INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

M99/410/H(2)

BIOLOGY

Higher Level

Tuesday 11 May 1999 (afternoon)

Paper 2 — 2 hours 15 minutes

A

Candidate name:	Candidate category & number:

This examination paper consists of 2 sections, Section A and Section B.
The maximum mark for Section A is 32.
The maximum mark for Section B is 40.
The maximum mark for this paper is 72.

INSTRUCTIONS TO CANDIDATES

Write your candidate name and 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 TWO question from Section B. You may use the lined pages at the end of this paper or attach extra sheets of paper with your candidate number clearly marked at the top.

At the end of the examination, complete box B below with the number of each question answered in Section B.

B

QUESTIONS ANSWERED	
A/ ALL	
B/	
B/	
Number of extra sheets attached	

C

EXAMINER	TEAM LEADER
/32	/32
/20	/20
/20	/20
TOTAL /72	TOTAL /72

D

IBCA
/32
/20
/20
TOTAL /72

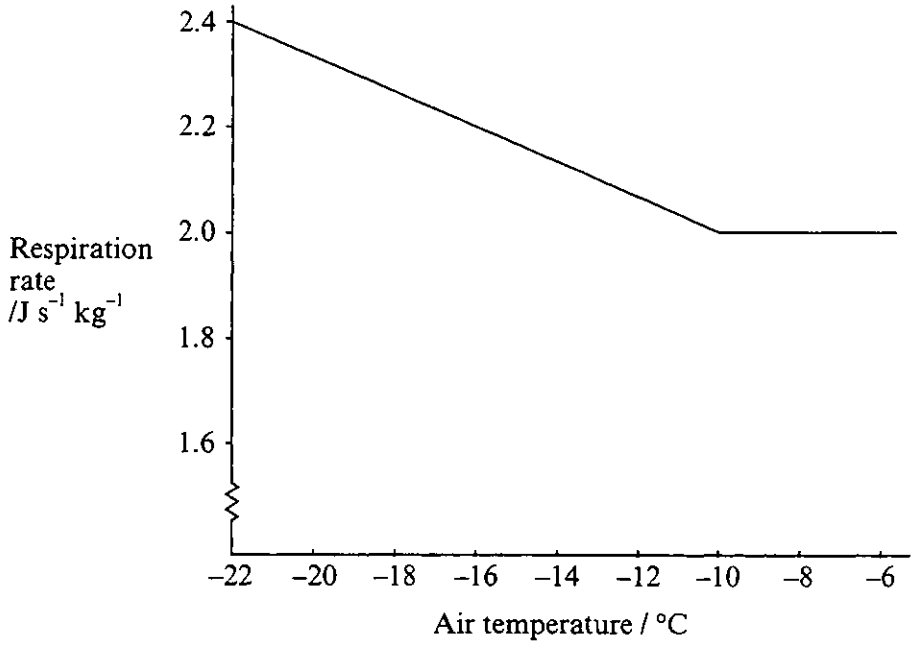
EXAMINATION MATERIALS

Required:
None

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

SECTION A

1. Emperor penguins *(Atenodytes forsteri)* are the only birds to live and breed through the severe Antarctic winter. In order to investigate how they survive at very low temperatures, the respiration rates of birds placed in a controlled temperature chamber were measured. The results are shown in the graph below.



(a) (i) Using only the data in the graph, outline the effect of air temperature on the rate of respiration in emperor penguins. *[2]*

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. . . . . .

. . . . . .

(ii) Suggest reasons for the effect of temperature on respiration rate. *[2]*

. . . . . .

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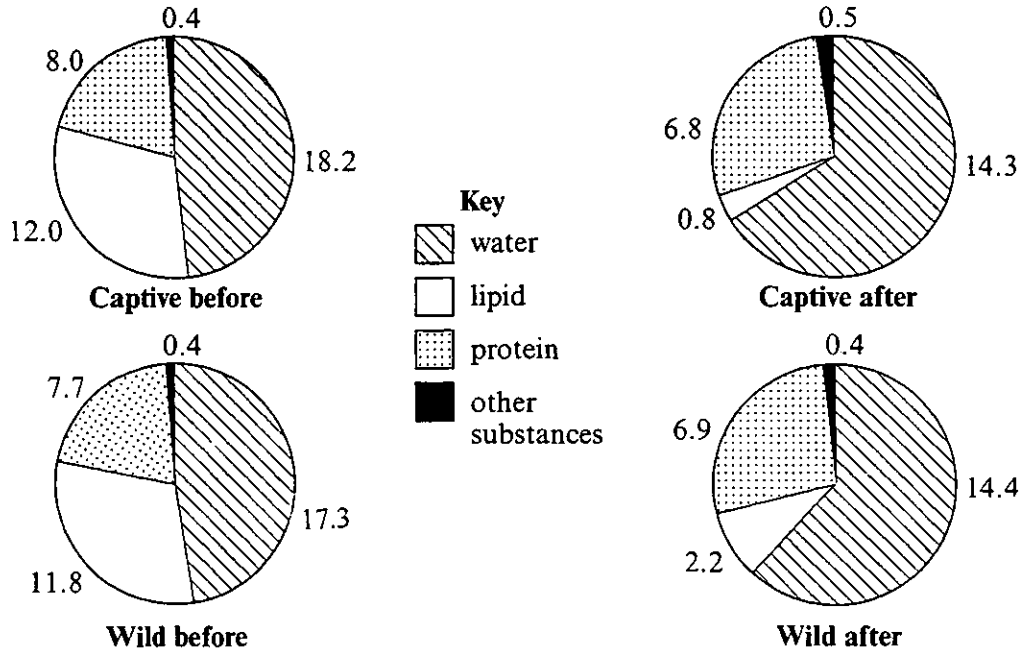
(This question continues on the following page)

(Question 1 continued)

During the Antarctic winter female emperor penguins live and feed in the sea, but males have to stay on the ice to incubate the single egg that the female has laid. Throughout this time the males eat no food. After 16 weeks the eggs hatch and the females return. While the males are incubating the eggs they stand in tightly packed groups of about 3000 birds.

To investigate the reasons for standing in groups, ten male birds were taken from a colony at Pointe Geologie in Antarctica. They had already survived 4 weeks without food. They were kept for 14 more weeks without food in fenced enclosures where they could not form groups. All other conditions were kept the same as in the wild colony. The mean air temperature was minus 16.4 °C (–16.4 °C). The composition of the captive and the wild birds' bodies was measured both before and after the 14 week period of the experiment. The results in **kilograms** are shown in the pie charts below.



(b) Calculate the total mass loss for each group of birds. *[2]*

Answers: captive birds .....

wild birds .....

(c) Compare the changes in lipid content of the captive birds with those of the birds living free in the colony. *[2]*

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(This question continues on the following page)

(Question 1 continued)

During the experiment, different processes caused both losses and gains of water in the birds. Metabolic water production was calculated from the amount of fat and other substrates oxidised. Water loss, mostly in exhaled breath, was measured by injecting labelled water and finding how quickly it disappeared from the body. Although the birds drank no water they ate some snow off the ground and this quantity was measured. The results are shown in the table below.

	metabolic water production / g day^{-1}	**water intake from eating snow** / g day^{-1}	**water loss** / g day^{-1}
captive birds	144.5	16.5	206.3
wild birds	109.5	12.4	151.6

[Source of data: Ancel *et al*, *Nature*, (1997) 385, pages 304-305]

(d) Explain the difference in water production between the captive and the wild birds. *[2]*

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(e) Suggest **one** reason for

(i) more water loss in captive birds than in the wild birds *[1]*

. . . . . .

(ii) more snow eaten by the captive birds than the wild birds. *[1]*

. . . . . .

(f) Using the information given in this question, explain the importance of forming large, tightly packed groups of male emperor penguins in Antarctica. *[3]*

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2. (a) State **one** disease caused by bacteria and **one** disease caused by viruses. *[2]*

bacteria: .....

viruses: .....

(b) State **two** examples of groups of organisms that can cause infectious diseases other than bacteria and viruses. *[2]*

1. .....

2. .....

(c) Outline the process of immunisation against bacterial or viral diseases. *[3]*

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3. In some plants two genes control flower colour. [Note: _ represents any allele]

Plants with the genotype A_ B_ have blue flowers.
Plants with the genotype A _bb have red flowers.
Plants with the genotype aa_ _ have white flowers.

(a) State the name given to the type of inheritance where more than one gene controls a single phenotypic characteristic. *[1]*

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A homozygous blue flowered plant (AABB) is crossed with a homozygous white flowered plant (aabb).

(b) State the genotype and phenotype of the F_1 offspring. *[2]*

genotype ..... phenotype .....

(c) The F_1 plants are allowed to pollinate each other. Deduce, using the Punnett grid below, the genotypes of the gametes produced by the F_1 plants, and the genotypes and phenotypes of all the possible F_2 offspring. *[5]*

gametes → ↓				

(d) State the expected ratio of flower colours in the F_2 offspring. *[1]*

.....

(e) The two genes code for enzymes used to convert a white substance into a red pigment and the red pigment into a blue pigment. Deduce the effect of the enzymes produced from: *[1]*

gene A .....

gene B .....

SECTION B

*Answer TWO questions. Up to **two** additional marks are available for the quality of construction of each of your answers. You may use the lined pages at the end of this paper or attach extra sheets of paper with your candidate number clearly marked at the top.*

4. (a) Describe how replicated DNA molecules are separated to form two genetically identical nuclei during mitosis in animal cells. *[8]*

(b) Explain the relationships between tissues, organs and organ systems in multicellular organisms such as humans. *[5]*

(c) Discuss whether the light microscope or the electron microscope is more useful for studying cells, tissues and organs. *[5]*

5. (a) Outline the light-independent reactions of photosynthesis in C_3 plants. *[8]*

(b) Explain why the light-independent reactions of photosynthesis in C_3 plants can only continue for a short time in darkness. *[6]*

(c) Compare the role of carbon dioxide, oxygen, light and heat in photosynthesis with their effects on seed germination. *[4]*

6. (a) Outline how enzymes in the cytoplasm of cells are produced. *[8]*

(b) Compare the induced fit model of enzyme activity with the lock and key model. *[4]*

(c) Explain, using **one** named example, the effect of a competitive inhibitor on enzyme activity. *[6]*

7. (a) Describe the processes involved in spermatogenesis. *[8]*

(b) Explain the hormonal control of puberty in boys. *[5]*

(c) Discuss the ethical issues of contraception. *[5]*