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

M06/4/BIOLO/HP2/ENG/TZ2/XX+

22066014

BIOLOGY
HIGHER LEVEL
PAPER 2

Thursday 4 May 2006 (afternoon)

2 hours 15 minutes

Candidate session number

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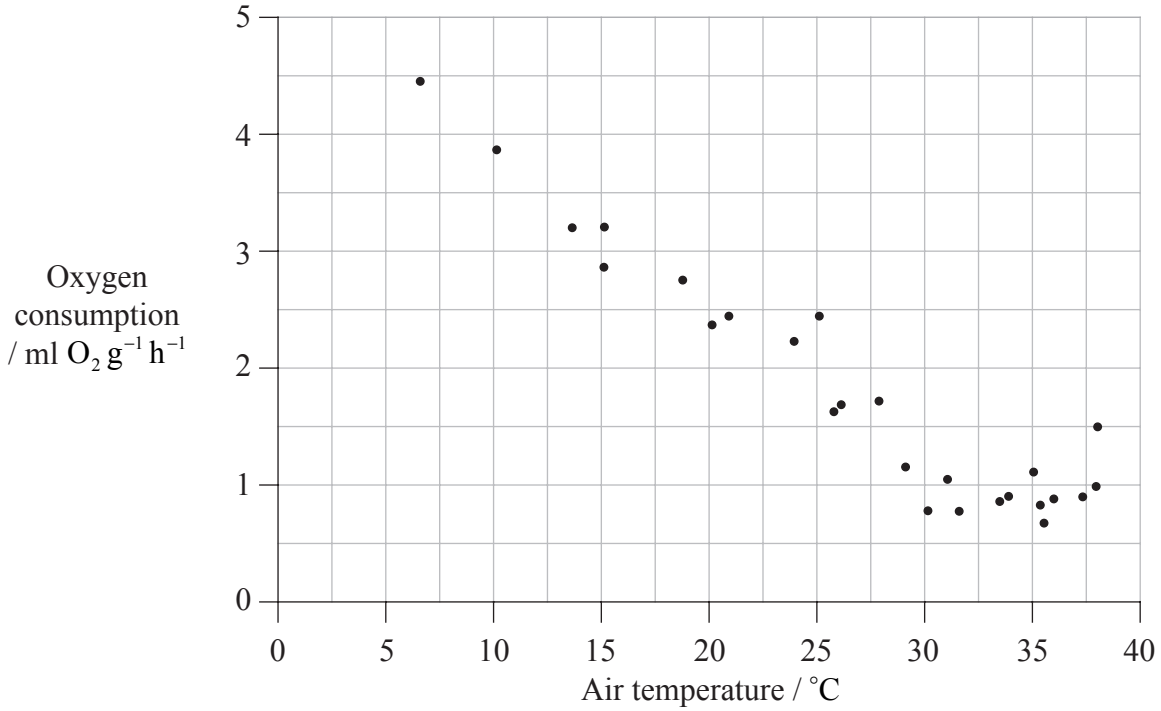
INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer two questions from Section B. Write 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 numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

SECTION A

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

1. Studies have been carried out on the consumption of oxygen by mammals under different conditions. The graph below shows the oxygen consumption of a pigmy possum (*Cercaertus nanus*) at various air temperatures.



[K Schmidt-Nielsen, Animal Physiology, Adaptation and Environment, (1978), Cambridge Uiversity Press]

(a) Estimate the oxygen consumption at 20 °C. *[1]*

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(b) Outline the effect of temperature on oxygen consumption. *[2]*

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(This question continues on the following page)

(Question 1 continued)

(c) An air temperature of 32 °C is the lower critical temperature for a pigmy possum. Deduce the meaning of lower critical temperature. *[1]*

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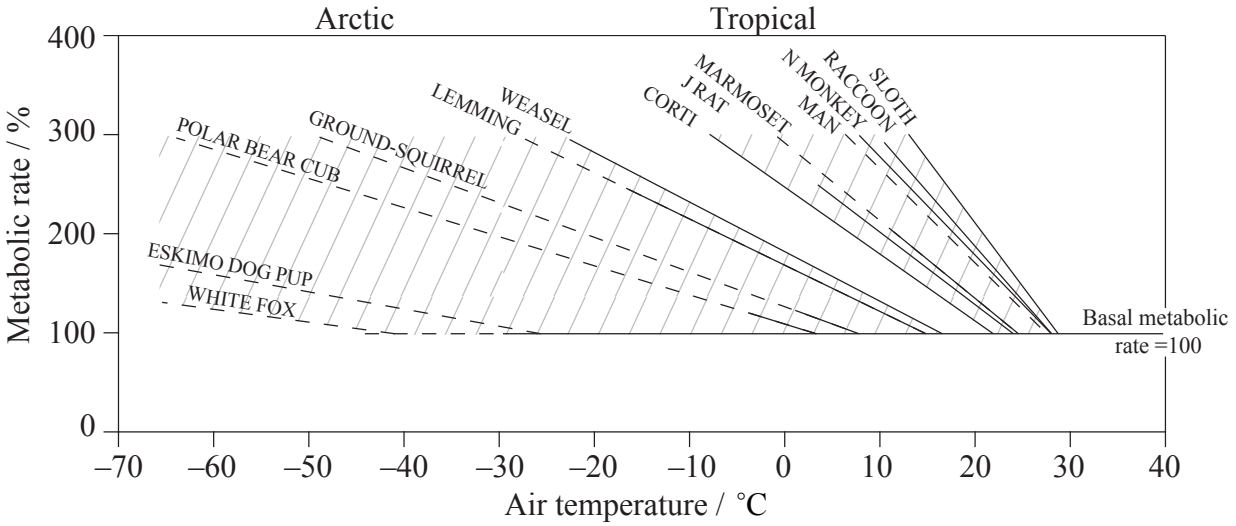
(This question continues on the following page)

(Question 1 continued)

The graph below shows the metabolic rates of various mammals in relation to air temperatures. Metabolic rate refers to the rate of use of energy by an animal and may be measured indirectly by oxygen consumption. The basal metabolic rate (BMR) for each animal, in the absence of stress, is given the value of 100 %. This occurs at different temperatures for different animals. The changes in metabolic rate as the temperature falls are expressed as a percentage of the BMR for each animal.



Key: ——— = observed - - - - = estimated

[Source: K Schmidt-Nielsen, *Animal Physiology, Adaptation and Environment*, (1978), CUP, pp 319]

(d) (i) Identify the mammal with the greatest increase in metabolic rate per degree of temperature, as the temperature decreases. *[1]*

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(ii) Calculate the average change in the metabolic rate, per degree of temperature, of a weasel as the temperature decreases from 17 °C to –20 °C. Show your workings. *[2]*

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(e) Suggest **one** reason for the increase in metabolic rate of mammals at lower temperatures. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(f) Discuss the differences between tropical and arctic mammals regarding the changes in their metabolic rates as the temperature decreases. *[3]*

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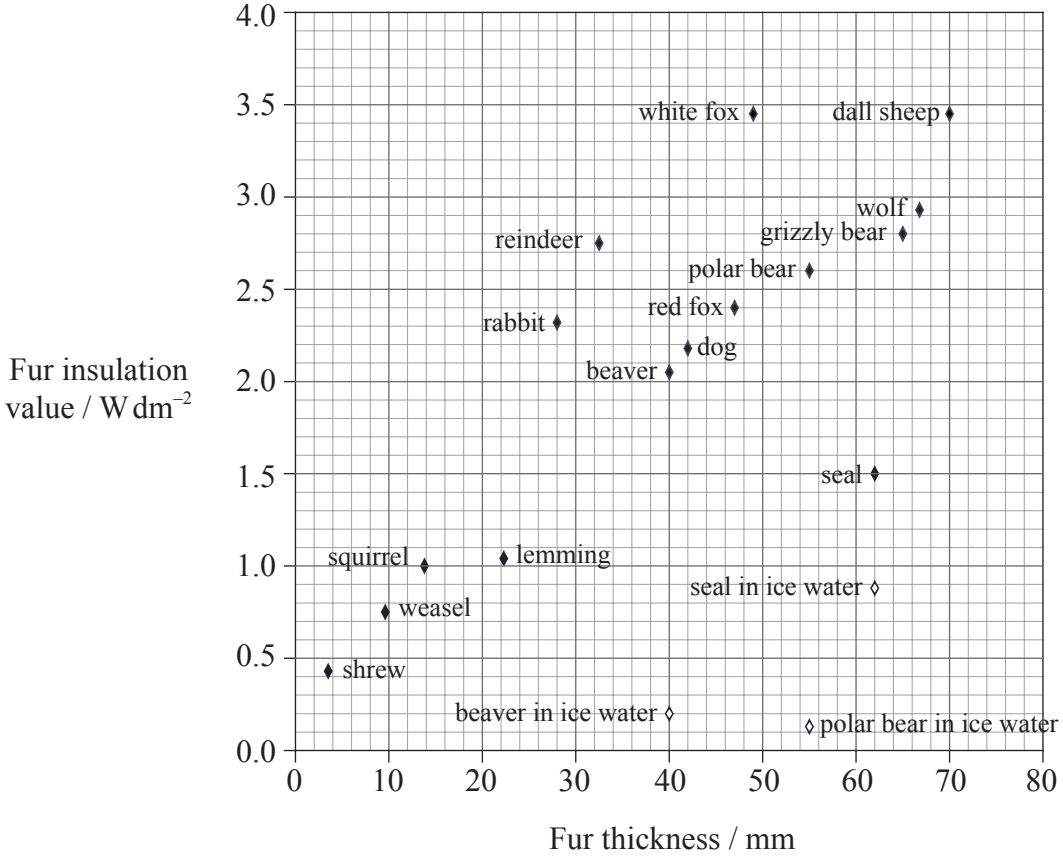
(Question 1 continued)

Other studies were carried out to see the relationship of the thickness of fur in mammals to its value as an insulator. A good insulator prevents heat loss from the animals to their environment. The graph below shows the relationship of the fur thickness to fur insulation in different mammals. Symbols represent the transfer of heat from fur to air or fur to ice water.



Key : ♦ = the rate of transfer of heat from fur to air
◇ = the rate of transfer of heat from fur to ice water

[Source: K Schmidt-Nielsen, *Animal Physiology, Adaptation and Environment*, (1978), CUP, pp 321]

(g) (i) Calculate the difference in fur thickness between a reindeer and a grizzly bear. *[1]*

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(ii) Suggest a reason for their similar fur insulation value. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(h) (i) Calculate the change in the insulation value for a beaver when it enters ice water. *[1]*

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(ii) Suggest an adaptation that allows a mammal to maintain its body temperature while in ice water. *[1]*

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(i) Discuss the relationship between metabolic rate and fur thickness in mammals. *[3]*

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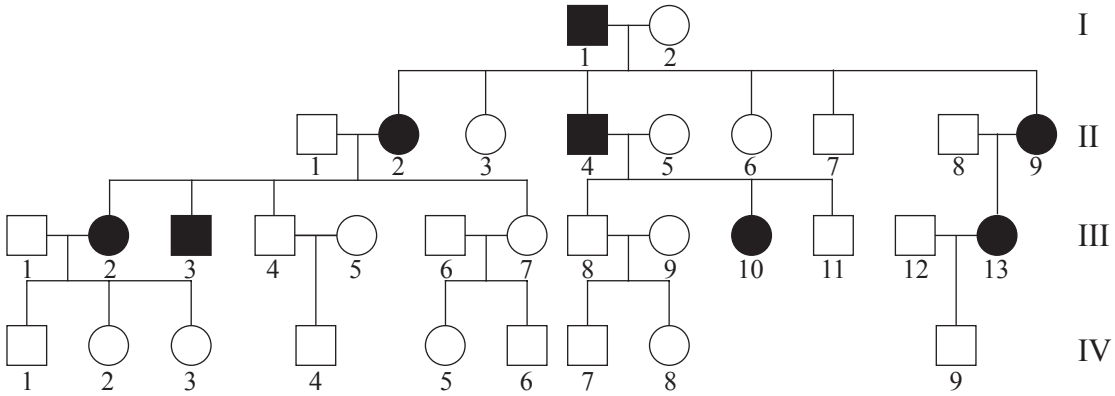
2. A genetically transmitted disease known as familial hypercholesterolemia (FH) results in the increase of low-density lipoprotein (LDL) cholesterol concentration in the blood. This may result in damage to blood vessel walls, premature heart attacks and early death. The symptoms of the disease appear in adults of different ages. In Quebec, Canada, this disease occurs in about 1 in 100 people.

The pedigree chart below shows a family with FH.



Key: □ = males no symptoms ■ = males with symptoms
○ = females no symptoms ● = females with symptoms

[Source: J Friedman *et al.*, *Genetics* (1992), Harwal Publishing Company, USA, pp 75, http://lww.com]

(a) Explain how the data shows that the allele for familial hypercholesterolemia (FH) is *[2]*

(i) autosomal. . . . . .

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(ii) dominant. . . . . .

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(This question continues on the following page)

(Question 2 continued)

(b) (i) Using genetic notation of alleles, identify the most likely genotype of the persons III-1 and III-2. *[1]*

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(ii) Calculate the probability that the male IV-1 is heterozygous for the disease. *[1]*

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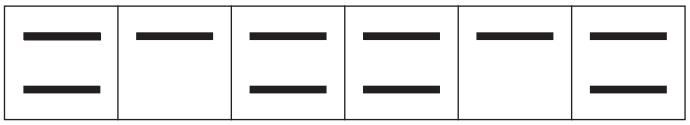
The male III-8 had a minor heart attack at age 33 and his father II-4 died of a heart attack at age 42. With the development of DNA analysis by electrophoresis various members of the family had their blood analysed. The results are shown below for the FH/fh alleles.



III-8 II-5 III-2 II-2 III-1 IV-3

(c) Using the above data, deduce the probability of the female IV-3 having FH. *[1]*

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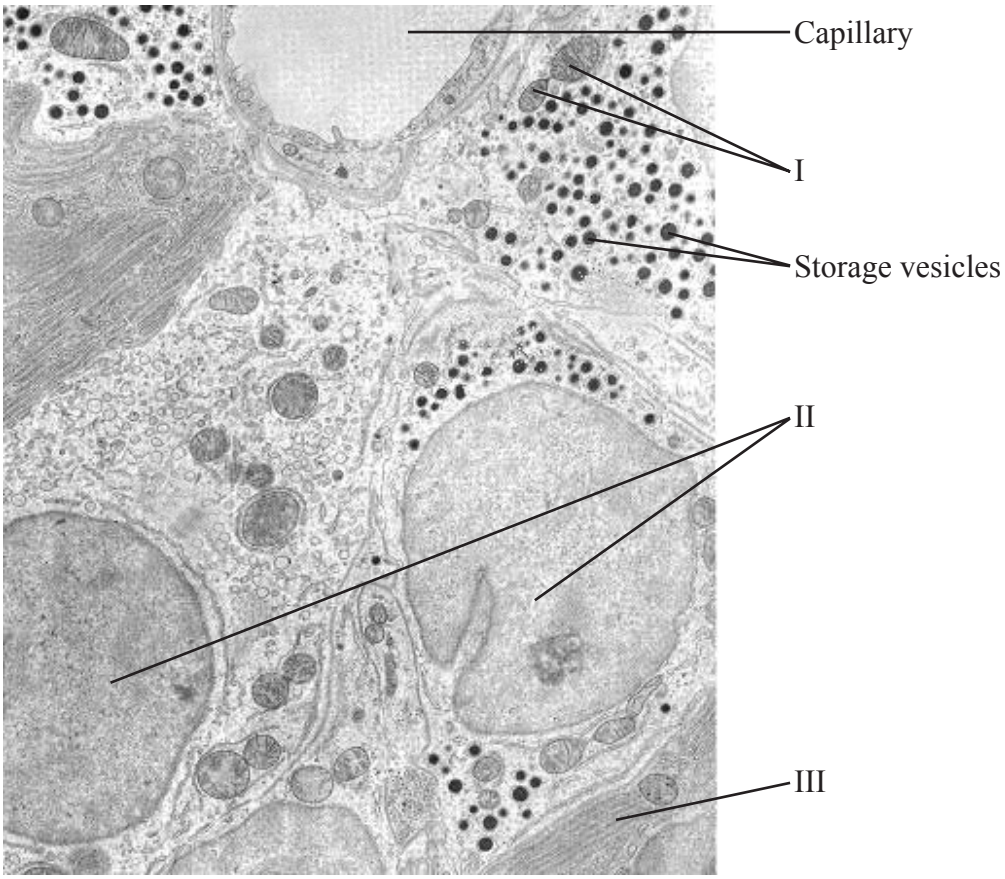
3. The electron micrograph below shows part of several pancreatic islet cells.



(a) Identify the structures labelled I, II and III in the micrograph above and give a role for each one. *[3]*

	Structure	Role
I		
II		
III		

(b) (i) Using the letter A, identify **one** location on the micrograph where transcription takes place. *[1]*

(ii) Using the letter B, identify **one** location on the micrograph where chemiosmosis occurs. *[1]*

(This question continues on the following page)

(Question 3 continued)

The large, black vesicles store products of the cells that are released into the capillaries of the pancreas.

(c) (i) Suggest what product each cell is likely to be making. *[1]*

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(ii) Explain how the products are transported from the site of production and released from the islet cells. *[3]*

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SECTION B

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

4. (a) Draw a diagram of a dicotyledonous animal-pollinated flower as seen with the naked eye and hand lens. *[4]*

(b) Outline the movement of water in plants from root to leaf, including the effects of abiotic factors on the rate of transport. *[6]*

(c) Explain photophosphorylation in terms of chemiosmosis. *[8]*

5. (a) Draw the structure of a mature human egg. *[4]*

(b) Compare the processes of mitosis and meiosis. *[6]*

(c) Explain how both meiosis and fertilization promote variation in a species that leads to natural selection. *[8]*

6. (a) Draw the structure of a generalized dipeptide. *[4]*

(b) Explain the process of translation leading to peptide linkage formation. *[8]*

(c) Using examples, outline the role of homeostasis in the body in controlling enzyme function. *[6]*

7. (a) Draw a food web containing at least eight specifically named organisms properly linked to indicate the energy flow. *[4]*

(b) Outline the relationship between the habitats and different nitrogenous waste products of mammals, birds and freshwater fish. *[6]*

(c) Discuss the benefits and dangers of vaccinations against bacterial and viral infections. *[8]*