22096009

Baccalauréat International
Bachillerato Internacional

BIOLOGY
HIGHER LEVEL
PAPER 3

Brett

Thursday 7 May 2009 (morning)

1 hour 15 minutes

Candidate session number

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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.

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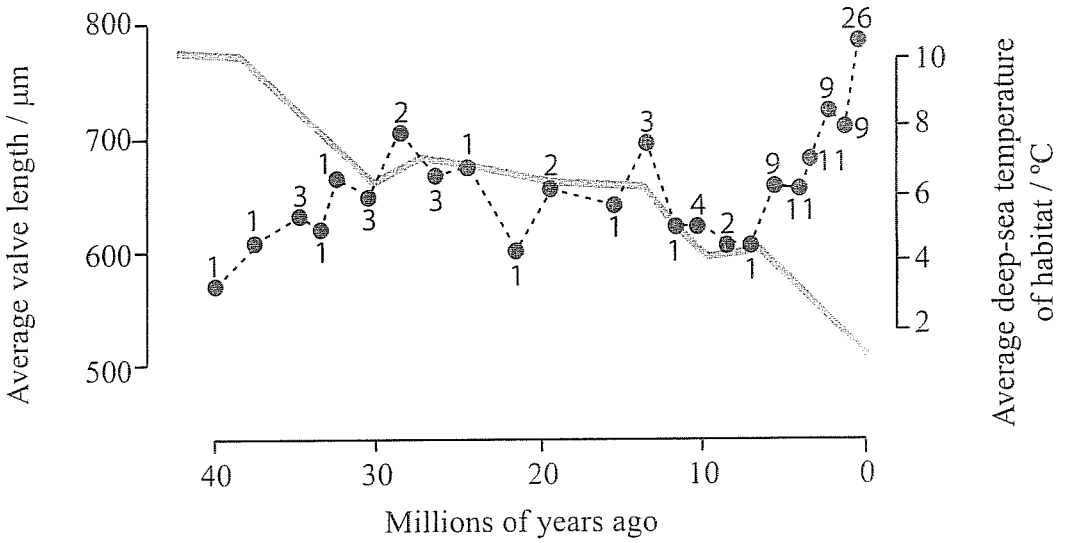
Option D — Evolution

D1. There is evidence that body size of animals tends to increase over time. In this study, fossils and living species from the genus *Poseidonamicus*, deep-sea ostracods, were used to test this hypothesis. The numbers on the dotted line represent the number of different *Poseidonamicus* species found either as fossils or living. For each time period, the average valve length of all species studied is plotted. Valve length is an indication of total body size. The continuous line is the estimated temperature of their deep-sea habitat.



[Source: adapted from G Hunt and K Roy, (2006), *PNAS*, **103**, pages 1347–1352]

(a) Calculate the percentage increase in valve length between the species studied from 40 million years ago and the species from the present day. *[2]*

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(b) Suggest **two** reasons for the increase in the number of species of *Poseidonamicus* over time. *[2]*

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(This question continues on the following page)

(Question D1 continued)

(c) Evaluate the hypothesis that changes in size of *Poseidonamicus* are caused by changes in sea temperature. *[3]*

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D2. (a) State one process needed for the spontaneous origin of life on Earth. *[1]*

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(b) Outline the contribution of prokaryotes to the creation of an oxygen-rich atmosphere. *[2]*

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D3. (a) Outline allopatric and sympatric speciation. *[4]*

(b) Explain the biochemical evidence for the common ancestry of living organisms. *[6]*

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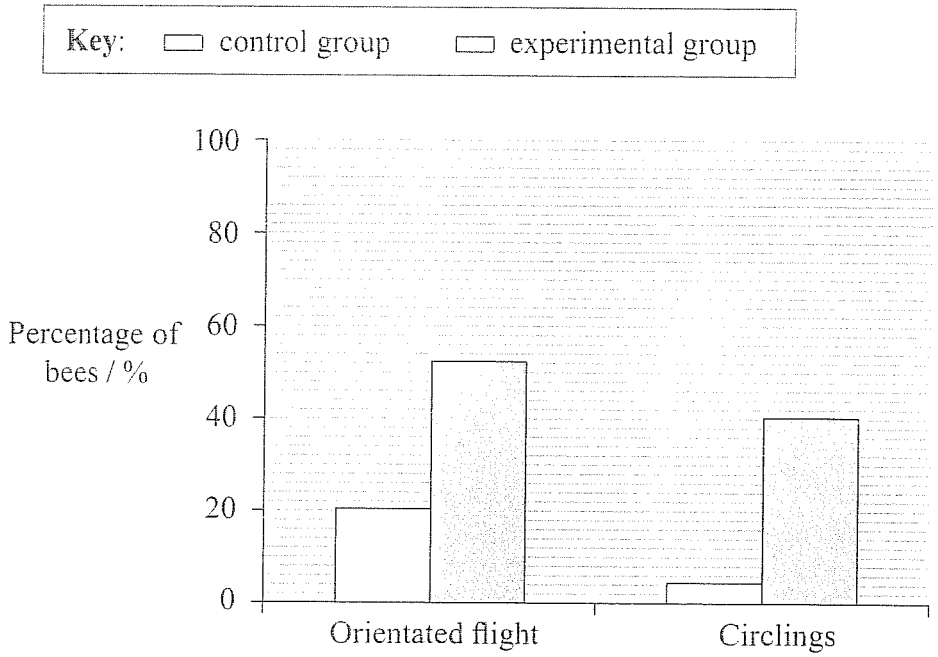
Option E — Neurobiology and behaviour

E1. There is significant evidence that bees use odours as cues for much of their behaviour. Scientists placed bees into a wind tunnel 200 cm from an attractive odour source. The experimental group of bees had previous exposure to the attractive odour, the control group had no previous exposure. The bees were measured for the total time spent flying, time spent flying around the odour source, orientated flights (flights towards the odour source) and circling behaviour.



[Source: adapted from A Chaffiol, *et al.*, (2005), *Journal of Experimental Biology*, **208**, pages 3731–3737]

(a) Describe the effect of previous exposure to the odour on the flight of bees. *[2]*

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(b) Outline the type of behaviour that the experimental group demonstrates. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(c) Discuss the implications of this study for the survival of bees. *[3]*

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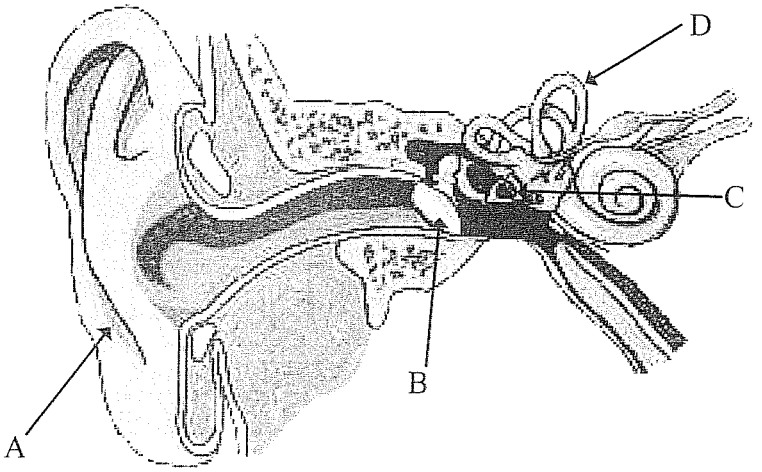
E2. (a) Label this diagram of the ear. *[2]*



A. .....

B. .....

C. .....

D. .....

(b) (i) Define *reflex*. *[1]*

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(ii) List **two** inhibitory psychoactive drugs. *[1]*

1. .....

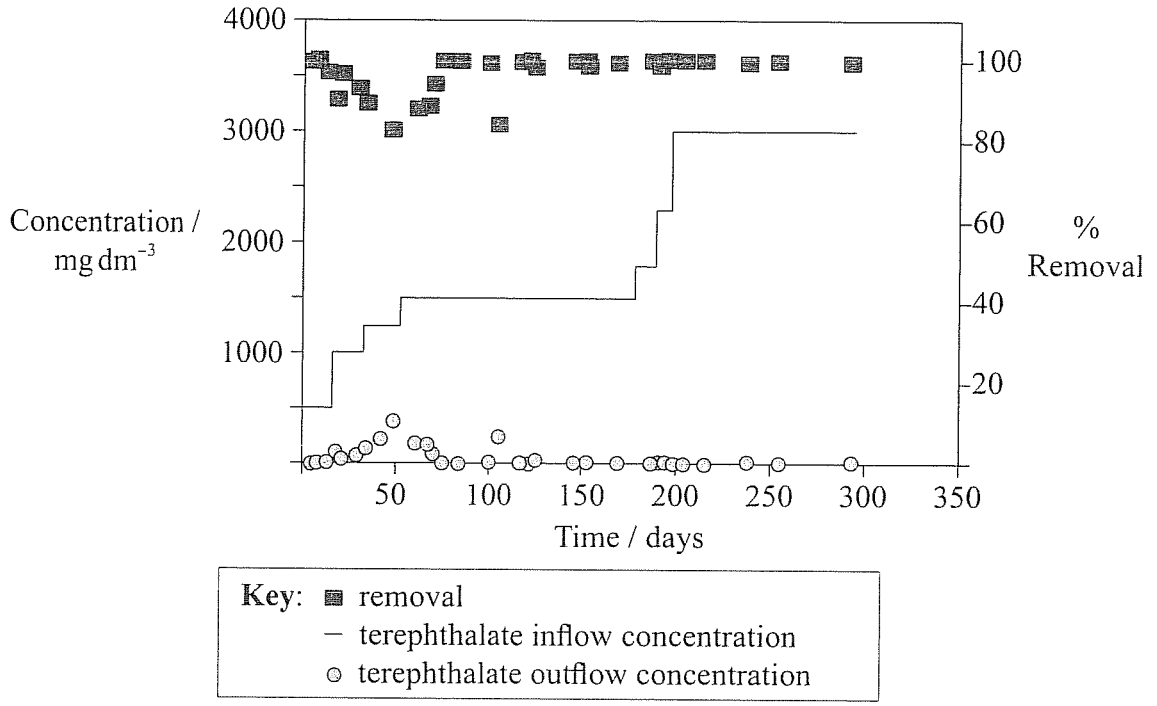
2. .....

E3. (a) Describe an experiment investigating innate behaviour in invertebrates. *[4]*

(b) Explain how fMRI (functional magnetic resonance imaging) scanning can be used in investigation of how the human brain functions. *[6]*

Option F — Microbes and biotechnology

F1. Wastewater from factories producing polyester fibres contains high concentrations of the chemical terephthalate. Efficient removal of this compound can be achieved by certain bacteria. The graph below shows what percentage of the compound can be removed from the wastewater in an experimental reactor. Researchers increased the amount of terephthalate entering the reactor stepwise over a 200 day period.



[Source: adapted from J H Wu, *et al.*, (2001), *Microbiology*, **147**, pages 373–382]

(This question continues on the following page)

(Question F1 continued)

(a) The reactor has a volume of 12 litres. Calculate the initial amount of terephthalate in the reactor. *[1]*

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(b) (i) Outline the relationship between terephthalate concentration in the outflow and percentage removal. *[2]*

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(ii) Suggest why the drop in removal percentage occurs. *[1]*

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(c) Deduce which bacteria can be used for the degradation of terephthalate. *[1]*

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(d) Evaluate the efficiency of the terephthalate removal. *[2]*

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F2. (a) State the roles of: *[1]*

Rhizobium: .....

Nitrosomonas: .....

(b) Outline the production of soy sauce. *[2]*

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F3. (a) Outline the diversity in structure of viruses. *[4]*

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(b) Discuss the origin and epidemiology of a pandemic. *[6]*

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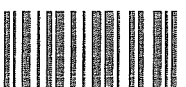
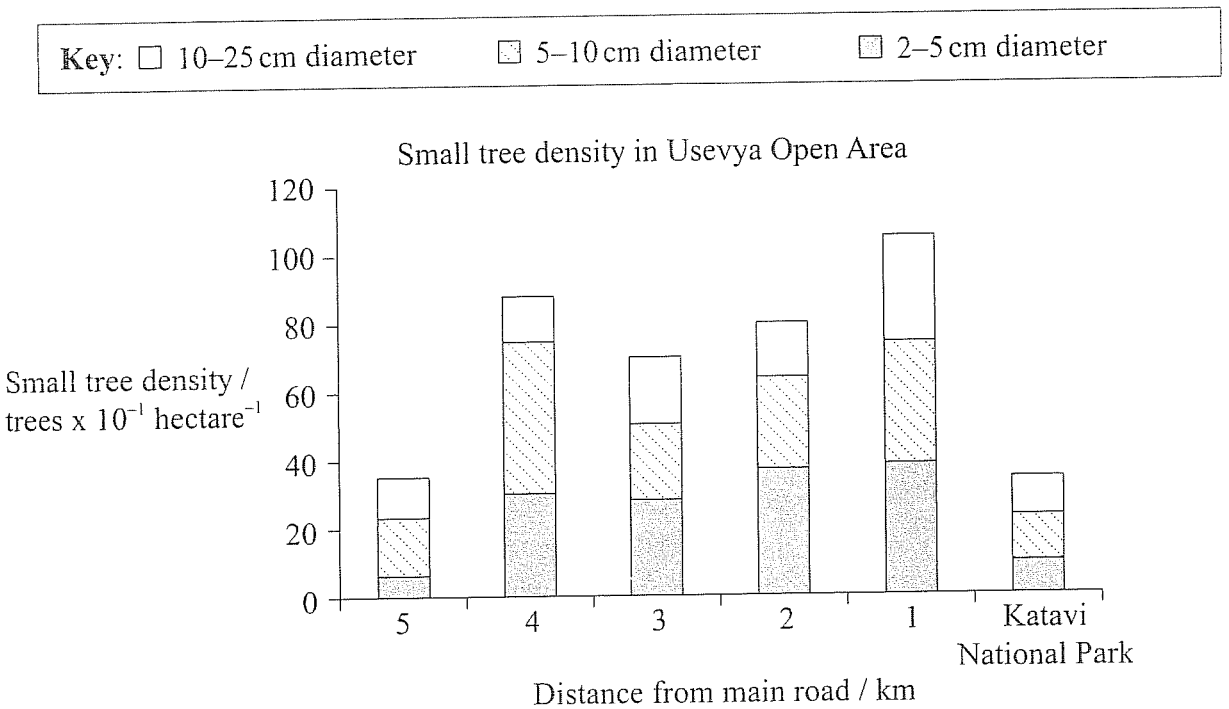


Option G — Ecology and conservation

G1. In south-central Africa trees are used for furniture production or building material by the local population. Large trees are cut down selectively. The densities of small trees were studied in Usevya Open Area where there are three settlements. Katavi National Park, where tree cutting is not allowed, is next to Usevya Open Area.

The graph below shows the density of three categories of small trees up to 25 cm in diameter at set distances from the main road.



[Source: adapted from M W Schwartz and T M Caro, (2003), *African Journal of Ecology*, **41**, pages 75–82]

(a) Identify the density of trees with a diameter between 5–10 cm in Usevya Open Area at a distance of 4 km from the main road. *[1]*

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(Question G1 continued)

(b) In Usevya Open Area describe the relationship between distance from the main road and small trees. *[2]*

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(c) Outline the density of small trees in Usevya Open Area. *[1]*

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(d) Discuss the distribution of small trees in Katavi National Park with those at a distance of 5 km from the road. *[3]*

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G2. (a) Define *biomass*. *[1]*

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(b) Outline the effects of ultraviolet (UV) radiation on living tissues. *[2]*

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G3. (a) Describe the causes and consequences of a **named** example of biomagnification. *[5]*

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(b) Discuss conditions that favour K-strategies. *[5]*

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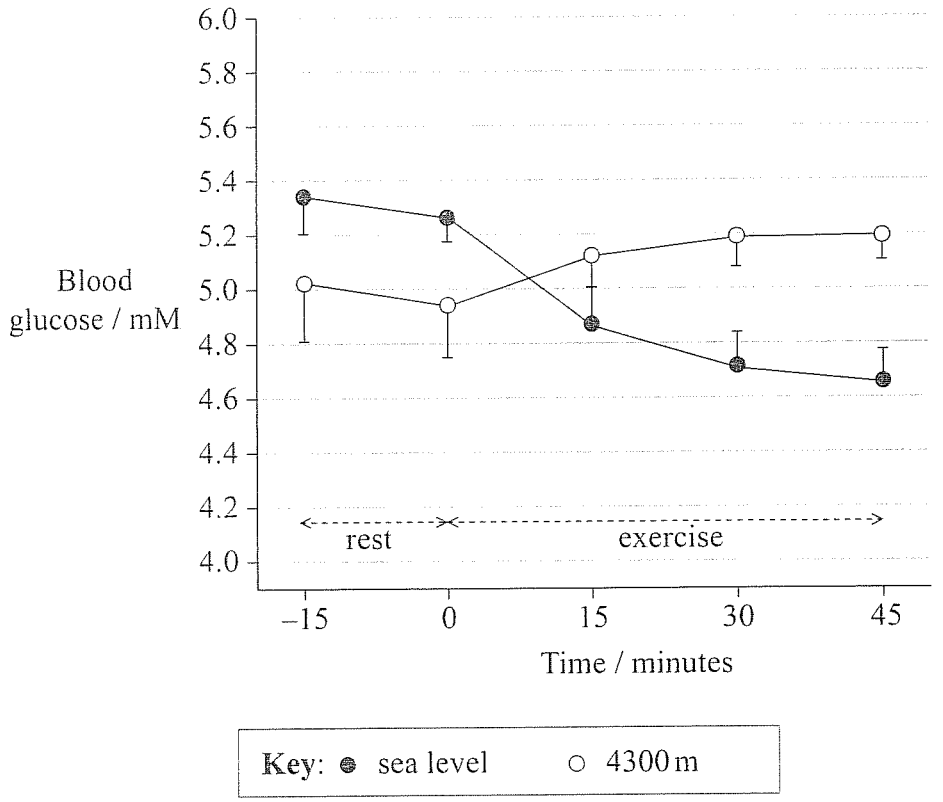
Option H — Further human physiology

H1. Sixteen women were studied to evaluate blood glucose and blood lactate levels while exercising at sea level and at high altitude, 4300 m above sea level.



[Source: adapted from B Braun, *et al.*, (2000), *Journal of Applied Physiology*, **88**, pages 246–256]

(This question continues on the following page)

(Question H1 continued)

(a) (i) Calculate the percentage increase in blood lactate concentration after 30 minutes of exercise at 4300 m. *[1]*

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(ii) Suggest a reason for the difference in blood lactate concentration between women exercising at sea level and at high altitude. *[1]*

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(b) Describe the variation in the blood glucose and lactate concentrations in the women at sea level. *[2]*

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(c) Analyse the effect of high altitude on the blood glucose and lactate levels. *[3]*

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H2. (a) Outline mechanisms used by the ileum to absorb amino acids. *[2]*

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(b) State two materials which are not absorbed in the ileum. *[1]*

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H3. (a) Outline factors that affect the incidence of coronary heart disease. *[5]*

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(b) Discuss the roles of gastric acid and *Helicobacter pylori* in the development of stomach ulcers and cancers. *[5]*

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