



**BIOLOGY
 HIGHER LEVEL
 PAPER 3**

Thursday 16 November 2000 (morning)

1 hour 15 minutes

Name

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Number

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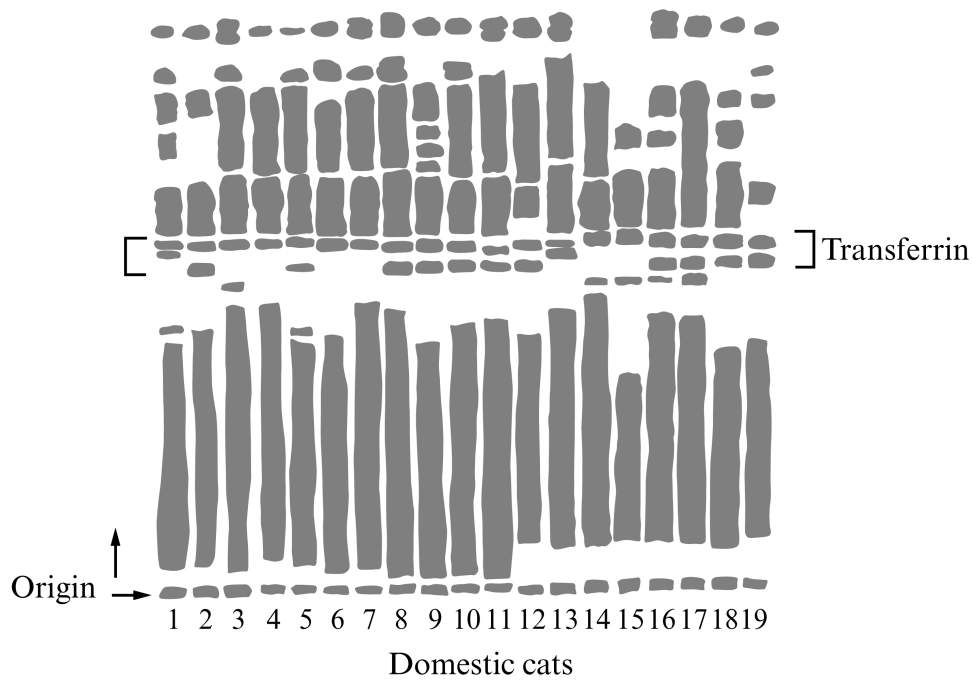
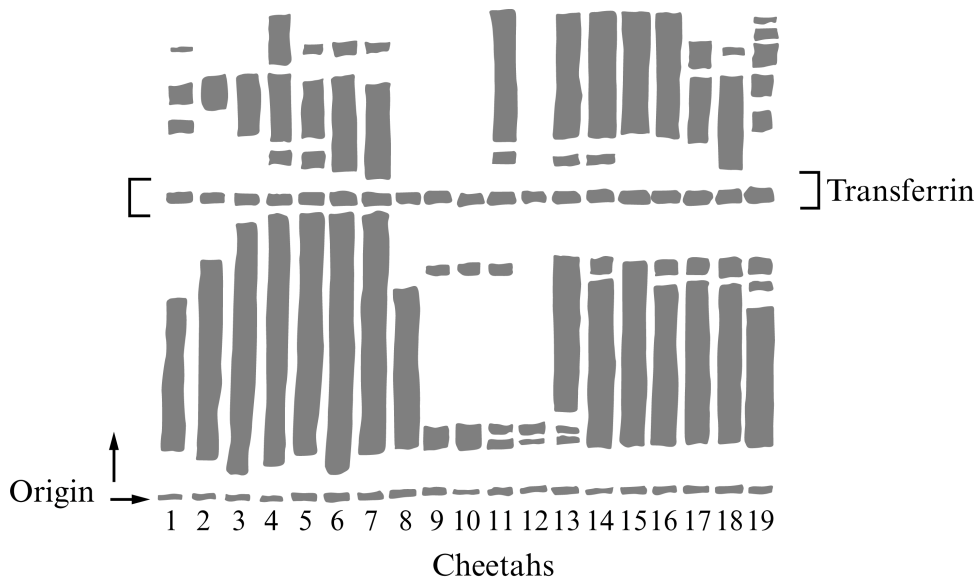
INSTRUCTIONS TO CANDIDATES

- 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 two 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
		/20	/20	/20
		/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	TOTAL /40	TOTAL /40	TOTAL /40

Option D — Evolution

DI. The cheetah (*Acinonyx jubatus*) is an endangered species of large cat found in South and East Africa. A study of the level of variation of the cheetah gene pool was done. In one part of this study, blood samples were taken from 19 cheetahs and analysed for the protein transferrin using gel electrophoresis. The results were compared with the electrophoresis patterns for blood samples from 19 domestic cats (*Felix sylvestrus*). Gel electrophoresis is a process by which proteins can be separated using the same principles as that used for DNA profiling. The bands on the gel which represent forms of the protein transferrin are indicated.



[Source: O'Brien *et al*, *Science* (1985), **227**, page 1428]

(This question continues on the following page)

(Question D1 continued)

(a) State the maximum number of forms of transferrin in any individual cat. [1]

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(b) Using the data provided, deduce with reasons

(i) the number of domestic cats and the number of cheetahs that were heterozygous for the transferrin gene; [2]

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(ii) the number of alleles of the transferrin gene in the gene pool of domestic cats and the number in the gene pool of cheetahs. [2]

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Other cheetah genes that were studied gave similar results.

(c) Evaluate the potential for evolution in the cheetah population in Africa. [2]

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D2. List **three** pieces of evidence that *Australopithecus* species were bipedal primates. [3]

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2.
3.

D3. (a) Describe the experimental evidence for the process of natural selection shown by the predation of birds on moths. [4]

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(b) Discuss the theory for the origin of species by panspermia and the evidence for the theory. [6]

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E2. (a) State **two** examples of cranial reflexes. [2]

1.
2.

(b) Define *insight learning*. [2]

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E3. Female African lions (*Panthera leo*) live in groups of up to 18 adults. They co-operate in hunting prey and in defending their territory. They are sometimes killed in territorial disputes.

Scientists studied how female lions (lionesses) responded to other lions entering their territory. The scientist played the roar of a lion through a loud speaker when pairs of lionesses were 200 metres away. The lionesses responded by running towards the sound. Six lionesses (A to F) were observed and they always led in these responses. Their behaviour was recorded when paired with other lionesses (J to O and U to Z). These other lionesses showed one of two different behavioural patterns.

The time taken for the lionesses to move 100 metres towards the loudspeaker was measured. The number of times the leader lionesses looked at the other lioness was also noted. The results for the lionesses, divided according to their behaviour pattern, are shown in the table below.

Pair of lionesses	Time taken to move 100 metres to the loudspeaker		Number of glances
	Leading Lioness	Following Lioness	
Behaviour Pattern I			
A and J	128	129	2
B and K	185	186	0
C and L	55	80	0
D and M	134	143	3
E and N	91	97	1
F and O	65	85	0
Behaviour Pattern II			
A and U	224	310	7
B and V	304	362	4
C and W	191	271	2
D and X	174	280	5
E and Y	126	174	4
F and Z	134	190	4

[Source: Heinshon and Packer, *Science* (1995), **269** page 1260]

(This question continues on the following page)

(Question E3 continued)

- (a) Compare behaviour pattern I with behaviour pattern II. [3]

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- (b) Predict, with a reason, whether territory would be defended more successfully using behaviour pattern I or II. [1]

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- (c) Discuss the extent to which the lionesses in the study showed altruistic behaviour. [2]

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Option F — Applied Plant and Animal Science

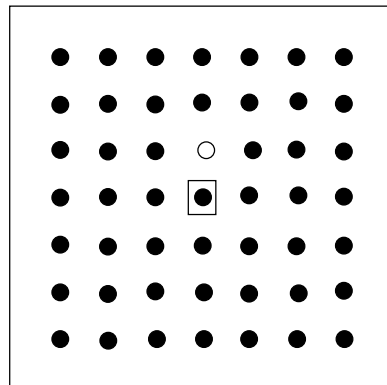
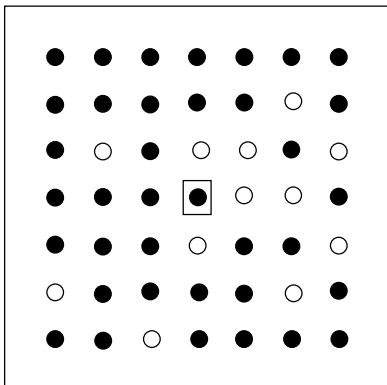
Fl. Aphids are insect pests of crop plants. They suck the sap from these plants and they can also spread plant viruses when they move from plant to plant. The aphid *Acyrtosiphon pisum* transmits the Bean Yellow Mosaic virus to bean plants. *Coccinella californica* (a species of ladybird or ladybug) feeds on aphids and can be used to control aphids. Plant scientists investigated the spread of viruses when *C. californica* was used to control *A. pisum*.

Bean plants were grown in groups with individual plants 14 cm apart. At the centre of each group was a plant which was infected with the virus. The scientists put fifteen aphids on the infected plant and left them for twenty four hours to feed on it. Then they placed twenty ladybirds next to the infected plants.

The ladybirds were left for three days and were observed feeding on the aphids. The aphids and the ladybirds were then all removed from the plants. Several controls were also set up with aphids but without ladybirds. The plants were examined for symptoms of the Bean Yellow Mosaic virus twelve days later. The results of a typical experimental and control group are shown below.

Experimental group **with**
C. californica

Control group **without**
C. californica



- Key
- infected plants
 - uninfected plants
 - ◻ original infected plants

[Source: B Roitberg and J H Myers, *Journal of Applied Ecology* (1978), **15**, pages 775-779]

(a) Compare the spread of Bean Yellow Mosaic virus in the experimental group with the control group. [2]

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(This question continues on the following page)

(Question F1 continued)

- (b) During the three days of the trial period the aphids were observed feeding on thirteen plants in the experimental group and on three plants in the control group. A total of ten aphids were found after three days in the experimental group and forty seven in the control group.

State **two** effects of *C. californica* on the aphids, revealed by these observations. [2]

- 1.
- 2.

- (c) Deduce whether the aphids transmit viruses to all plants on which they feed. [1]

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- (d) Evaluate the effectiveness of using *C. californica* to increase productivity in bean crops. [2]

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F2. Outline **three** ethical issues concerning the use of animals for research. [3]

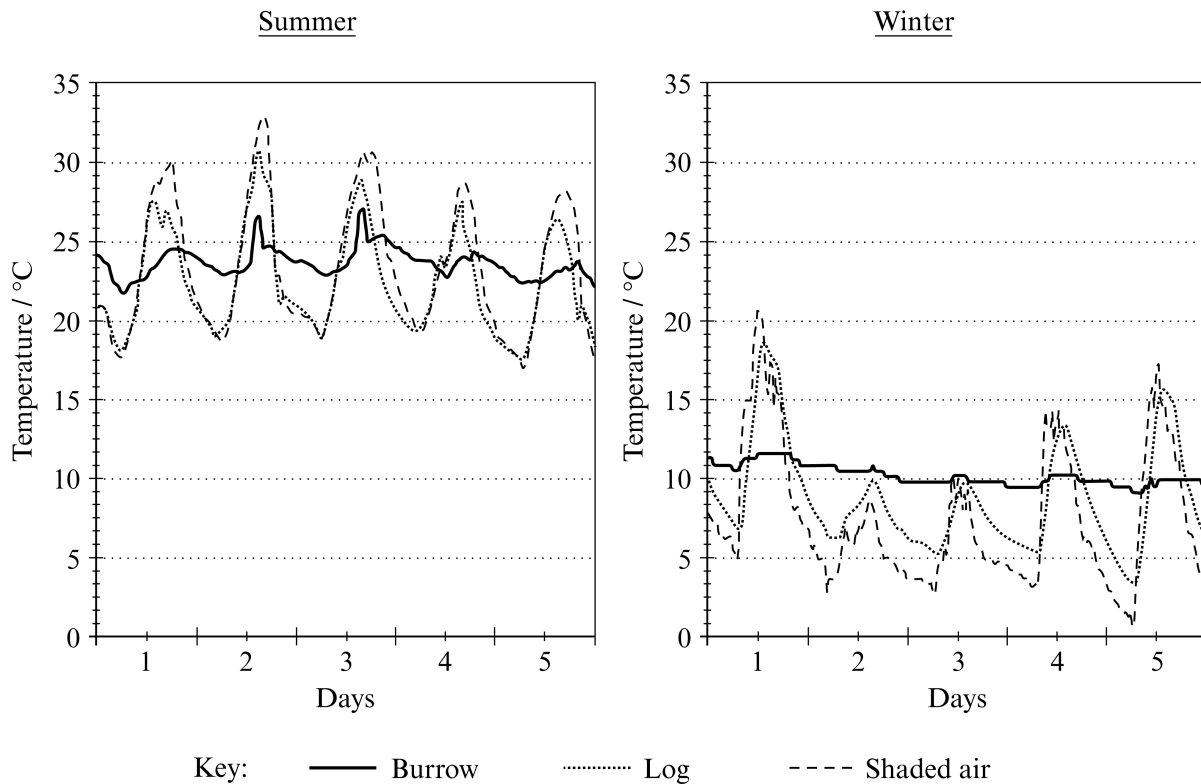
- 1.

- 2.

- 3.

G2. The echidna (*Tachyglossus aculeatus*) is a nocturnal mammal found in Australia. Ecologists investigated the factors affecting the choice of sites used by these animals to shelter in the daytime when they are not active. Nine animals were followed using radio transmitters. In the summer, the echidnas used hollow logs 37 % of the time and rabbit burrows 28 % of the time for sheltering during the day. In winter the animals sheltered in hollow logs for 8 % of the time and in rabbit burrows for 38 % of the time.

Temperatures were measured inside the sites and in the air outside. Results are shown below for five days in summer and five days in winter.



[Source: D A Wilkinson *et al*, *Wildlife Research* (1998), **25**, page 219]

(a) Using only the data in the graphs, compare the results for summer with the results for winter by giving **three** similarities. [3]

1.
2.
3.

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(Question G2 continued)

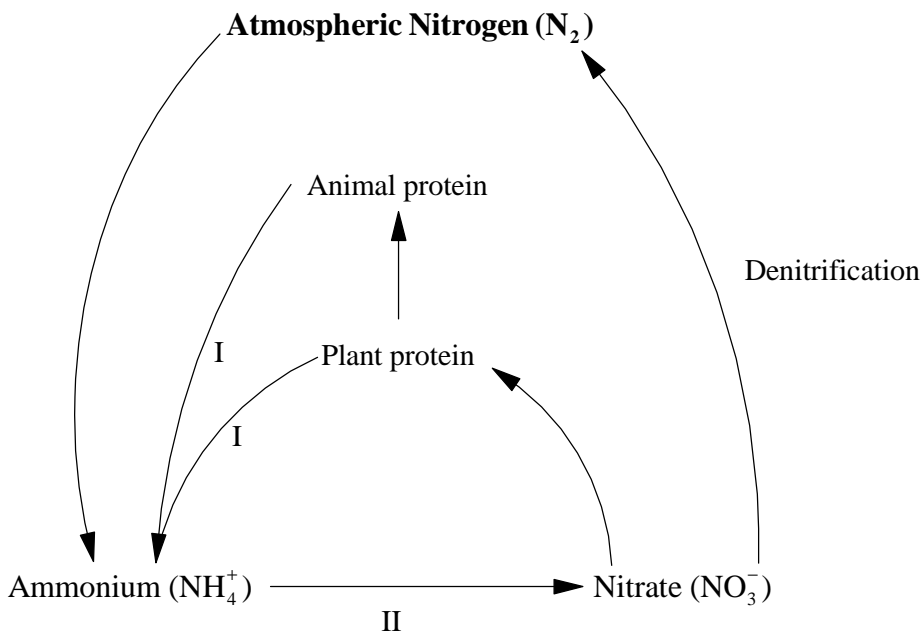
(b) Suggest reasons for the differences between winter and summer in the choice of shelters. [2]

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(c) Rabbits are an alien species in Australia. Predict the effect of eliminating the rabbit population on the echidna population. [2]

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G3. Study the diagram of the biogeochemical cycle shown below.



(a) State the names of the processes labelled I and II. [2]

I.
II.

(b) State the condition that favours denitrification. [1]

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Option H — Further Human Physiology

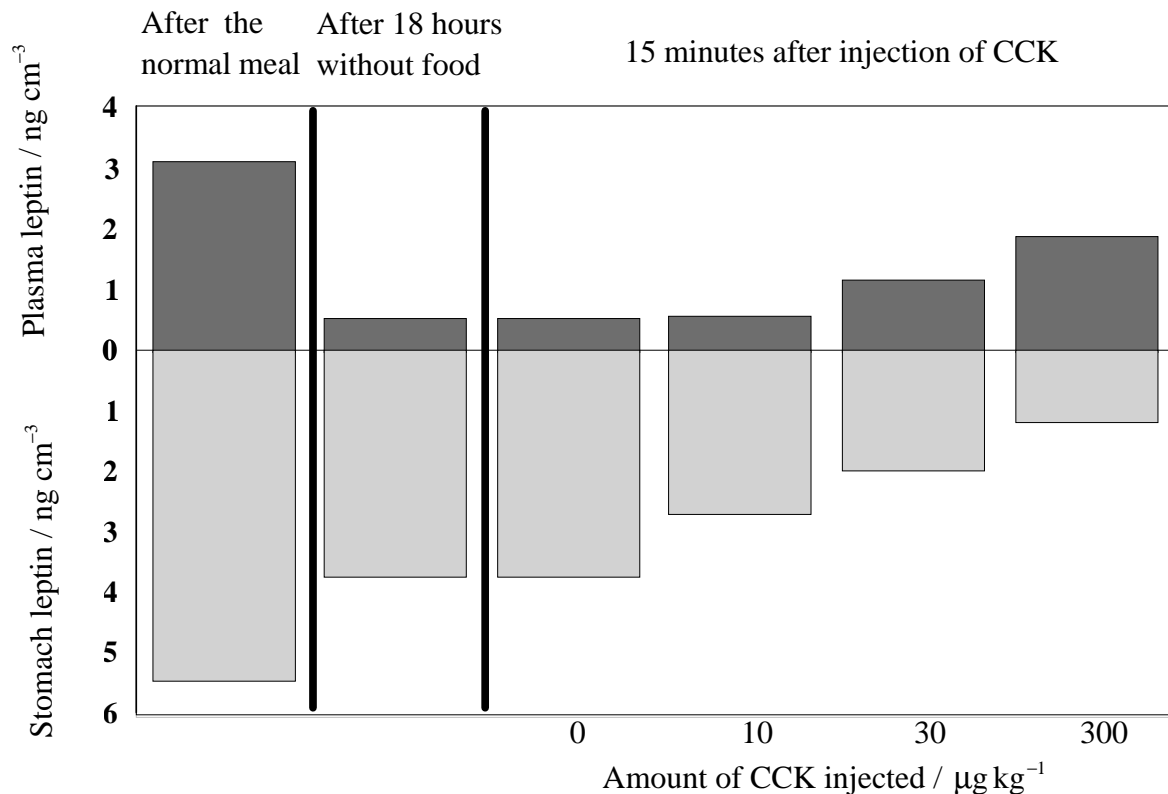
H1. The effects of two hormones, leptin and cholecystokinin (CCK) have been investigated by physiologists.

After a heavy meal humans feel satiated (feel that they have had enough to eat). Leptin, secreted by cells in the stomach wall into the blood stream, helps to cause this feeling. Leptin levels can be measured in stomach wall cells and in blood plasma.

CCK is secreted by cells of the duodenum. It stimulates the release of digestive enzymes by the pancreas. CCK can be injected, experimentally, into the blood stream.

Volunteers were given a normal meal and after this were given no more food for 18 hours. They were then given an injection of either 0, 10, 30 or 300 $\mu\text{g kg}^{-1}$ of CCK.

Leptin levels were measured in stomach wall cells and blood plasma after each stage of the experiment. The results are shown in the bar chart below.



[Source: A Bado *et al*, *Nature* (1998), 394 page 790]

(This question continues on the following page)

(Question H1 continued)

(a) Outline the effects of eighteen hours without food on the levels of leptin. [2]

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(b) Analyse the results of the injections of CCK. [3]

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(c) Suggest, with a reason for each, **two** possible treatments to help control obesity in humans on the basis of the information given in this question. [2]

1.
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2.
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H2. (a) State which blood component prevents large fluctuations in blood pH. [1]

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(b) List **two** ways carbon dioxide is carried by the blood. [2]

1.
2.

