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

N06/4/BIOLO/HP3/ENG/TZ0/XX+

88066003

BIOLOGY
HIGHER LEVEL
PAPER 3

Friday 17 November 2006 (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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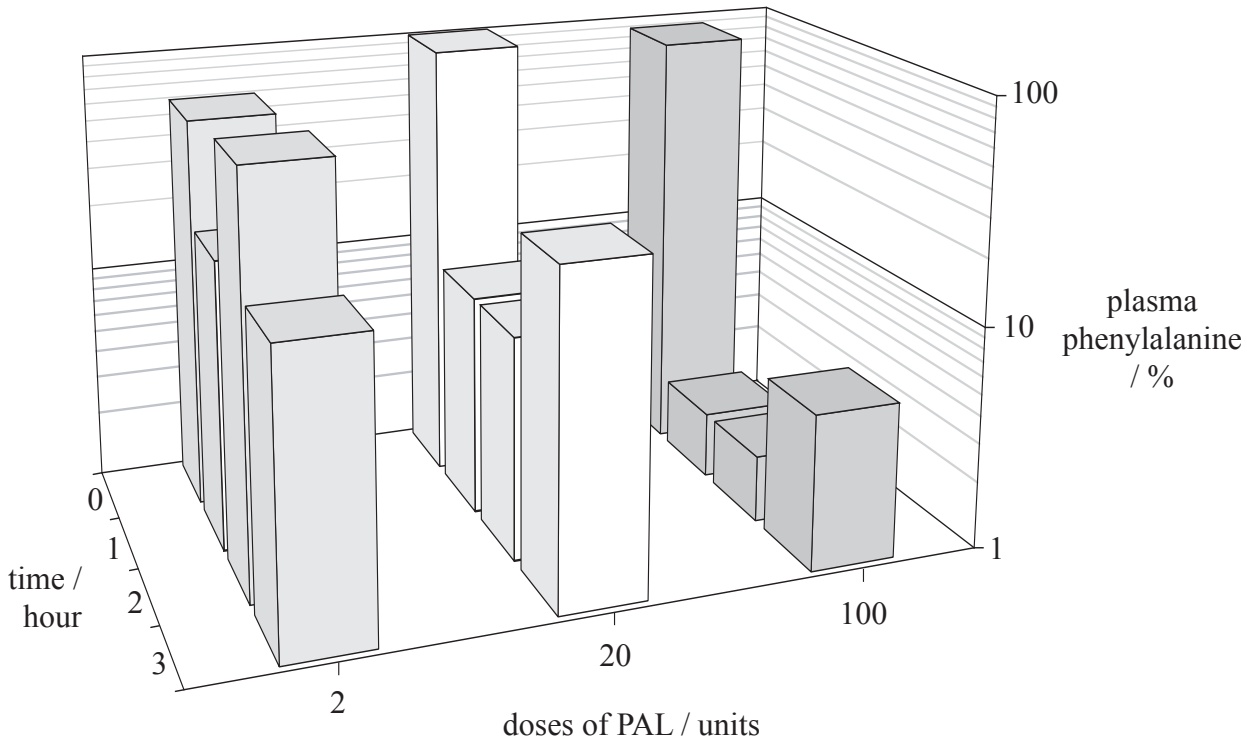
Option D — Evolution

D1. Phenylketonuria (PKU) is a disease caused by a gene mutation that makes too much phenylalanine which may cause brain damage. The enzyme phenylalanine ammonia lyase (PAL), converts phenylalanine into harmless products. Mice with PKU were injected with PAL. The levels of phenylalanine in blood plasma were measured immediately after the injection (0 hour) and every hour for the next three hours. Different groups of mice with PKU were injected with three different doses of PAL. The results are shown below as a percentage of the levels of phenylalanine before the PAL injection.



[Source: C Sarkissian *et al.*, (March 1999), *Proceedings of the National Academy of Sciences*, **96**, pages 2339–2344
]

(a) Calculate the approximate percentage reduction in phenylalanine at 0 hour when the mice were injected with a dose of two units of PAL. *[1]*

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(b) Outline the effect of a dose of twenty units of PAL on phenylalanine levels. *[2]*

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(This question continues on the following page)

(Question D1 continued)

(c) Discuss the effectiveness of the different doses of PAL to treat PKU mice. *[3]*

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(d) Outline how the type of mutation that causes PKU differs from Klinefelter's syndrome. *[1]*

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D2. (a) Define and describe **one** example of balanced polymorphism. *[2]*

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(b) State which theory suggests that eukaryotic cells could have evolved from prokaryotic cells. *[1]*

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D3. (a) Describe the major physical features that define humans as primates. *[4]*

(b) Explain how variations in specific molecules can indicate phylogeny. *[6]*

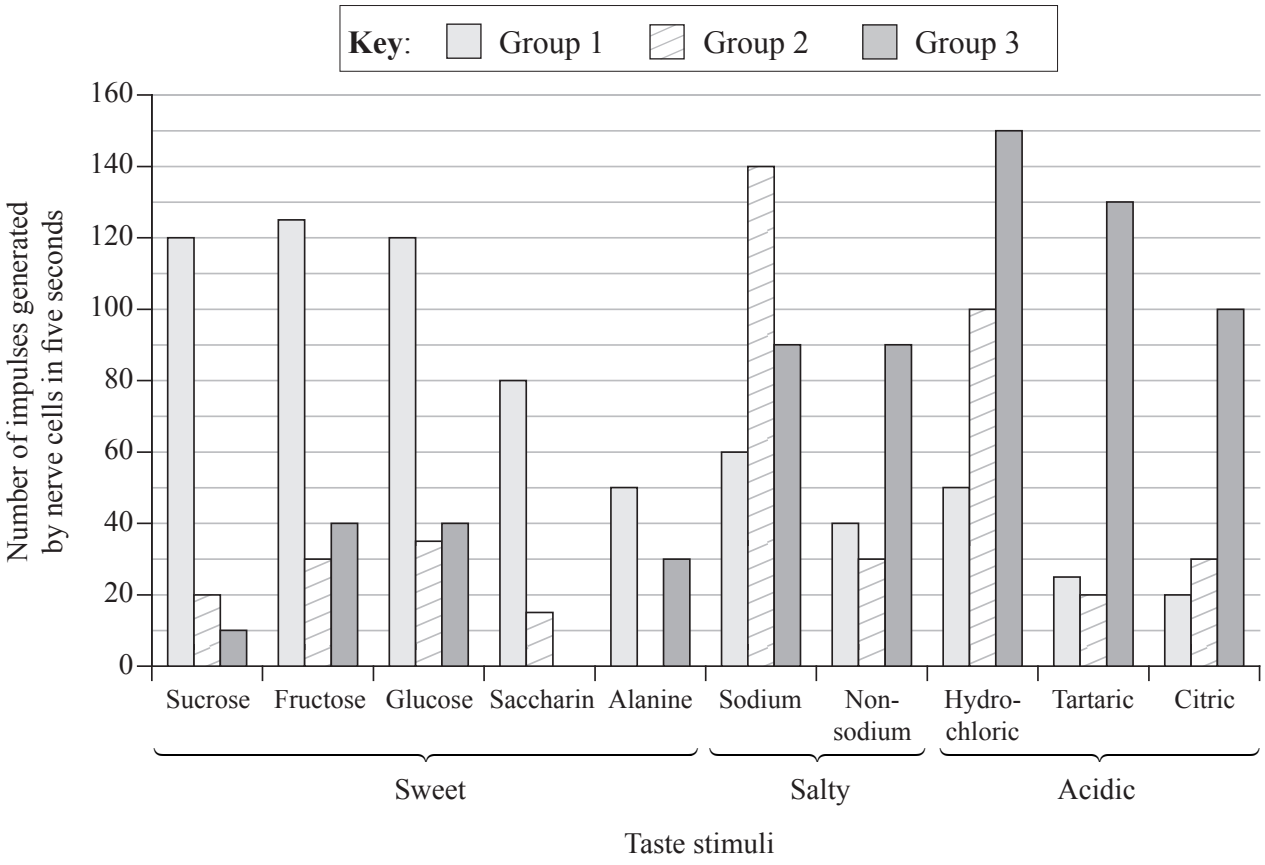
Option E — Neurobiology and Behaviour

E1. (a) Discuss the behavioural effects of cocaine. *[6]*

(b) Outline the pain withdrawal reflex and the components of reflex arc. *[4]*

E2. The brain can identify four basic tastes: salty, sour, sweet and bitter. These result from a variety of chemical reactions in the taste cells of the tongue. The various concentrations of ions in food cause the depolarization of taste cell membranes. This causes the release of neurotransmitters that stimulate neurons connected to the brain which can respond to more than one type of taste.

The bar chart below shows how three different groups of neurons respond to different tastes.



[Source: D V Smith and R F Margolskee, (March 2001), *Scientific American*, pages 26–33]

(a) Identify which group of neurons gives the greatest response to sweet taste. *[1]*

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(b) Compare the number of impulses generated by salty stimuli on neurons. *[2]*

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(This question continues on the following page)

(Question E2 continued)

(c) Predict how the taste cell membranes would react when a person eats a fruit rich in citric acid and fructose. *[3]*

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(d) Identify the type of sensory receptor which responds to taste stimuli. *[1]*

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E3. (a) Define the term *classical conditioning*. *[1]*

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(b) Moths are attracted to light. Explain what type of innate behaviour this demonstrates. *[2]*

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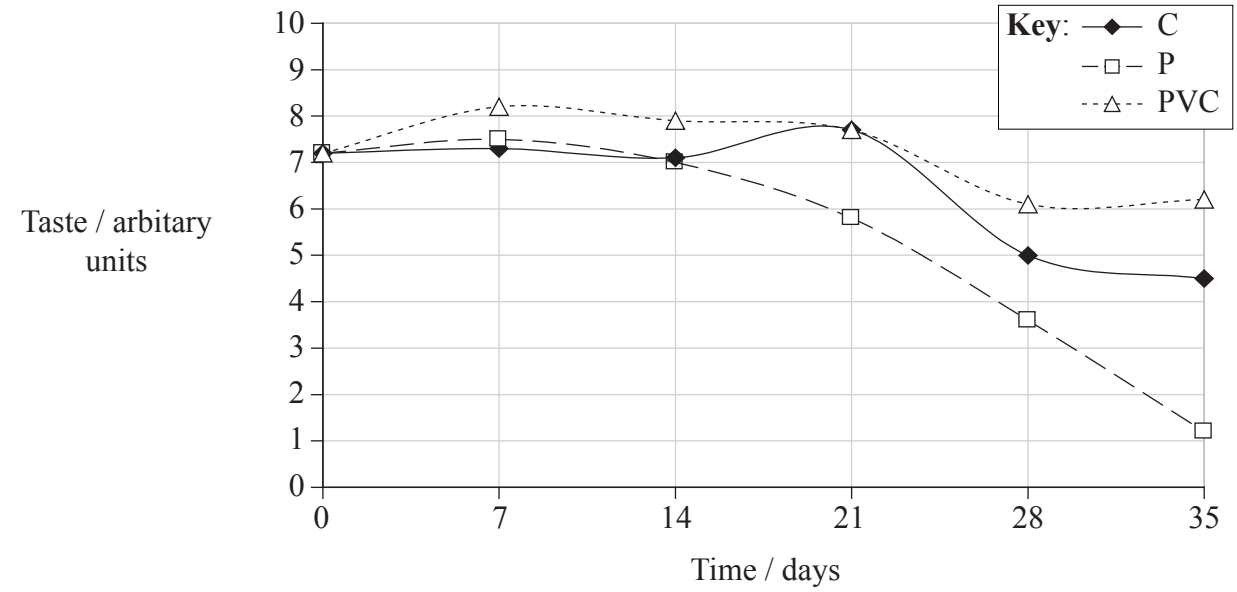
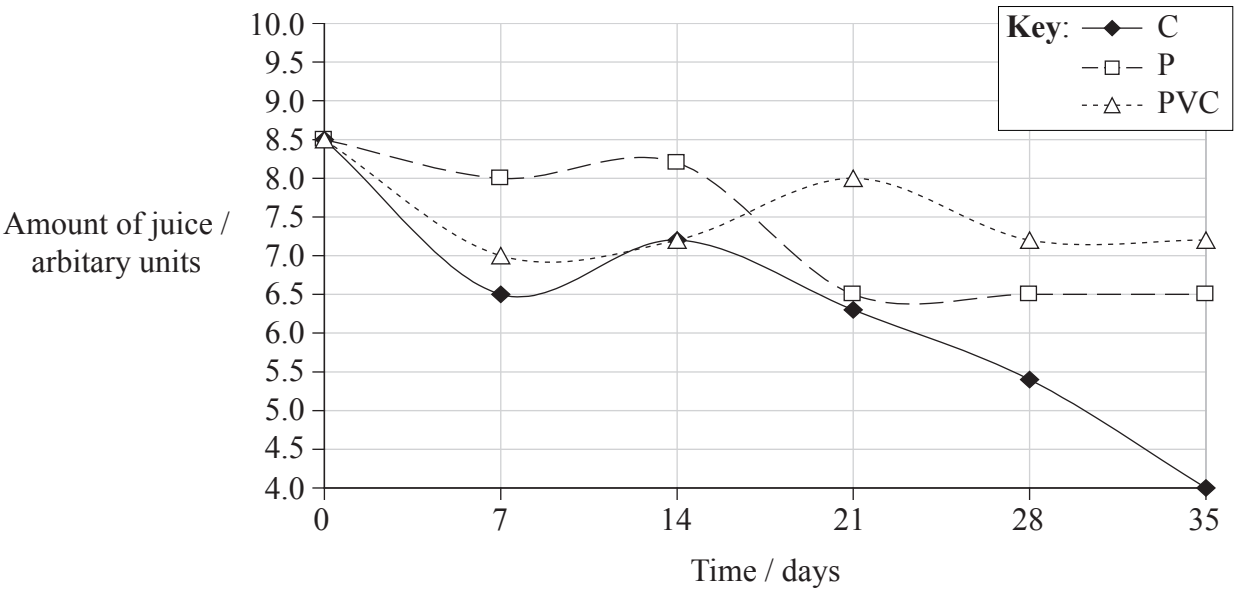
Option F — Applied Plant and Animal Science

F1. The quality of Sweetheart cherries can be judged by their taste and amount of juice they contain. The quality of these cherries decreases soon after being harvested and so various storage methods were investigated. 500 g of cherries were kept under the following conditions at 0 °C

- uncovered, as a control (C)
- in polythene bags (P)
- in polyvinyl chloride bags (PVC).

Trained "fruit testers" examined the taste and amount of juice every seven days. The results obtained after storage are shown in the graphs below as arbitrary units.





[Source: P Gomez *et al*. (2002), www.inta.gov.ar/balcarce/info/indices/alfabetico/abc/cereza.html, Instituto Nacional de Tecnología Agropecuaria]

(This question continues on the following page)

(Question F1 continued)

(a) State the amount of taste in uncovered cherries (C) after thirty-five days. *[1]*

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(b) Compare the effect of storage between those in polythene bags (P) and those uncovered (C), and the quality of the cherries after thirty-five days. *[2]*

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(c) Evaluate the efficiency of polythene bags (P) and polyvinyl chloride bags (PVC) in maintaining the amount of juice. *[2]*

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(d) People prefer to eat tasty, juicy cherries. Using only the data provided, discuss the best storage conditions for these cherries. *[2]*

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F2. Draw a diagram to show a flower of a cereal crop plant, such as wheat or rice, as seen with the naked eye and using a hand lens. Label clearly the structures that distinguish it as a wind pollinated flower. *[3]*

F3. (a) Discuss the biological issues and ethical issues concerning biological pest control. *[6]*

(b) Describe **one** example of the use of transgenic techniques in animals. *[4]*

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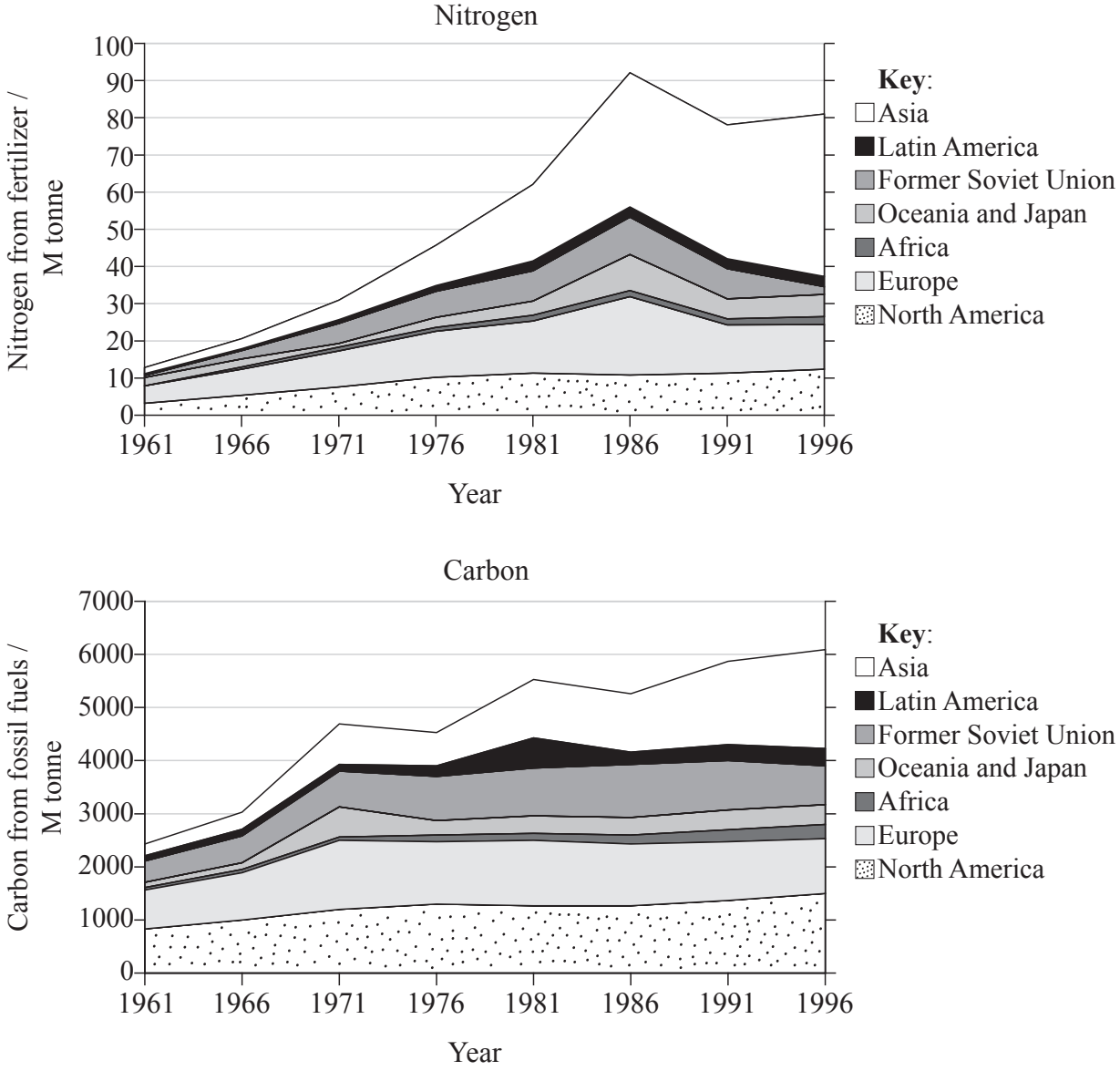
Option G — Ecology and Conservation

G1. (a) Explain the use of biotic indices to monitor environmental change. *[6]*

(b) Outline the use of the Simpson diversity index. *[4]*

G2. Food production is linked to the nitrogen cycle because considerable quantities of nitrogen are added to soil as fertilizers. This extra nitrogen contaminates drinking water, causes eutrophication of rivers and lakes and generally stresses ecosystems. Various chemical reactions in soil together with the burning of fossil fuels release nitrogen oxides into the air. These are effective greenhouse gases and contribute to acid rain and smog.

The graphs below show the release of nitrogen from fertilizer and carbon from fossil fuels (millions of metric tonnes) in seven world regions between 1961 and 1996.



[Source: adapted from R Socolow (1999), *Proceedings of the National Academy of Sciences*, **96**, (11), pages 6001–6008,
]

(This question continues on the following page)

(Question G2 continued)

(a) Identify the year in which most nitrogen was released from fertilizers. *[1]*

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(b) Compare the nitrogen released in Latin America in 1986 with 1991. *[1]*

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(c) Identify the world region that used the greatest amount of carbon from fossil fuels in 1996. *[1]*

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(d) Suggest a reason for the difference in overall nitrogen release between 1981 and 1986. *[2]*

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(e) State how nitrogen can be lost from the soil, other than by absorption in plants. *[1]*

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G3. (a) Define the term *net production*. *[1]*

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(b) Explain **one** factor other than water and temperature that affects the distribution of animal species. *[3]*

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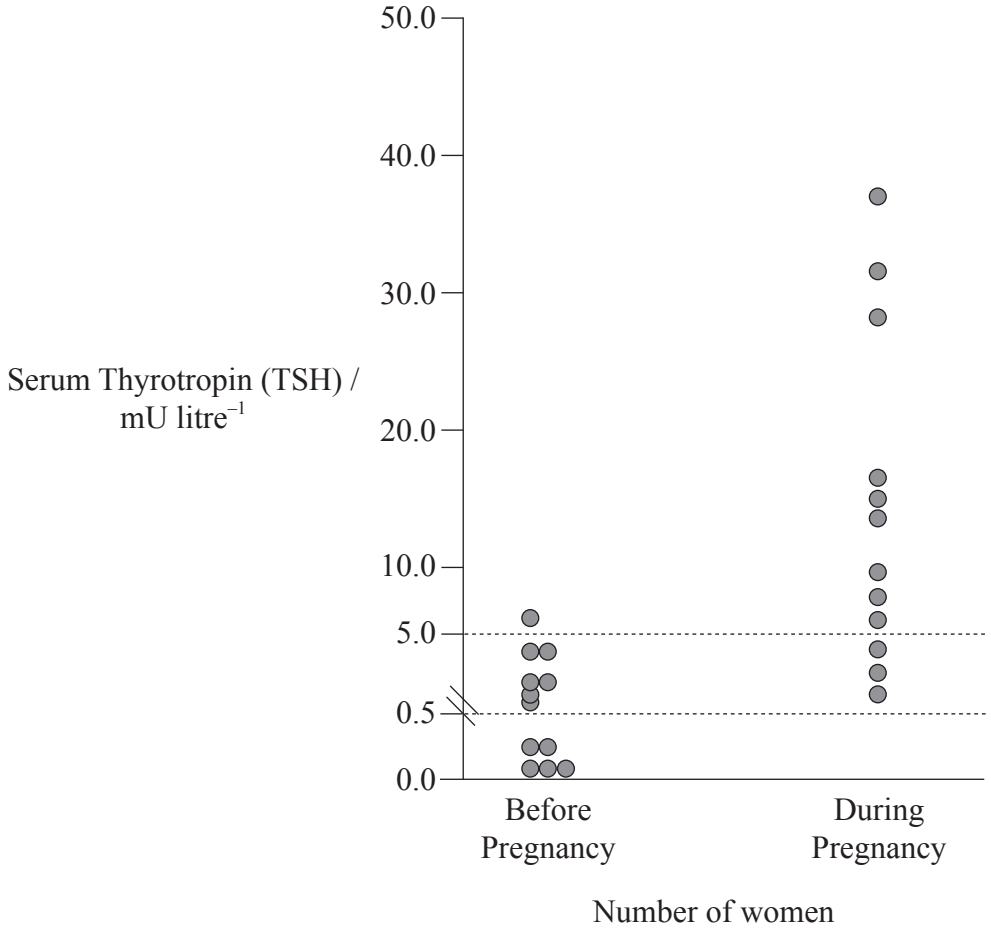
Option H — Further Human Physiology

H1. During pregnancy a condition called sub-clinical hypothyroidism can occur. This condition causes increased levels of thyrotropin (TSH) which triggers the release of a protein in blood serum. The protein then binds to thyroxin preventing it from working. Decreased levels of thyroxin can increase the risk of death in mother and fetus.

The graph below shows the levels of TSH in twelve women before and during pregnancy. The dotted lines show the safe lower and upper limits of TSH.



[Source: A Toft, *The New England Journal of Medicine*, **331**, no 3, (July 21 1994), pages 174–180**,**
]

(a) Identify the number of women in this study whose levels of TSH were within the safe limits before pregnancy. *[1]*

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(b) Calculate the proportion of women whose levels of TSH are above the safe limits during pregnancy. *[1]*

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(This question continues on the following page)

(Question H1 continued)

(c) Compare the levels of TSH in these women before and during pregnancy. *[2]*

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(d) Discuss why the results of this study contradict the normal control of thyroxin levels. *[3]*

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H2. (a) Explain the role of the Bohr shift in the release of oxygen to the respiring tissues. *[2]*

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(b) State the role of the sinoatrial node in the control of the heartbeat. *[1]*

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

(b) Explain lipid digestion in a hydrophilic medium. *[6]*