88086003

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

BIOLOGY
HIGHER LEVEL
PAPER 3

Tuesday 18 November 2008 (morning)

1 hour 15 minutes

Candidate session number

0	0							

INSTRUCTIONS TO CANDIDATES

- Write your session 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 on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

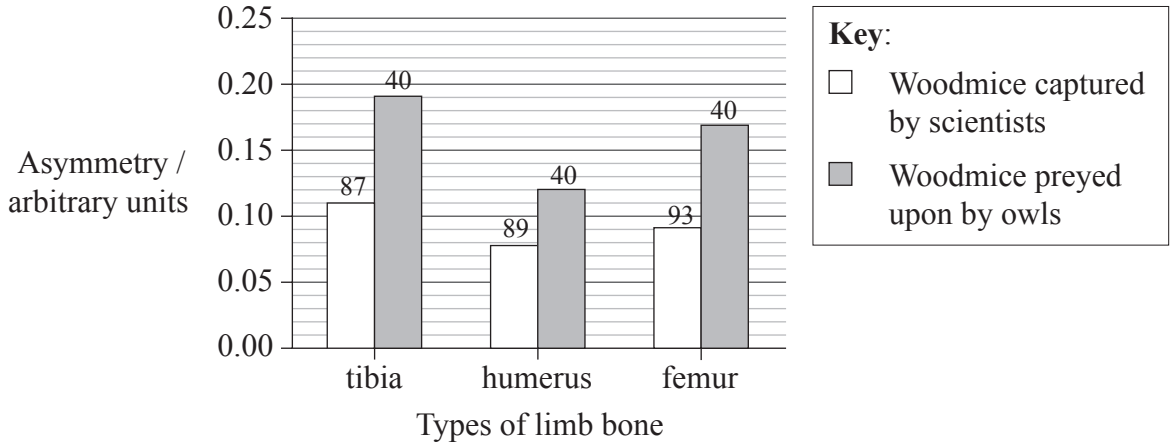
0120

© International Baccalaureate Organization 2008

Option D — Evolution

D1. Evolutionary biologists have suggested that asymmetry (unequal length in paired limbs) in a prey species decreases its survival chances. In this study the capture of the woodmouse *(Apodemus sylvaticus)* by its natural predator the tawny owl *(Strix aluco)* was investigated.

The figures above the bars indicate the number of individuals caught. The study was conducted in the same habitat.



[Paolo Galeotti, "Fluctuating Asymmetry in Body Traits Increases Predation Risks: Tawny Owl Selection Against Asymmetric Woodmice", *Evolutionary Ecology*, vol. 19 (4) pages 405–18. © 2005. With kind permission from Springer Science and Business Media.]

(a) Calculate the percentage increase in tibia asymmetry shown by preyed woodmice compared to those captured by the scientists. Show your calculations. *[2]*

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question D1 continued)

(b) Suggest why woodmice with limb asymmetry may be caught more easily than those with less limb asymmetry. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) Using the information provided, discuss the survival of asymmetric woodmice. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

D2. (a) Define the term *half-life*. *[1]*

. . . . . .

. . . . . .

(b) Outline how the radioisotope ^{40}K can be used to date rocks **or** fossils. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

D3. (a) Outline the evidence for evolution provided by the pentadactyl limb. *[3]*

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

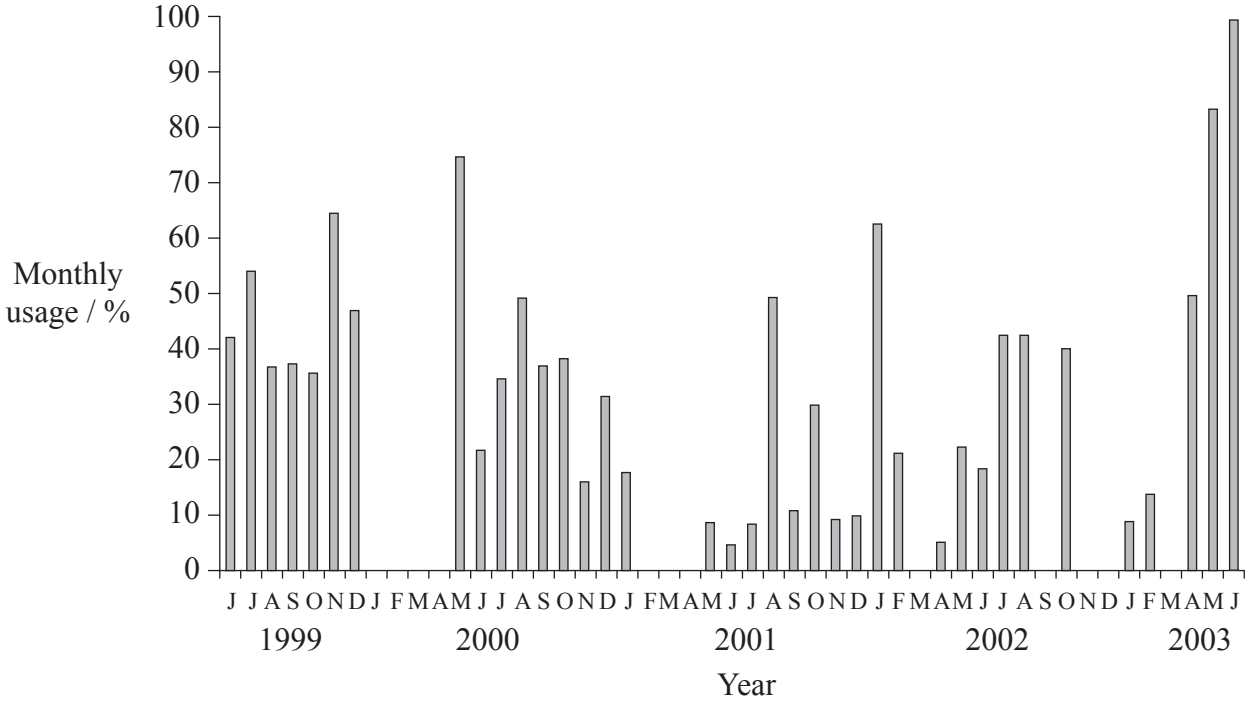
(b) Explain how variation in a population can occur. *[7]*

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

Blank page

Option E — Neurobiology and Behaviour

E1. Scientists studied the use of a cave system by baboons *(Papio hamadryas)* living in the northern Cape of South Africa. The graph below shows the percentage monthly usage of the caves by baboons over a five year period.



[Reprinted from L. Barrett *et al*., "Habitual cave use and thermoregulation in chacma baboons (*Papio hamadryas ursinus*)", *Journal of Human Evolution*, vol. 46, issue 2 pp. 215–222, © 2004 with permission from Elsevier]

(a) Identify the month in 2002 during which the baboons made the greatest use of the caves. *[1]*

. . . . . .

(b) Suggest why baboons might choose to occupy caves. *[1]*

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question E1 continued)

(c) Analyse the **general** pattern of cave usage over the five year study period. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(d) Compare the use of the caves by the baboons in January, February and March 2000, 2001 and 2002. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

E2. (a) Outline a human spinal reflex. *[2]*

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

(b) Outline how the autonomic nervous system controls pupil size. *[2]*

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

E3. (a) For each of the following terms, state the type of stimulus with an example. *[2]*

	Type of stimulus	**Example of stimulus**
Mechanoreceptor:		
Thermoreceptor:		
Chemoreceptor:		

(b) Using **two** examples, discuss how psychoactive drugs affect synaptic transmission. *[7]*

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

Blank page

Option F — Applied Plant and Animal Science

F1. Tests were conducted to evaluate the effectiveness of various plant extracts toxic to the Colorado potato beetle *(Leptinotarsa decemlineata)*. Prior to the adult stage there are four separate larval development stages called instars. Each of the four instars and the adult were treated with one of the plant extracts or a conventional insecticide called imidacloprid. In the control, the insects were treated with distilled water and acetone (chemicals used to obtain the plant extracts).

The table below shows the mortality rates caused by plant extracts and imidacloprid to instars and the adult stage of Colorado potato beetles.

	Mortality / %				
Treatment	**First instar**	**Second instar**	**Third instar**	**Fourth instar**	**Adult**
Control	2.24	2.24	0.97	0.97	0.00
Artemisia vulgaris	11.14	8.16	7.79	10.93	24.69
Chenopodium album	3.29	11.57	0.97	4.99	16.36
Hedera helix	11.57	11.57	16.36	12.21	7.79
Humulus lupulus	78.38	73.48	83.79	39.96	11.14
Lolium temulentum	9.59	13.24	11.14	5.64	5.18
Salvia officinalis	11.14	13.24	12.56	11.14	3.29
Sambucus nigra	13.24	8.16	8.16	11.57	3.29
Verbascum songaricum	19.58	8.16	6.87	9.59	8.16
Xanthium strumarium	5.64	6.49	4.25	7.79	14.39
Imidacloprid	100.00	94.82	100.00	11.57	44.37

[Adapted from A Gökçe, M E Whalon, H Can, Y Yanar, I Demirtas and N Goren, "Plant extract contact toxicities to various developmental stages of Colorado potato beetles (Coleoptera: Chrysomelidae), *Annals of Applied Biology*, Vol. 149, Issue 2, October 2006, pages 197-202. Copyright © 2006 Blackwell Publishing Ltd. Reprinted with permission of Blackwell Publishing Ltd.]

(a) (i) Identify the stage at which the *Chenopodium album* extract is **least** effective as a pesticide. *[1]*

. . . . . .

(ii) State the name of the plant extract which is **most** effective against any of the instars. *[1]*

. . . . . .

(This question continues on the following page)

(Question F1 continued)

(b) Compare the instar mortality between treatment with *Salvia officinalis* and imidacloprid. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(c) Evaluate the effectiveness of plant extracts in controlling Colorado potato beetle infestations. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

F2. (a) Define the term *net assimilation rate.* *[1]*

. . . . . .

. . . . . .

(b) Describe how pruning can produce bushy plants. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

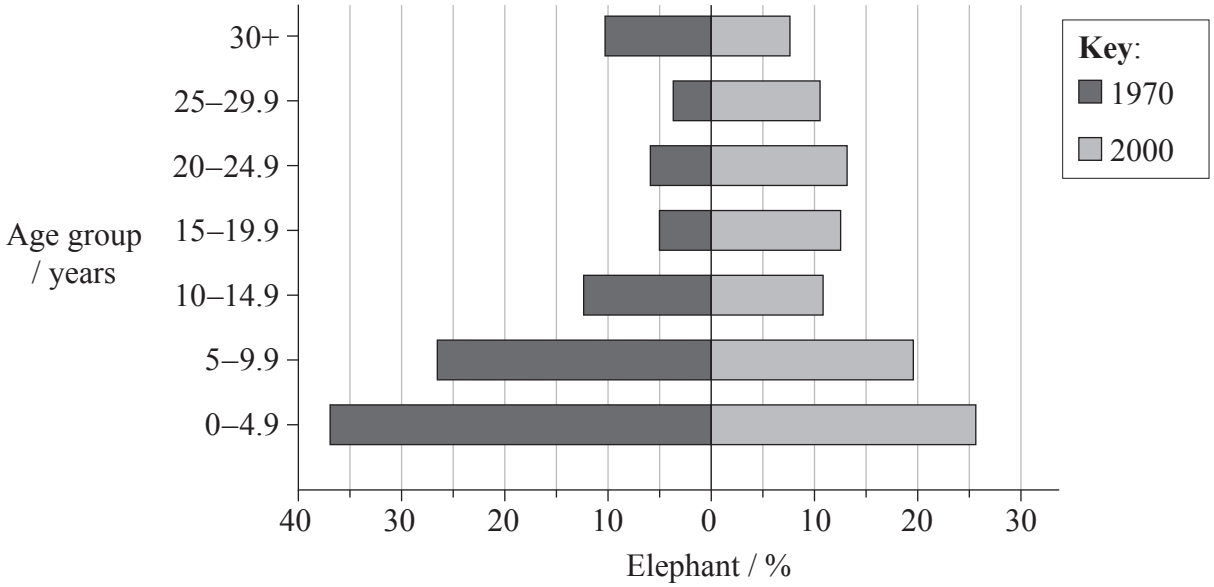
F3. (a) Draw the structure of a wind pollinated monocotyledonous flower. *[3]*

(b) Explain how flowering depends upon phytochromes. *[7]*

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

Option G — Ecology and Conservation

G1. The population of elephants in the Kidepo National Park, northern Uganda has been monitored over a number of years. The population has reduced from about 440 elephants in 1970 to 380 elephants by 2000. The graph shows the age distribution of elephants in 1970 and 2000.



[Adapted from Daniel Aleper and Stein R. Moe, "The African savannah elephant population in Kidepo Valley National Park, Uganda: changes in size and structure from 1967 to 2000", *African Journal of Applied Ecology*, vol. 44 (2) pages 157-64. Copyright © 2006 Blackwell Publishing Ltd. Reproduced with permission of Blackwell Publishing Ltd.]

(a) State the percentage of elephants aged 15 to 19.9 years that were in the Kidepo National Park in 1970. *[1]*

. . . . . .

(b) Describe the age profile of the elephant population in 1970. *[2]*

. . . . . .

. . . . . .

. . . . . .

(c) Suggest why the age profile has changed between 1970 and 2000 while the population has reduced slightly. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question G1 continued)

(d) Suggest **one** method to maintain the number of elephants in Kidepo National Park. *[1]*

. . . . . .

. . . . . .

G2. (a) In a grassland habitat the net primary production is 15 600 kJ m^{-2} $year^{-1}$ and the respiration rate of the autotrophs is 12 800 kJ m^{-2} $year^{-1}$. Calculate the gross primary production of the habitat. *[1]*

. . . . . .

. . . . . .

(b) Outline the role played by living organisms in the development of soil. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

G3. (a) Outline the importance of the ozone layer. *[3]*

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

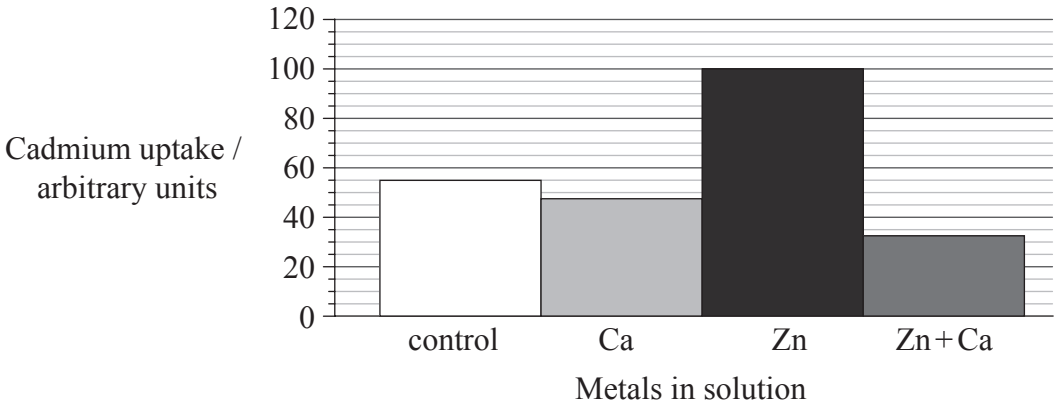
(b) Explain the generation of methane from biomass. *[7]*

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

Option H — Further Human Physiology

H1. Zinc is a metal which is an essential mineral in the diet. Cadmium is a toxic metal that causes severe poisoning in humans. Both are taken into the bloodstream by protein channels in intestinal cells during digestion. Biochemists investigated the uptake of these metals by cells in a solution.

The graph below shows the cadmium uptake by cells in a solution (control) and the uptake by cells in the same solution with the addition of either calcium (Ca) or zinc (Zn) or a mixture of both (Zn+Ca).



[Source: adapted from P M Bergeron and C Jumarie, (2006), *Biochimica et Biophysica Acta*, **1758**, pages 702–712]

(a) Calculate the percentage increase in cadmium uptake in the **presence** of zinc alone, compared to cadmium uptake with **no** other metal present. Show your calculations. *[2]*

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question H1 continued)

(b) Describe the effect of the different metals on the uptake of cadmium. *[2]*

. . . . . .

. . . . . .

. . . . . .

(c) Discuss the hypothesis that the presence of calcium reduces cadmium uptake by inhibiting zinc protein channels. *[3]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

H2. (a) Define the term *partial pressure*. *[1]*

. . . . . .

. . . . . .

(b) Outline how increases in carbon dioxide concentration result in a greater supply of oxygen to respiring tissues. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

H3. (a) Outline the transport functions of the lymphatic system. *[3]*

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

(b) Explain the events of the cardiac cycle. *[7]*

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