



BIOLOGY

Higher Level

Friday 8 May 1998 (morning)

Paper 3

1 hour 15 minutes

A

Candidate name:	Candidate category & number:								
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<p>This examination paper consists of 5 Options. The maximum mark for this paper is 40.</p> <p style="text-align: center;">INSTRUCTIONS TO CANDIDATES</p> <p>Write your candidate name and number in the boxes above.</p> <p>Do NOT open this examination paper until instructed to do so.</p> <p>Answer ALL of the questions from TWO of the Options in the spaces provided.</p> <p>At the end of the examination, complete box B below with details of the Options answered.</p>									

B

OPTIONS ANSWERED

C

EXAMINER	MODERATOR
/20	/20
/20	/20
TOTAL /40	TOTAL /40

D

IBCA
/20
/20
TOTAL /40

EXAMINATION MATERIALS

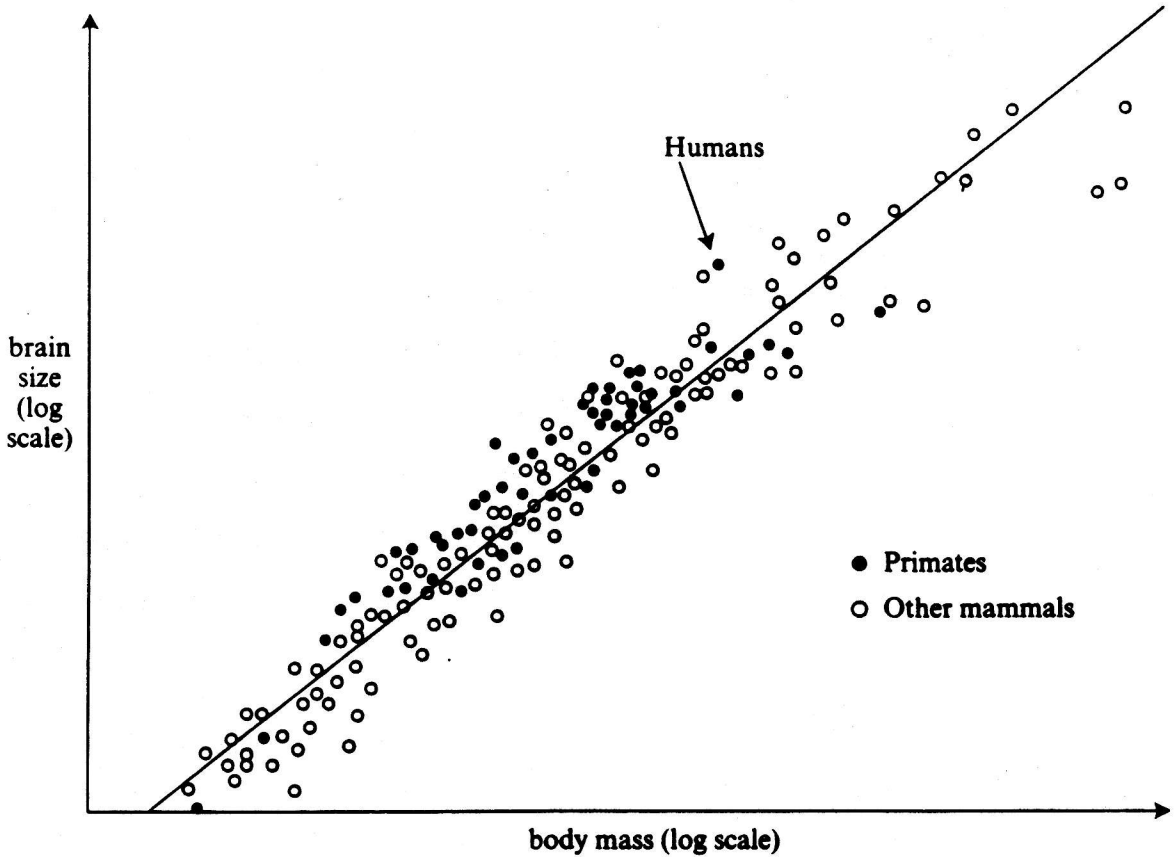
Required:
Calculator

Allowed:

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

Option D—Evolution

D1. The scattergram below shows the relationship between brain size and total body mass in species of mammal. Primate species are shown as solid circles and other species of mammal as open circles.
[Source: CUP, Encyclopedia of Human Evolution.]



(a) Using the data in the scattergram,

(i) state the relationship between body mass and brain size in mammals [1 mark]

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(ii) compare the brain size in relation to body mass of primates with that of other mammals [2 marks]

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(This question continues on the following page)

(Question D1 continued)

(iii) explain briefly how the scattergram can be interpreted to show that human brains are larger than those of other primates.

[2 marks]

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(b) Increases in brain size in relation to body mass could be due either to increases in brain size or decreases in body mass. Suggest one advantage to primates of reduced body mass.

[1 mark]

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D2. (a) Outline the main stages in fossilisation.

[3 marks]

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(b) State one method that can be used to date fossils.

[1 mark]

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Option E—Neurobiology and Behaviour

E1. (a) Describe the social organisation of honey bee colonies.

[6 marks]

Describe la organización social de una colonia de abejas

(b) Discuss briefly the role of altruistic behaviour in social organisations, other than human ones.

[4 marks]

Discuta brevemente el rol del comportamiento altruista en organizaciones sociales. (no considere la especie humana)

E2. (a) Define *innate* behaviour.

[2 marks]

Defina comportamento innato

(b) Suggest **one** example of the survival chances of an animal being increased by innate behaviour.

[1 mark]

E3. The crested newt, (*Triturus cristatus*), has a courtship consisting of the following stages:

1. male approaches female and sniffs her head
2. male waves his tail towards the female's head
3. male hits female on her head with his tail
4. male deposits sperm next to the female
5. female picks up sperm.

A receptive female responds to the courtship by remaining motionless until picking up the sperm. The male or female can stop the courtship at any stage by moving away.

(a) Using only the information given above, suggest **one** way in which:

(i) the male can find out if the female is of the correct species;

[1 mark]

(ii) the female can decide whether or not to select the male for mating.

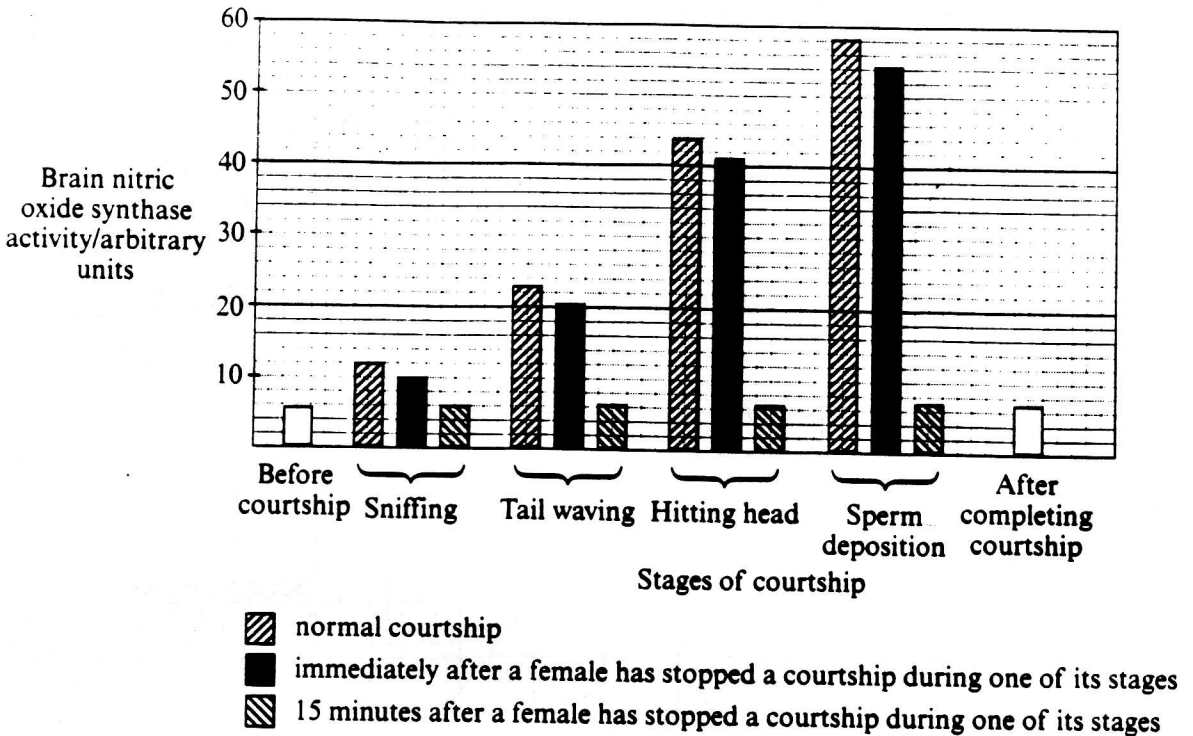
[1 mark]

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(Question E3 continued)

Nitric oxide (NO) regulates sexual behaviour in some animals. Newt brains contain nitric oxide synthase, which catalyses the formation of nitric oxide. The amount of this enzyme was measured in the brains of **male** newts at various stages as shown below.

[Source: Nature vol 382, p 31. Zerani and Gobetti]



(b) Outline the changes in the amount of nitric oxide synthase in the brain of a male during the stages of normal courtship and after completing it. [2 marks]

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(c) Using the data in the question, deduce the effects of the female newt on nitric oxide levels in the brains of male newts. [3 marks]

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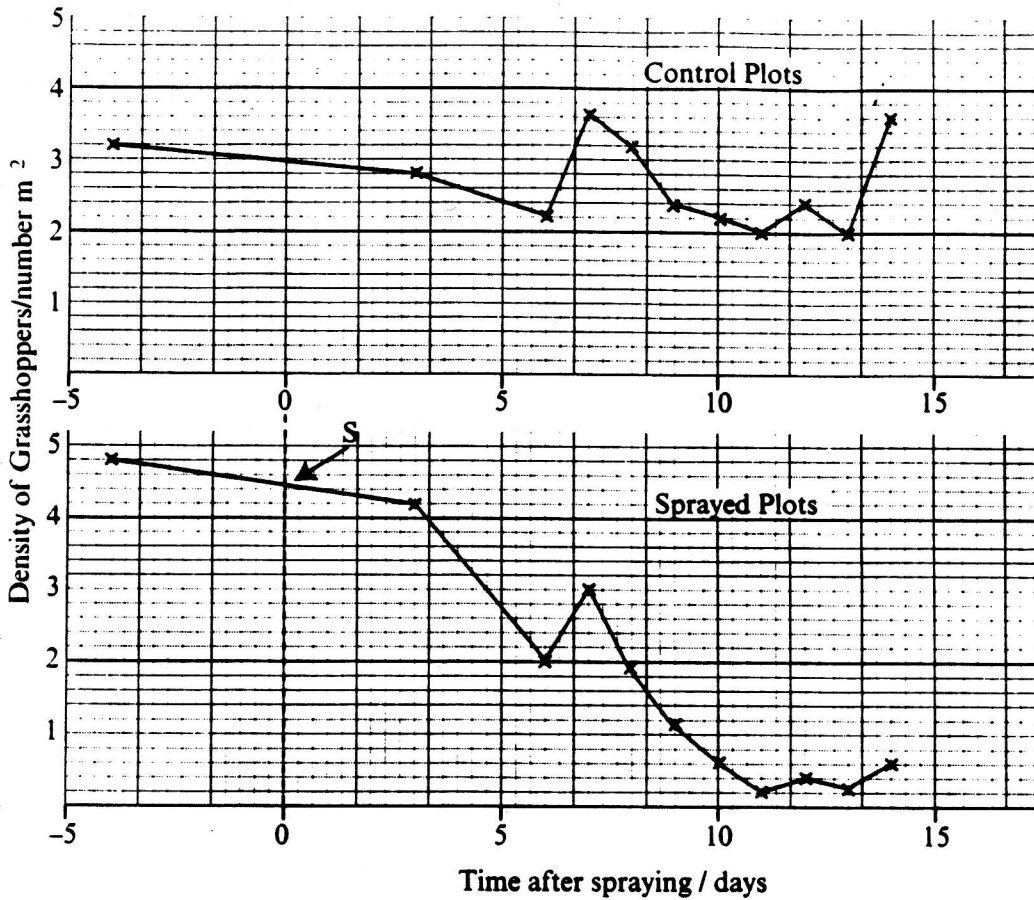
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Option F—Applied plant and animal science

F1. Crops of cassava in parts of Benin in West Africa are sometimes attacked by a grasshopper, *Zonocerus variegatus*. A field trial was carried out to investigate a method of biological control of the grasshoppers. Four 100 m × 100 m plots were sprayed with spores of a fungus, *Metarhizium flavoviride*. Four other similar plots were left untreated. The density of grasshoppers in the plots was measured before and after spraying. The time of spraying (S) and the mean results are shown below.



- (a) Compare the results for the sprayed plots with those for the control plots, during the period from before the spraying until eight days after spraying. [2 marks]

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(This question continues on the following page)

(Question F1 continued)

(b) Explain the evidence from the trial that the biological control method was effective.

[2 marks]

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(c) Studies showed that there was significant movement of grasshoppers into and out of the sprayed plots. Using the data in the graphs, deduce whether grasshoppers migrating into the plots after the spraying were infected by the spores of the fungus.

[2 marks]

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(d) Suggest one advantage of this method of biological control, compared with the use of chemical pesticides.

[1 mark]

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F2. (a) State one use of domesticated animals.

[1 mark]

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(b) Suggest two effects of rearing domesticated animals using intensive methods.

[2 marks]

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F3. (a) Describe the differences between wind-pollinated and insect-pollinated flowers.

[7 marks]

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(b) Explain the advantage of preventing the pollination or fertilisation of cut flowers.

[3 marks]

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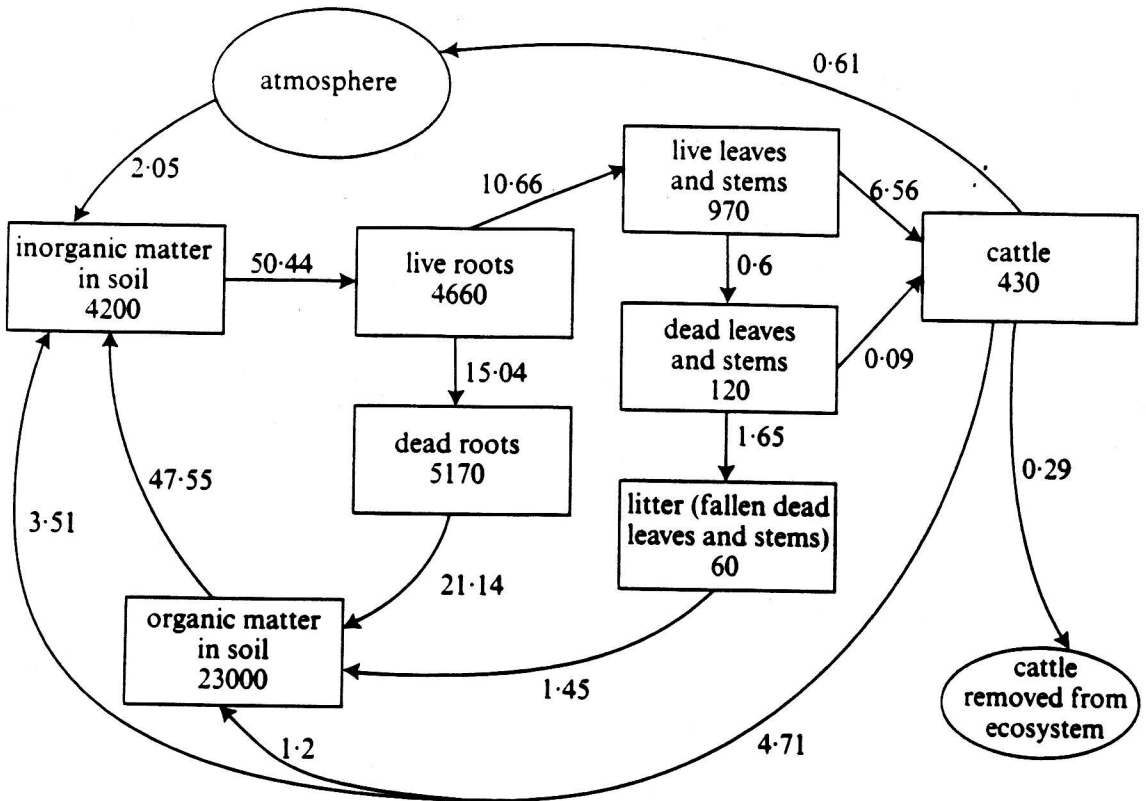
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G2. Ecologists have recently completed a study of nitrogen cycling in the Flooding Pampa ecosystem of Argentina. The study took place during spring. Part of this ecosystem is heavily grazed by cattle. The results of this part are shown below. The numbers in the boxes show mean nitrogen contents in milligrams per square metre (mg m^{-2}). The numbers beside the arrows show the mean daily flows of nitrogen per square metre ($\text{mg m}^{-2} \text{ day}^{-1}$).
 [Source: Chaneton Lemcoff and Lavado, J. Applied Ecology 1996, 33 pp 291-302]



- (a) (i) State the nitrogen-containing chemical absorbed by the plant roots from the soil. [1 mark]

- (ii) Predict the name of the nitrogen-containing chemical released into the atmosphere by the cattle. [1 mark]

- (b) (i) Calculate the daily change in mass of nitrogen in organic matter in soil. [1 mark]

Answer mg

(This question continues on the following page)

(Question G2 continued)

- (ii) With reference to microbial activity in the soil, suggest a reason for the change.

[1 mark]

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Another part of the ecosystem from which cattle had been excluded for seven years was investigated. Although there was some feeding by wild herbivores, the amount of grazing was much lower. The amount of litter was found to be 470 mg m^{-2} . Nitrogen absorption by roots was found to be $37 \text{ mg m}^{-2} \text{ day}^{-1}$.

- (c) Explain the differences between the grazed and the ungrazed areas in:

- (i) amount of nitrogen in litter

[1 mark]

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- (ii) rate of absorption of nitrogen by plant roots.

[2 marks]

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- G3. (a) State the difference between tropical forests and temperate forests in:

- (i) relative biodiversity

[1 mark]

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- (ii) photosynthetic efficiency.

[1 mark]

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- (b) Suggest **one** reason for the difference in photosynthetic efficiency between tropical forests and temperate forests.

[1 mark]

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Option H—Further Human Physiology

H1. Physiologists recently investigated glucose absorption in the ileum using the following method. They placed two substances similar to D-glucose in the small intestine of a living rat and took blood samples from the aorta and hepatic portal vein during one minute afterwards. For each substance the aortic concentration was subtracted from the concentration in the hepatic portal vein to obtain an estimate of the amount absorbed.

[Source: Uhing and Kimura, J. Clinical Investigation 1995, p 2790]

- (a) Explain the reason for subtracting the aortic concentration from the concentration in the hepatic portal vein.

[1 mark]

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The table below shows the mean results of the experiment.

Concentration placed in the small intestine /mmol dm ⁻³	Difference in blood concentration between aorta and hepatic portal vein /nmol g ⁻¹	
	L-glucose	3-methyl glucose
100	20	420
200	30	760
400	50	930

- (b) Using only the data in the table, compare the absorption of L-glucose with that of 3-methyl glucose.

[2 marks]

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D-glucose, L-glucose and 3-methyl glucose are absorbed passively in the small intestine at the same rate. D-glucose and 3-methyl glucose can also be absorbed by active transport, using the same carriers.

- (c) If the experiment was repeated using D-glucose, deduce whether more would be absorbed by passive or by active transport, at a concentration in the small intestine of 400 mmol dm⁻³ of D-glucose.

[2 marks]

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(This question continues on the following page)

(Question H1 continued)

(d) Using the data in the table, discuss the effect of glucose concentration on the proportion of active and passive transport.

[2 marks]

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H2. List three factors which increase the risk of coronary heart disease, other than genetic factors.

[3 marks]

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