INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

BIOLOGY
STANDARD LEVEL
PAPER 3

Friday 12 May 2000 (morning)

1 hour 15 minutes

Name

Number

INSTRUCTIONS TO CANDIDATES

- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from three of the Options in the spaces provided. You may continue your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the boxes below.

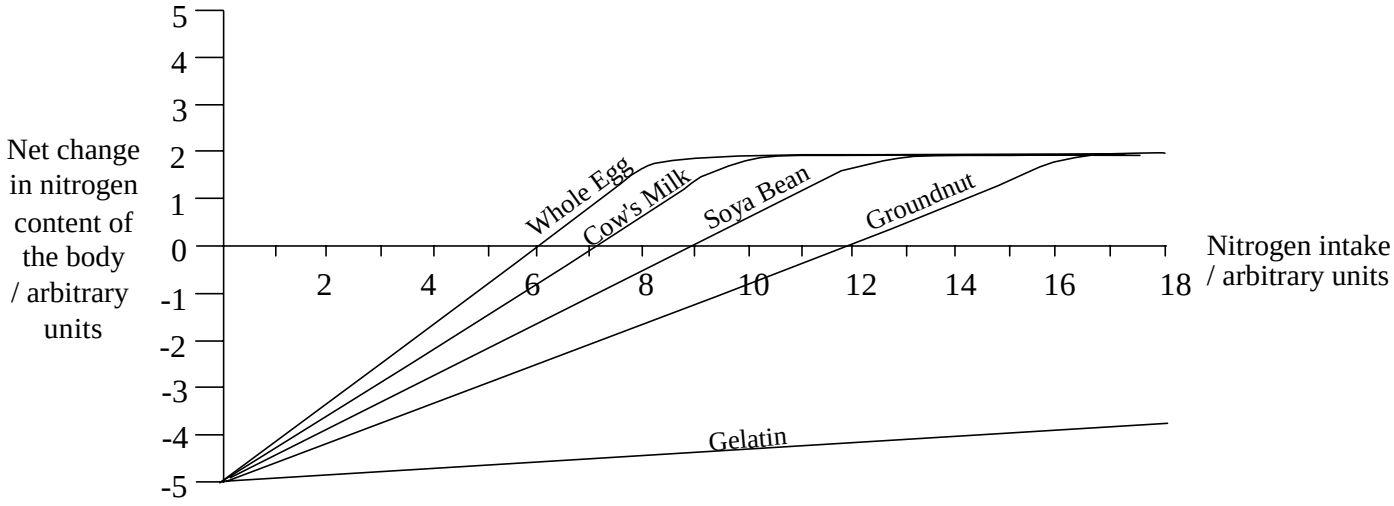
OPTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
		/15	/15	/15
		/15	/15	/15
		/15	/15	/15
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /45	TOTAL /45	TOTAL /45

10Option A — Diet and Human Nutrition

Al. Proteins contain the element nitrogen. When a person is in nitrogen balance they are taking in as much nitrogen in protein as they are losing in nitrogen compounds in urine, sweat and faeces. Adult volunteers in an experiment were given a protein-free diet for one week. During this period they started to break down body tissues to obtain a supply of amino acids. Some of these amino acids were deaminated and the nitrogen excreted as urea.

Each volunteer was then given a diet containing pure protein from one food source. The nitrogen intake and loss from the body was monitored.

The graph below shows the net change in nitrogen content of the body at different levels of protein intake for each food source. The scales are the same for both axes and are in arbitrary units.



(Source: Taylor, T G (1978), *Principles of Human Nutrition*, Ed Arnold)

(a) State how many units of groundnut are required to achieve nitrogen balance. *[1]*

. . . . . .

(b) (i) Identify the protein source that can be used: *[1]*

most efficiently . . . . . .

least efficiently . . . . . .

(ii) Suggest reasons for the differences in efficiency. *[2]*

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question A1 continued)

(c) Suggest why, at higher levels of protein intake, a maximum net increase of protein is reached. *[2]*

. . . . . .

. . . . . .

. . . . . .

A2. (a) State the function in the human diet of *[3]*

(i) potassium; . . . . . .

. . . . . .

(ii) retinol; . . . . . .

. . . . . .

(iii) fibre. . . . . .

. . . . . .

(b) Outline **one** named example of a deficiency disease. *[2]*

. . . . . .

. . . . . .

. . . . . .

A3. Explain how malnutrition can be caused by economic and social conditions. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Option B — Physiology of Exercise

B1. When a person runs, each foot exerts a downward force on the ground as it lands and pushes off from it. These forces (in Newtons) are shown on the diagram below, for an athlete on a training run at a speed of 3.5 m s^{-1}.

(Source: McNeill Alexander, R (1975), *Biomechanics*, John Wiley and Sons)

(a) Identify the maximum downward force. *[1]*

. . . . . .

(b) Suggest why the force is zero between about 0.23 and 0.35 seconds. *[1]*

. . . . . .

. . . . . .

(c) Calculate the time taken for ten strides. (One stride is one step.) *[1]*

. . . . . .

(d) The coach suggests that the athlete should increase the frequency of strides in order to go faster. Predict the effect of this change by sketching a new line on the graph above. *[2]*

(e) With reference to the data in the graph, suggest **one** injury that may be caused by training runs. *[1]*

. . . . . .

. . . . . .

B2. (a) If a muscle uses ATP to provide energy for contraction, but no more is produced, the ATP supplies of the muscle will run out. Estimate how long this will take. *[1]*

. . . . . .

. . . . . .

(b) Outline the role of myoglobin in muscles. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) Outline how an oxygen debt is repaid. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

B3. Explain the role of inhibitory neurones in co-ordinating the activity of antagonistic muscles at a joint. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Option C — Cells and Energy

C1. Many organisms can photosynthesise including algae and certain bacteria. The graphs below show the absorption spectra of three of these organisms.

(Source: Stanier R, Doudoroff M, Adelberg E, *General Microbiology* (1971), Macmillan)

(a) Identify which organism can absorb strongly at the longer wavelengths. *[1]*

. . . . . .

(b) (i) Compare the absorption spectrum of *Chlorella* with that of *Porphyridium*, by giving **one** similarity and **one** difference. *[2]*

Similarity . . . . . .

. . . . . .

Difference . . . . . .

. . . . . .

(ii) Using the data in the graphs, suggest **one** reason for the difference. *[1]*

. . . . . .

. . . . . .

(This question continues on the following page)

(Question C1 Continued)

(c) One of the chlorophylls in *Chlorobium* is the same as in *Chlorella* but the other one is different. Explain how the data in the spectrum indicates this fact. *[2]*

. . . . . .

. . . . . .

. . . . . .

C2. (a) State **three** functions of proteins, other than membrane proteins. *[3]*

. . . . . .

. . . . . .

. . . . . .

(b) Outline the difference between fibrous proteins and globular proteins. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

C3. Explain the relationship between the structure of the mitochondrion and its function. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

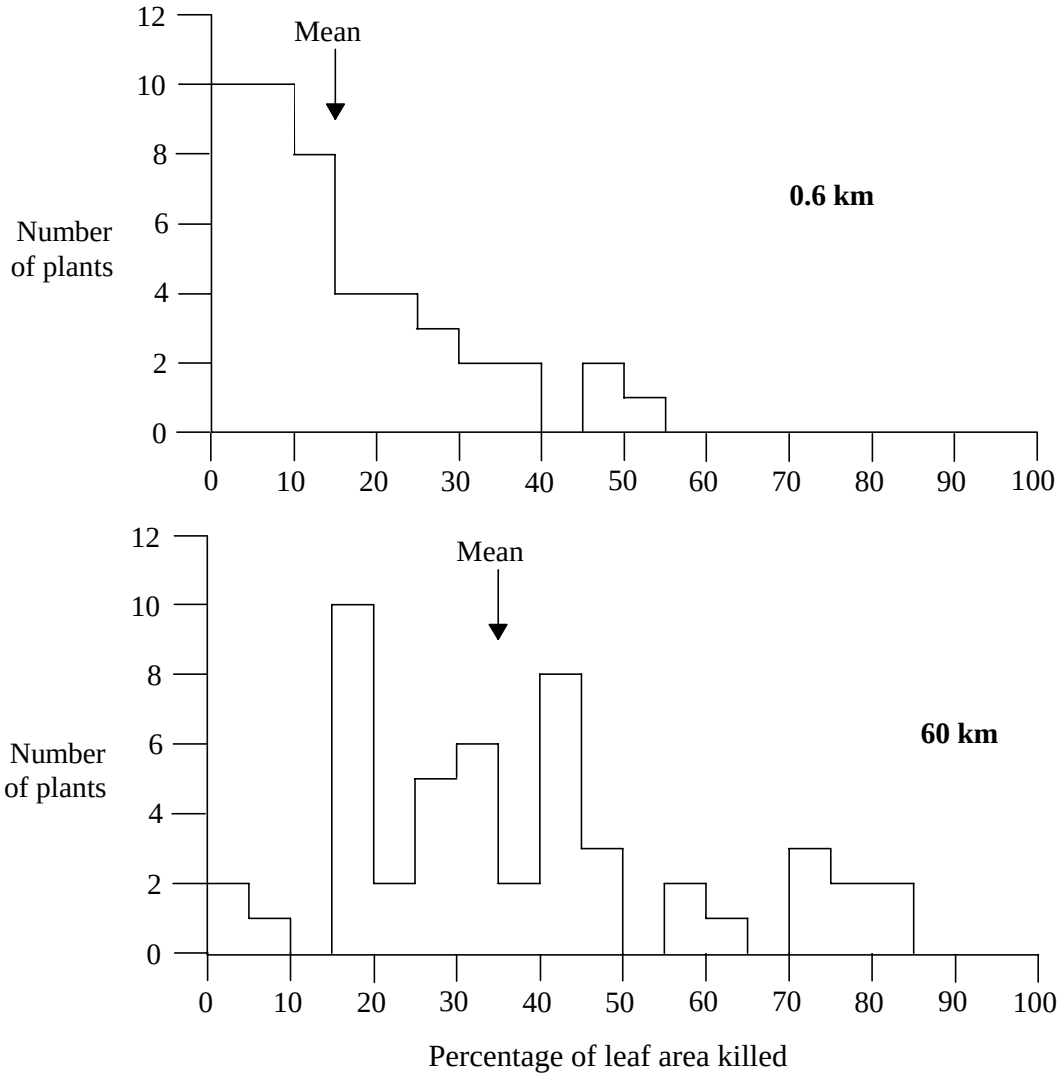
. . . . . .

. . . . . .

. . . . . .

Option D — Evolution

Dl. When coal burns, the sulfur in it is changed into sulfur dioxide (SO_2). Above a certain concentration this gas is poisonous to all plants. Scientists collected seeds from *Geranium carolinianum* plants at two distances from a coal-burning power station. The seeds were germinated under the same conditions and the plants then exposed to an SO_2 concentration of 1.56 mg m^{-3} for 8–12 hours, in controlled chambers. The amount of leaf damage is shown in the charts below.



(Source: Bradshaw and McNeilly, *Evolution and Pollution*, Edward Arnold)

(a) Compare the effect of SO_2 on the two populations. *[2]*

. . . . . .
. . . . . .
. . . . . .

(b) Identify which population is most tolerant of the SO_2 pollution. *[1]*

. . . . . .

(This question is continued on the following page)

(Question D1 continued)

(c) Predict how the population of plants growing 60 km from the power station would change if another coal-powered station was constructed close to them. *[3]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

D2. (a) Outline the major developments that took place on Earth from its formation until just before the appearance of life. *[3]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) Outline how biochemical variation can be used as an evolutionary clock. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .

D3. Discuss the importance of cultural evolution to humans. *[4]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

Option E — Neurobiology and Behaviour

El. Many birds use loud calls to communicate to other animals of the same and different species. The chart below shows the frequency of sound (pitch) and duration of calls made by *Turdus merula* (blackbird) and *Fringilla coelebs* (chaffinch) in two different situations. The charts on the left (**Figure I**) show a call made by a single bird when it saw a predator. The charts on the right (**Figure II**) show a call made by a single bird in a group attacking a predator to chase it away.

(Source: Marler P (1959), *Darwin's Biological Work*, P. Bell (Ed), CUP)

(a) Measure the frequency range of the calls made by blackbirds. *[1]*

Answer . . . . . .

(b) Compare the calls of the birds in the two situations. *[2]*

. . . . . .

. . . . . .

. . . . . .

(c) Suggest reasons for the differences in the calls made by the birds in the two situations. *[3]*

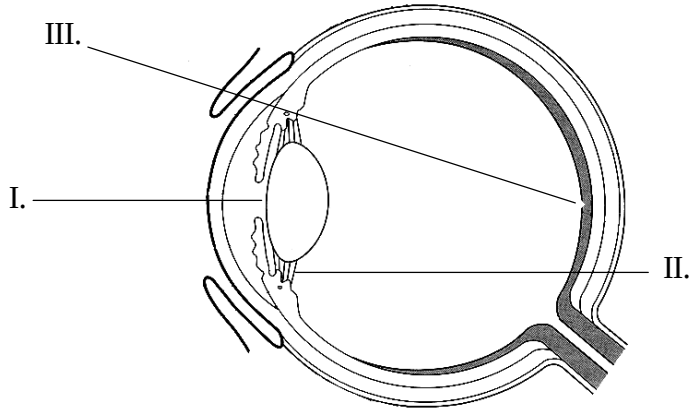
. . . . . .

. . . . . .

. . . . . .

. . . . . .

E2. (a) Name the structures of the human eye, labelled in the diagram below. *[3]*



I. . . . . .

II. . . . . .

III. . . . . .

(b) Outline the principle of trichromacy in relation to colour vision. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

E3. Explain with examples, the responses animals can make to stimuli from a particular direction. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Option F — Applied Plant and Animal Science

Fl. Enough food is produced on Earth to feed everyone. However, many millions of people are starving. One reason is that this food is distributed very unevenly and does not match the distribution of the human population. The table below shows the production of some classes of food and the percentage of the human population that live in five areas. The values for food production are in millions of tonnes. (1 tonne = 1000 kg).

	Western Europe	**Africa**	**Latin America**	**China**	**Asia (except China)**
World's Population	8 %	11 %	8 %	22 %	10 %
Meat	40	15	20	30	15
Vegetables	65	35	25	95	115
Pulses	5	15	15	25	25
Cereals	240	95	120	365	445
Root crops	60	100	60	180	85

(a) Identify which of the five areas has the greatest overall food production. *[1]*

. . . . . .

(b) Compare the productivity of Western Europe with Latin America, by giving **one** similarity and **one** difference. *[2]*

. . . . . .

. . . . . .

. . . . . .

(c) Explain which region is most likely to have the greatest problem feeding its population. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(d) Suggest **one** disadvantage of transporting food over long distances. *[1]*

. . . . . .

. . . . . .

F2. (a) State **three** ways in which plant growth substances can be used commercially. *[3]*

1. . . . . .
. . . . . .
2. . . . . .
. . . . . .
3. . . . . .
. . . . . .

(b) Outline **two** results of intensive monoculture. *[2]*

. . . . . .
. . . . . .
. . . . . .

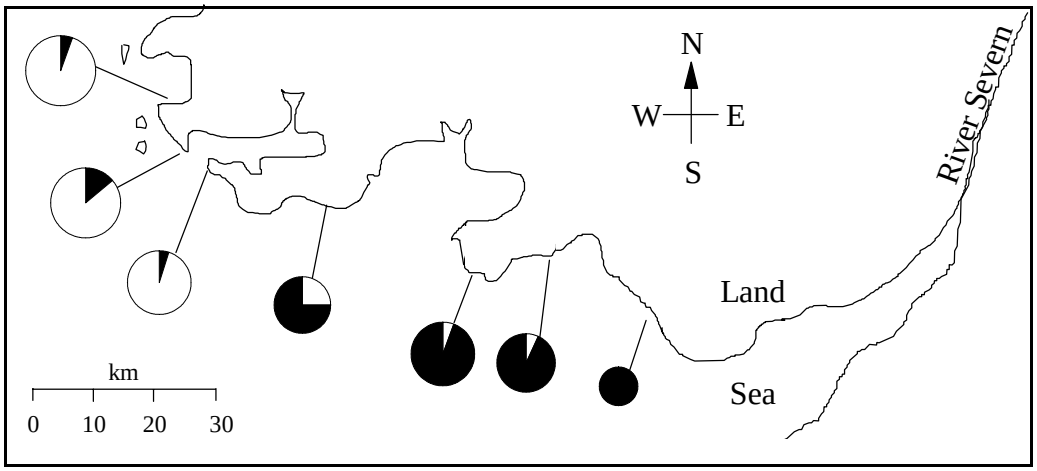
F3. Discuss the use of growth hormones in livestock production. *[3]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

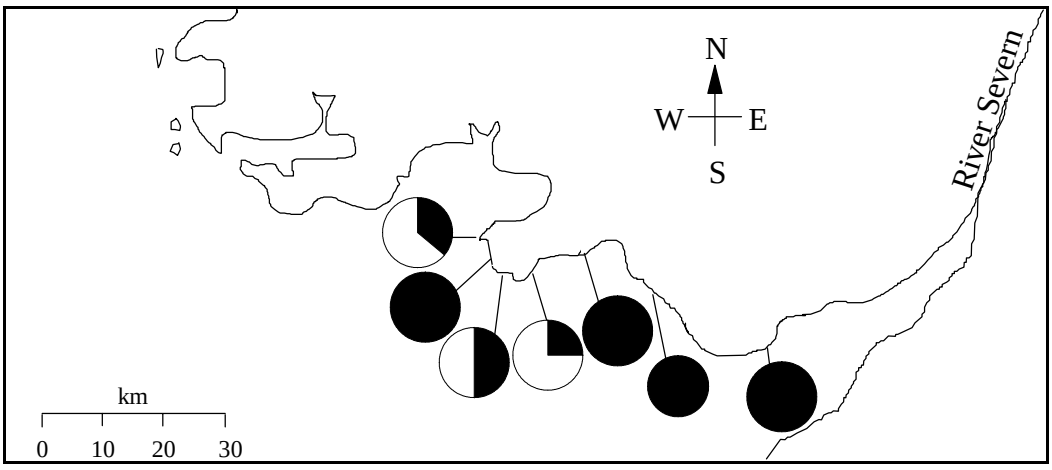
Option G — Ecology and Conservation

G1. Several years ago there was a sudden change in the populations of two species, *Monodonta lineata* and *Sabellaria alveolata,* along the coast of South Wales. These organisms are small marine animals, found attached to rocks. The changes are shown by means of the pie charts. The size of the circle indicates previous abundance. The size of the black sector represents the proportion of animals killed.

Monodonta lineata



Sabellaria alveolata



(Source: Williams G (1987), *Techniques and Fieldwork in Ecology*, Bell and Hyman)

(a) Compare the distribution of the two species **before** the change. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question G1 continued)

(b) Suggest **two** factors, which could affect the natural distribution of the two species. *[2]*

1. . . . . .

2. . . . . .

(c) The death of the animals was caused by oil pollution from a ship. Annotate **one** of the maps to show where the oil was most likely to have been spilled. Give a reason for your answer. *[2]*

. . . . . .

G2. (a) Compare the relative biodiversity of a temperate forest and a region of tundra. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) Outline **one** way in which biodiversity can be conserved by:

data collection. . . . . *[1]*

. . . . . .

legislation. . . . . *[1]*

. . . . . .

captive breeding. . . . . *[1]*

. . . . . .

G3. Explain how living things convert oxygen to and from oxygen-containing compounds. *[4]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .