22086015

International Baccalaureate®
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BIOLOGY
HIGHER LEVEL
PAPER 3

Thursday 15 May 2008 (morning)

1 hour 15 minutes

Candidate session number

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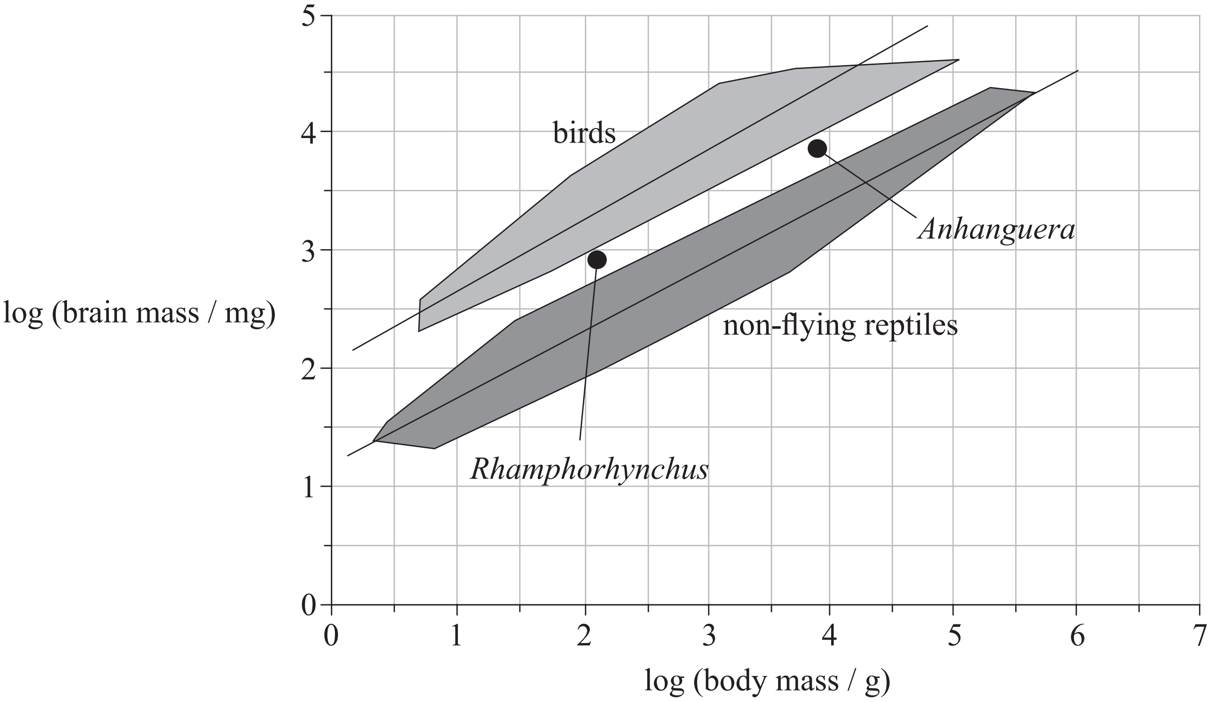
INSTRUCTIONS TO CANDIDATES

- 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.

Option D — Evolution

D1. As the ability to fly needs control by the nervous system, it is to be expected that the evolution of flight should have been accompanied by changes in the nervous system. Casts were made of the skulls from two extinct flying reptiles, *Rhamphorhynchus* and *Anhanguera*.

The graph below shows the brain mass and body mass of these two individuals. It also shows the range of brain mass and body mass for living birds and living non-flying reptiles.



[Source: Reprinted by permission from Macmillan Publishers Ltd: L W Witmer *et al*., 'Neuroanatomy of flying reptiles and implications for flight, posture and behaviour', *Nature,* **425**, (October 2003), page 950-3, © 2003]

(a) Compare the brain mass of birds and non-flying reptiles. *[3]*

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(This question continues on the following page)

(Question D1 continued)

(b) Suggest **one** reason, based on the data, for the extinction of *Rhamphorhynchus* and *Anhanguera*. *[1]*

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(c) Using the data in the graph, evaluate the claim that larger brains evolved to support the demands of flight. *[2]*

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D2. (a) State the conclusion drawn from the Miller-Urey experiment. *[1]*

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(b) Discuss a possible origin of membranes. *[2]*

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(c) In the Hardy-Weinberg equation $(p^2 + 2pq + q^2 = 1)$, state what 2pq represents. *[1]*

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D3. (a) Outline the evolutionary trends seen in fossils from *Homo habilis* to *Homo sapiens*. *[4]*

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(b) Discuss the process of speciation. *[6]*

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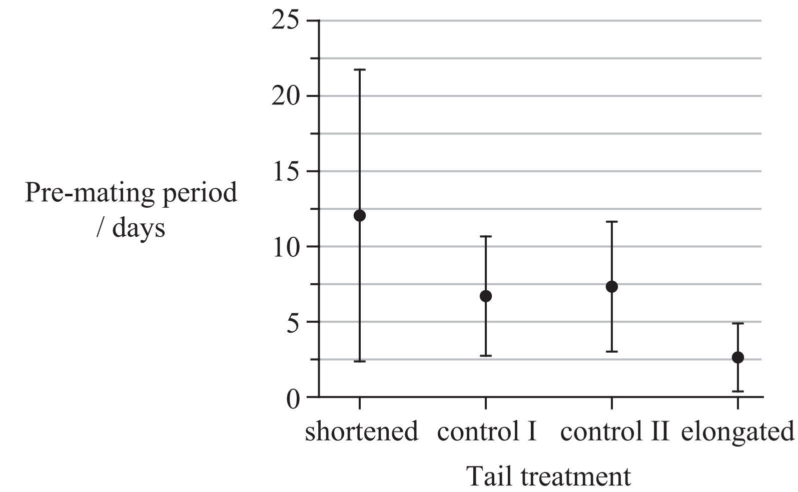
Option E — Neurobiology and Behaviour

E1. The barn swallow *(Hirundo rustica)* usually has one mate. A study was conducted to examine mate selection in barn swallows.

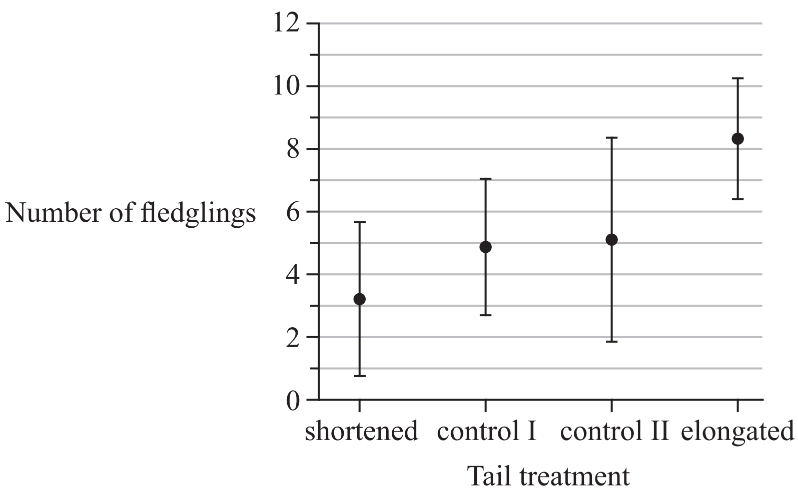
The hypothesis was that females prefer to mate with males displaying longer tail feathers. Four groups of male birds were captured for study. The first group had its tail feathers shortened. The second group (control I) had its tail feathers shortened and the pieces reattached. The third group (control II) was unaltered. The fourth group had its tail feathers elongated by attaching the pieces removed from the shortened group.

Graph A below shows the mean length of time required by each group to attract a mate (pre-mating period). Graph B shows the reproductive success of each group of male birds *i.e.* the number of chicks that reached full development and were ready to fly (fledglings) by the end of the reproductive season. The vertical lines on both graphs indicate the variability of the data.

Graph A



Graph B



[Source: adapted from Moller reported in *Evolutionary Analysis*, by J C Herron (2001), Prentice Hall, New Jersey]

(This question continues on the following page)

(Question E1 continued)

(a) Determine the difference in the mean pre-mating period for the elongated versus the shortened treatment groups. *[1]*

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(b) State the relationship between tail length and the number of fledglings. *[1]*

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(c) Suggest reasons for the difference in reproductive success of the shortened and elongated tail treatment groups. *[2]*

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(d) Explain the conclusions that can be drawn from the data for control I and control II. *[3]*

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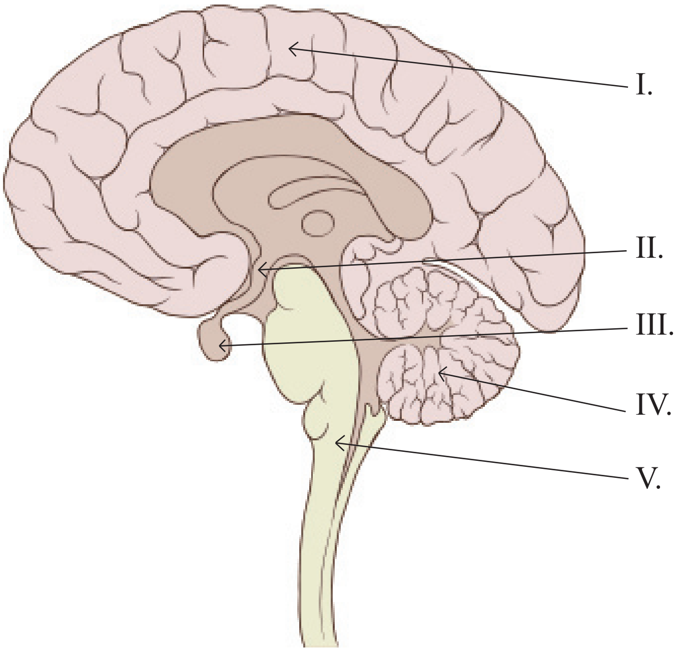
E2. (a) In the diagram of the brain below identify the name of the structures labelled I to V. *[2]*



I. . . . .

II. . . . .

III. . . . .

IV. . . . .

V. . . . .

[Source: Patrick J. Lynch, medical illustrator, Creative Commons Attribution 2.5 License 2006]

(b) Explain how a presynaptic neuron can inhibit a postsynaptic neuron. *[2]*

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E3. (a) Outline **two** examples of how the conscious part of the brain controls autonomic reflexes. *[3]*

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(b) With reference to **two** examples, discuss altruistic behaviour in social organizations. *[6]*

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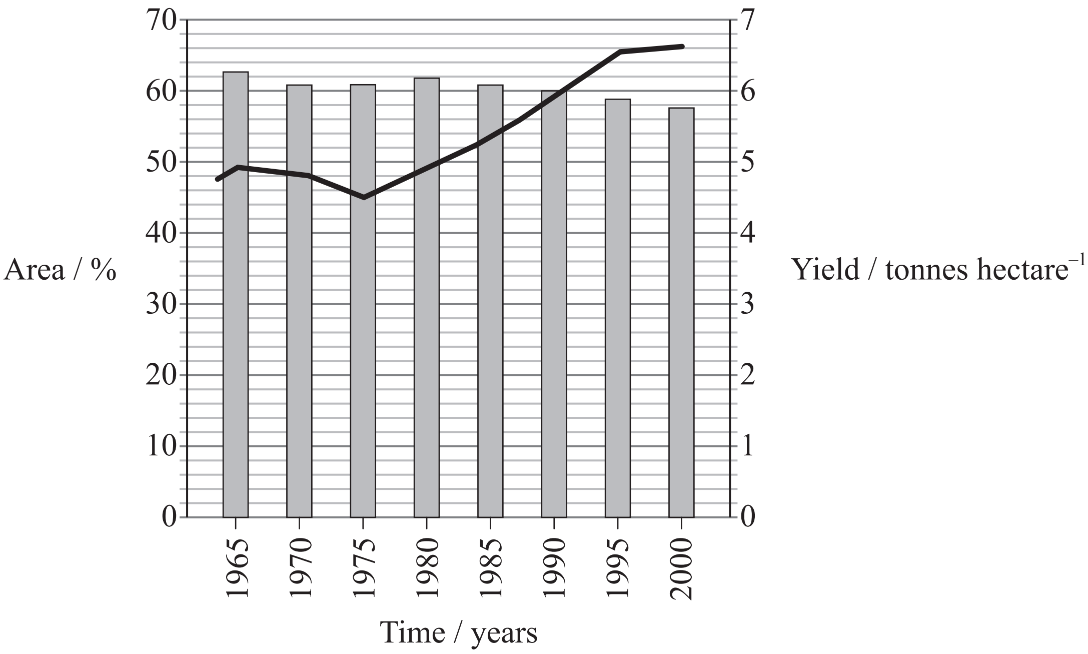
Option F — Applied Plant and Animal Science

F1. Since the mid 1980s, the use of pesticides and commercial fertilizers has declined in Denmark. Reduced application of these chemicals in agriculture has decreased environmental impacts, including pollution of groundwater with pesticides and decreased discharges of nutrients into watercourses, lakes and the sea. At the same time, the total amount of land available for growing crops such as barley has been reduced.

The graph below shows the agricultural area as a percentage of the total area of Denmark, and the yield per hectare of barley in Denmark.



Key: agriculture area — tonnes of barley per hectare (1 tonne = 1000 kg)

[Source: Statistics Denmark and the National Forest and Nature Agency, www.mst.dk. Reproduced with the permission of Frontlinien - The Danish Ministry of the Environment's Centre for Information.]

(a) Determine the change in percentage area under cultivation in Denmark between 1980 and 2000. *[1]*

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(b) Calculate the percentage change in barley yield per hectare from 1980 to the year 2000. *[2]*

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(This question continues on the following page)

(Question F1 continued)

(c) Suggest **two** methods that might have been used to increase barley yields without the use of chemicals. *[2]*

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(d) Discuss whether current trends in barley yields are sustainable. *[2]*

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F2. (a) List **two** veterinary techniques that have been used to improve the fecundity of animals. *[1]*

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(b) Describe how plant growth regulators can be used to produce fruit without seeds. *[2]*

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F3. (a) Outline the techniques involved in the production of Flavr-Savr™ tomatoes. *[4]*

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(b) Explain how flowering is controlled in long-day plants and short-day plants. *[6]*

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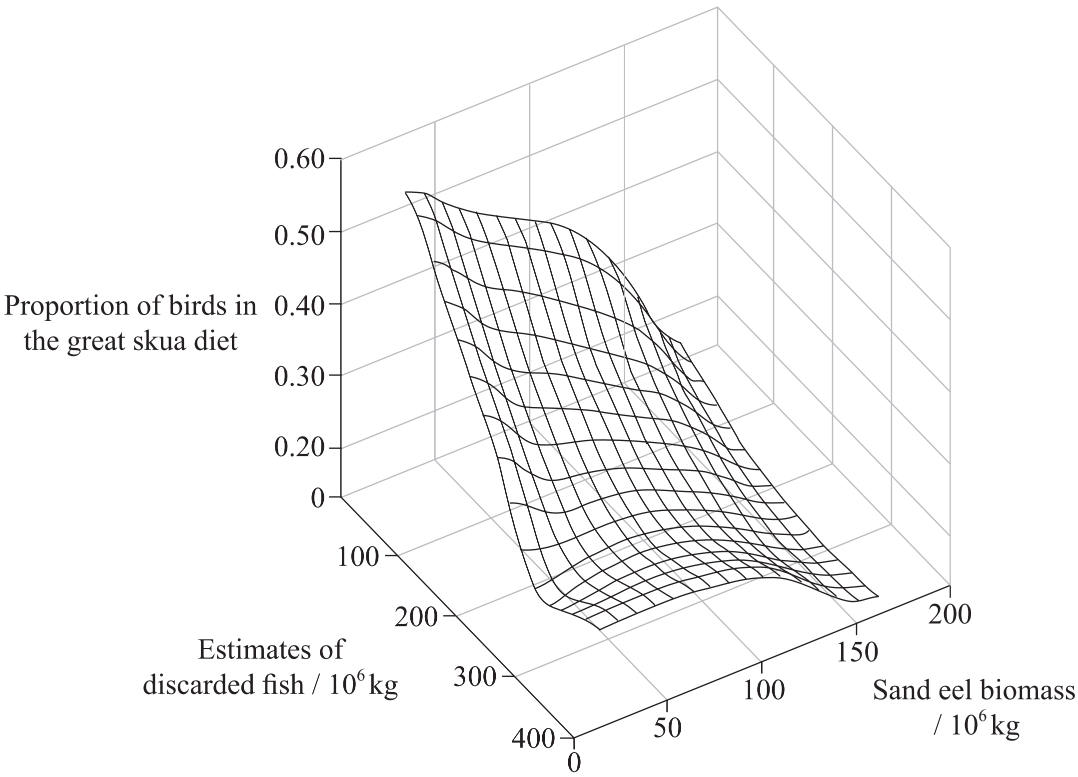
Option G — Ecology and Conservation

G1. Fishing activities in marine ecosystems often result in catching unwanted species in addition to the target species. Together with undersize fish, this unwanted catch is often discarded. Discarded fish are a key food resource for many seabird species. The great skua *(Stercorarius skua)* is a scavenger which feeds on other birds, sand eels and discarded fish.

The graph below shows the effect of the size of the sand eel population and the estimated amount of discarded fish on the proportion of birds in the great skua diet.



[Source: Reprinted by permission from Macmillan Publishers Ltd: adapted from S C Votier *et al*., 'Changes in fisheries discard rates and seabird communities', *Nature*, (19 February 2004), **427** (6976), page 727, © 2004]

(a) State the relationship between the amount of discarded fish and the proportion of birds in the great skua diet when sand eel biomass is low. *[1]*

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(This question continues on the following page)

(Question G1 continued)

(b) Outline the relationship between sand eel biomass and the proportion of birds in the great skua diet when the estimated amount of discarded fish is high. *[2]*

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(c) Suggest **one** reason why the amount of discarded fish may decrease in the future. *[1]*

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(d) Predict **two** possible consequences on the ecological community structure if the amount of discarded fish decreases. *[2]*

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G2. (a) Outline **one** example of mutualism. *[2]*

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(b) Explain why plowing soils might prevent the denitrification of soils. *[2]*

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G3. (a) Outline the use of a biotic index in identifying environmental change. *[4]*

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(b) Discuss the relationship between CFCs and the hole in the ozone layer. *[6]*

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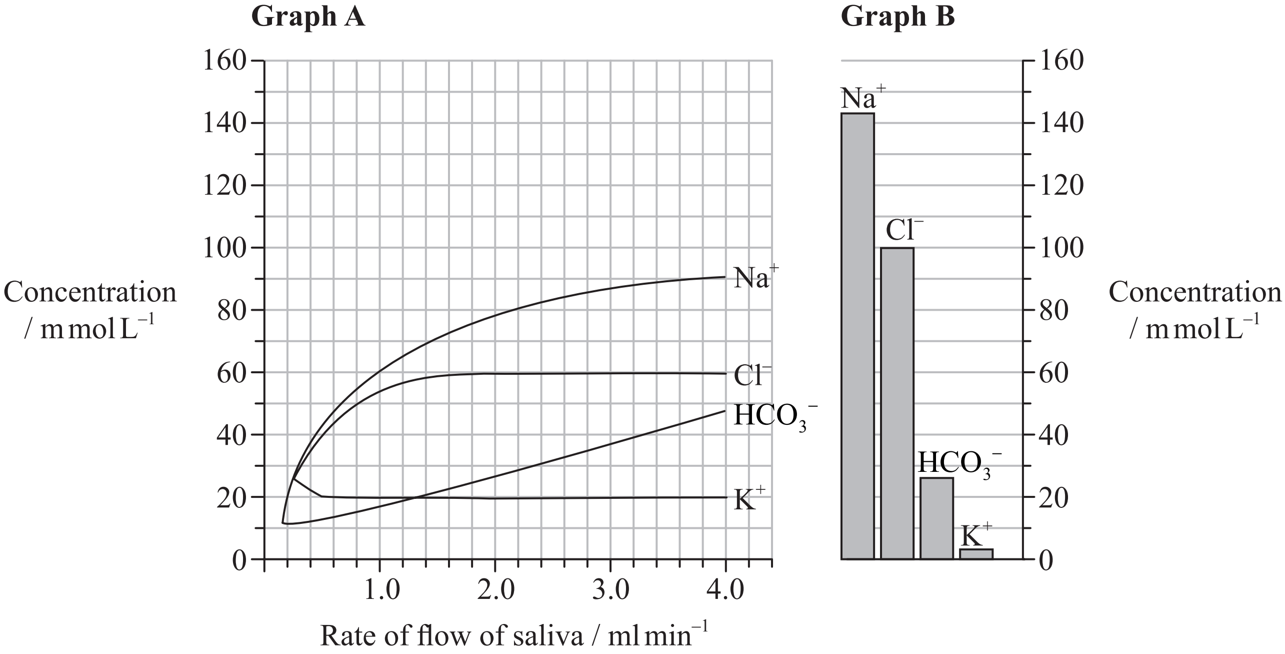
Option H — Further Human Physiology

H1. In the production of saliva, the acinar cells actively transport ions from the blood plasma into the ducts of the salivary gland resulting in water being drawn into the ducts. As this saliva moves down the duct, some ions are re-absorbed but the amount that can be re-absorbed depends on the rate of flow of saliva.

Graph A below shows how the composition of saliva varies depending on the rate of flow of saliva. Graph B shows the composition of blood plasma.



[Source: Jørn Hess Thaysen and Niels A. Thorn, Excretion of Urea, Sodium, Potassium and Chloride in Human Tears, American Journal of Physiology, 178: 160-164, 1954. American Physiological Society.]

(a) Using the data provided compare the concentration of ions in saliva produced at 4.0 ml min^{-1} with the concentration of those ions in the blood plasma. *[2]*

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(This question continues on the following page)

(Question H1 continued)

(b) Outline the relationship between the concentration of Na^+ in saliva and the rate of flow of saliva. *[2]*

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(c) As the saliva moves down the ducts, Na^+ is re-absorbed into the blood plasma. Deduce, with a reason, the type of transport used to bring Na^+ back into the blood plasma. *[1]*

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(d) Suggest why the concentration of Na^+ varies with rate of flow. *[2]*

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H2. (a) State **one** role of osmoreceptors in the hypothalamus. *[1]*

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(b) Explain the role of chemoreceptors in the regulation of ventilation rate. *[2]*

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H3. (a) Outline the circulation of blood through the liver. *[4]*

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(b) Explain the problem of gas exchange at high altitudes and the way the body acclimatizes. *[6]*

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