IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N03/410/S(2)

BIOLOGY
STANDARD LEVEL
PAPER 2

Candidate number

Friday 14 November 2003 (afternoon)

1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

- Write your candidate number in the box above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your candidate 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 numbers of the questions 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.

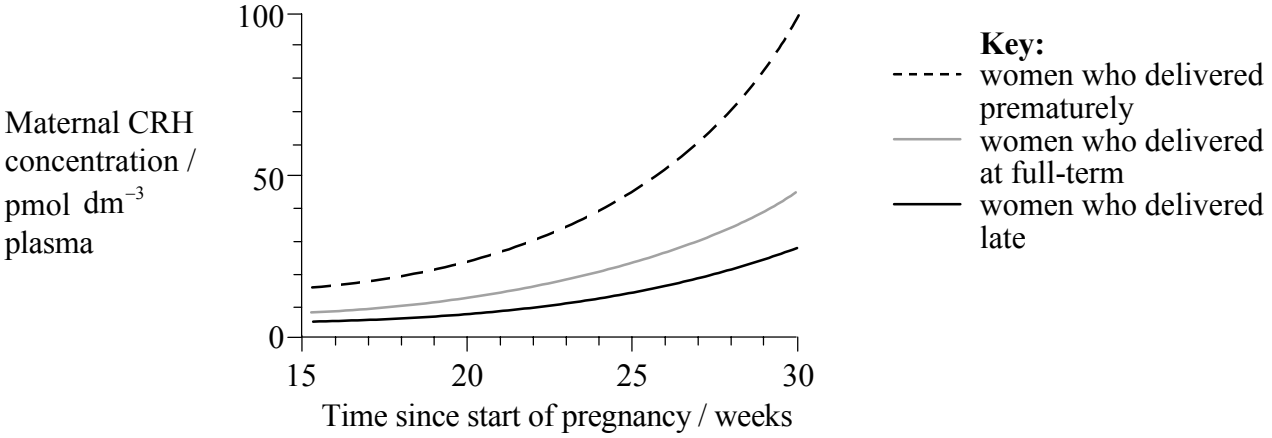
SECTION A

*Answer **all** the questions in the spaces provided.*

1. Near the middle of pregnancy in humans, the placenta begins to secrete a hormone called corticotrophin-releasing hormone (CRH). CRH influences the production of hormones which stimulate the development of the fetus.

A study was carried out to determine if levels of CRH were correlated with the timing of the baby's delivery. Blood samples were taken from 500 women during their pregnancies and the concentration of CRH was measured. The women were then divided into three groups according to whether their baby was delivered prematurely, at full-term (about 40 weeks) or late.

The graph below shows how the concentration of CRH varied in the mothers' blood (maternal blood) in each of the three groups during pregnancy.



[Source: R Smith, *Scientific America*, (March 1999), pages 68–75]

(a) Outline how the concentration of CRH in the blood changes during the pregnancies of women who delivered prematurely. *[2]*

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(b) Compare how the concentration of CRH changes during the pregnancies of women who delivered late with those that delivered at full-term. *[2]*

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(Question 1 continued)

(c) Measure the difference in CRH concentration at 30 weeks between the women who delivered prematurely and those that delivered at full-term. *[1]*

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(d) Suggest how knowledge of the CRH concentration in maternal blood might be used by doctors monitoring pregnancies. *[2]*

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The Western spadefoot toad *(Scaphiopus hammondii)* lives in desert areas in California and lays its eggs in pools formed by rain. When the egg first hatches, its body form is referred to as the tadpole stage. At some point, it undergoes metamorphosis (a change in body form) to develop into the adult toad.

If the pools where the eggs have been laid shrink due to a lack of rain, the tadpoles quickly develop into small adult toads. If there is sufficient rain and the pools persist, the tadpoles develop more slowly and grow large before developing into adult toads.

(e) Suggest how undergoing metamorphosis at different times in response to water levels helps the survival of the toad. *[3]*

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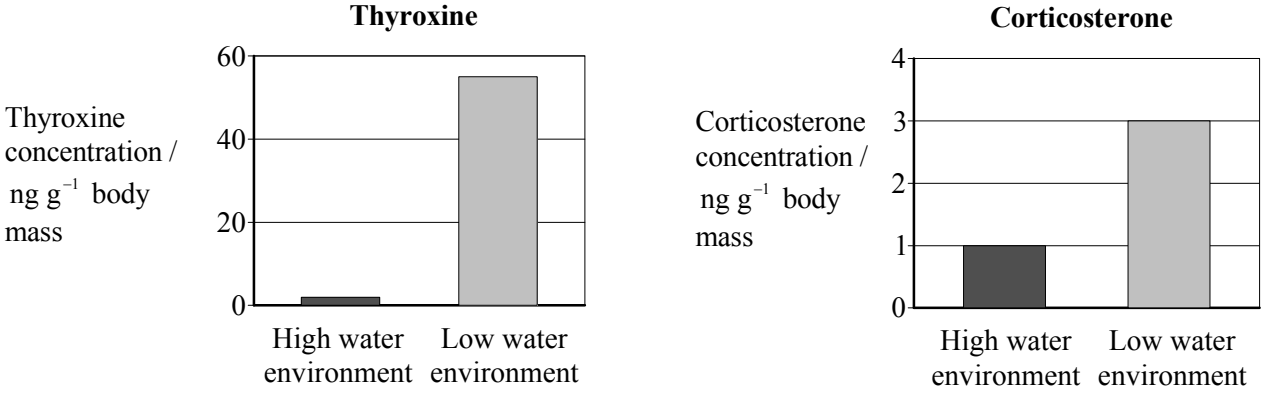
(Question 1 continued)

It has been suggested that CRH control of development might have evolved in amphibians long before mammals appeared. In toads, increase in CRH concentration leads directly to an increase in the level of the hormone thyroxine and indirectly to an increase in corticosterone levels.

An experiment was carried out to determine what hormones might be involved in triggering development in response to pond drying. Tadpoles were raised in a constant high water level environment. They were then divided into two groups. One group was transferred to a tank containing 10 dm^3 of water – a high water environment. The other group was transferred to a tank of the same size containing only 1 dm^3 of water – a low water environment. The concentrations of thyroxine and corticosterone were measured in each group. The results are shown below.



[Source: R J Denver, *General and Comparative Endocrinology*, (1998), **110**, pages 326–336]

(f) Compare the concentrations of thyroxine and corticosterone in the two groups. *[2]*

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(g) Predict how the concentration of CRH would be different in the two groups. *[1]*

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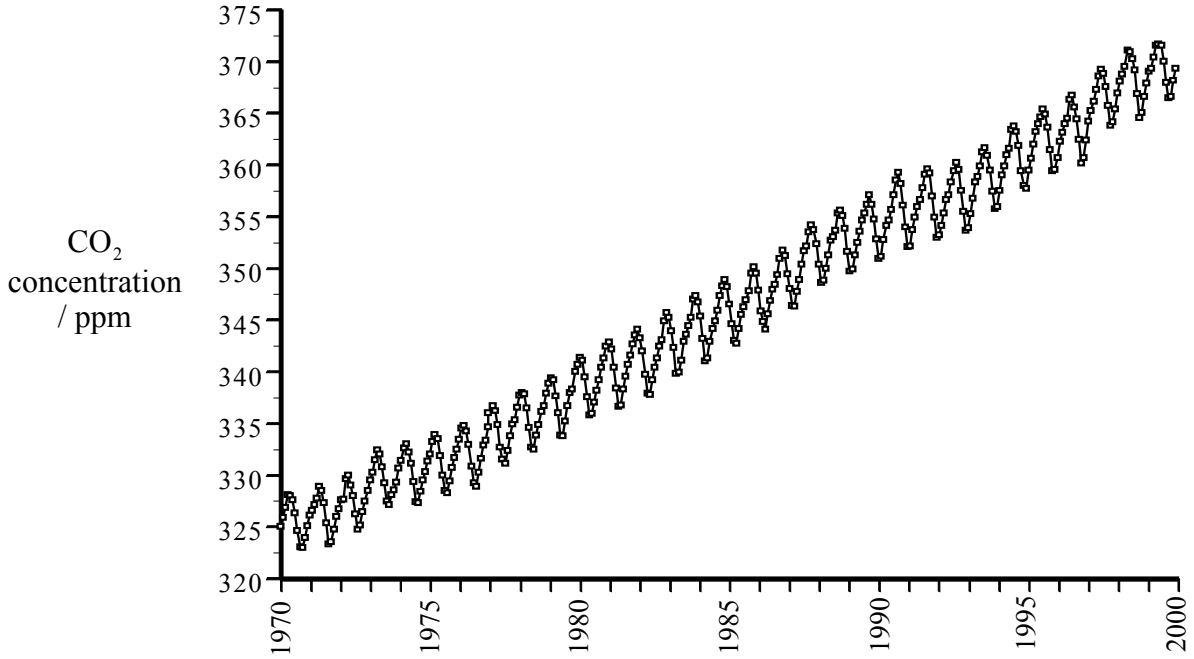
2. The graph below shows the variation in the concentration of atmospheric carbon dioxide since 1970.



[Source: C D Keeling and T P Whorf, *Atmosphere CO_2 concentrations (ppm) derived from in situ air samples*, collected at Mauna Loa Observatory, Hawaii]

The annual fluctuation is mainly the result of changes in the levels of photosynthesis associated with the seasons in Northern Hemisphere forests.

(a) (i) Describe the overall trend shown in the graph. *[1]*

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(ii) Suggest a cause for the overall trend throughout the period 1970–1999. *[1]*

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(b) (i) Using a clear label, identify any **one** point on the graph which shows the CO_2 level in mid-summer. *[1]*

(ii) Explain why the concentration of CO_2 varies with the seasons. *[2]*

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(c) Identify **one** gas, other than CO_2, which is contributing to the enhanced greenhouse effect. *[1]*

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3. The surface area to volume ratio is an important variable in determining biological structure.

(a) Explain the importance of the surface area to volume ratio as a factor limiting cell size. *[2]*

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(b) Define the term *absorption*. *[1]*

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(c) State **one** feature of alveoli that adapts them to gas exchange. *[1]*

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(d) Figure 1 below shows a cross-section through the small intestine and Figure 2 an enlarged longitudinal section through a single villus.

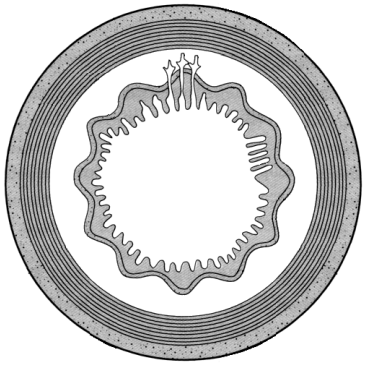

Figure 1

[Source: adapted from M Roberts *et al.*, *Advanced Biology*, Nelson, 2000, page 185]

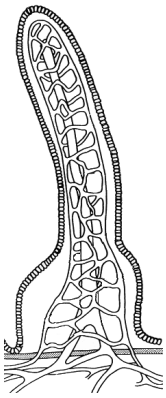

Figure 2

[Source: adapted from D J Taylor *et al*, *Biological Science 1*, Cambridge University Press, 1997, page 244]

Using these diagrams, outline **three** ways in which the structure of the small intestine is related to its function of absorbing food. *[3]*

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4. (a) Define the term *species.* *[2]*

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(b) List **three** kingdoms into which living organisms are classified. *[1]*

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(c) The seven levels used in hierarchy of taxa are:

Kingdom, Phylum, Class, Order, Family, Genus and Species.

State which **two** are used in the binomial system of nomenclature. *[1]*

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SECTION B

*Answer **one** question. Up to two additional marks are available for the construction of your answer. Write your answers on the answer sheets provided. Write your candidate number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

5. (a) Draw diagrams to show the four stages of mitosis in an animal cell with four chromosomes. *[5]*

(b) Outline the differences between the behaviour of the chromosomes in mitosis and meiosis. *[5]*

(c) Discuss the ethical issues of *in vitro* fertilisation (IVF) in humans. *[8]*

6. (a) Draw a diagram showing the molecular structure of a section of the DNA molecule. *[5]*

(b) Outline the process of translation. *[5]*

(c) Explain the effects of temperature, pH and substrate concentration on enzyme activity. *[8]*

7. (a) List the functions of membrane proteins. *[4]*

(b) Describe the cause, transmission and effect of **one** human bacterial disease. *[6]*

(c) Explain **two** examples of evolution in response to environmental change. *[8]*