forests.

What are the economic and ethical reasons for maintaining biodiversity?

economic reasons

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ethical reasons

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(d) One method to reduce the rate of deforestation is to recycle goods, such as waste paper.

State **two** further benefits of increasing the amount of waste recycled.

1 ....

2 ....[2]

[Total: 13]

END OF QUESTION PAPER