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BIOLOGY
HIGHER LEVEL
PAPER 2

Wednesday 14 May 2008 (afternoon)

2 hours 15 minutes

Candidate session number

0	0							

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.

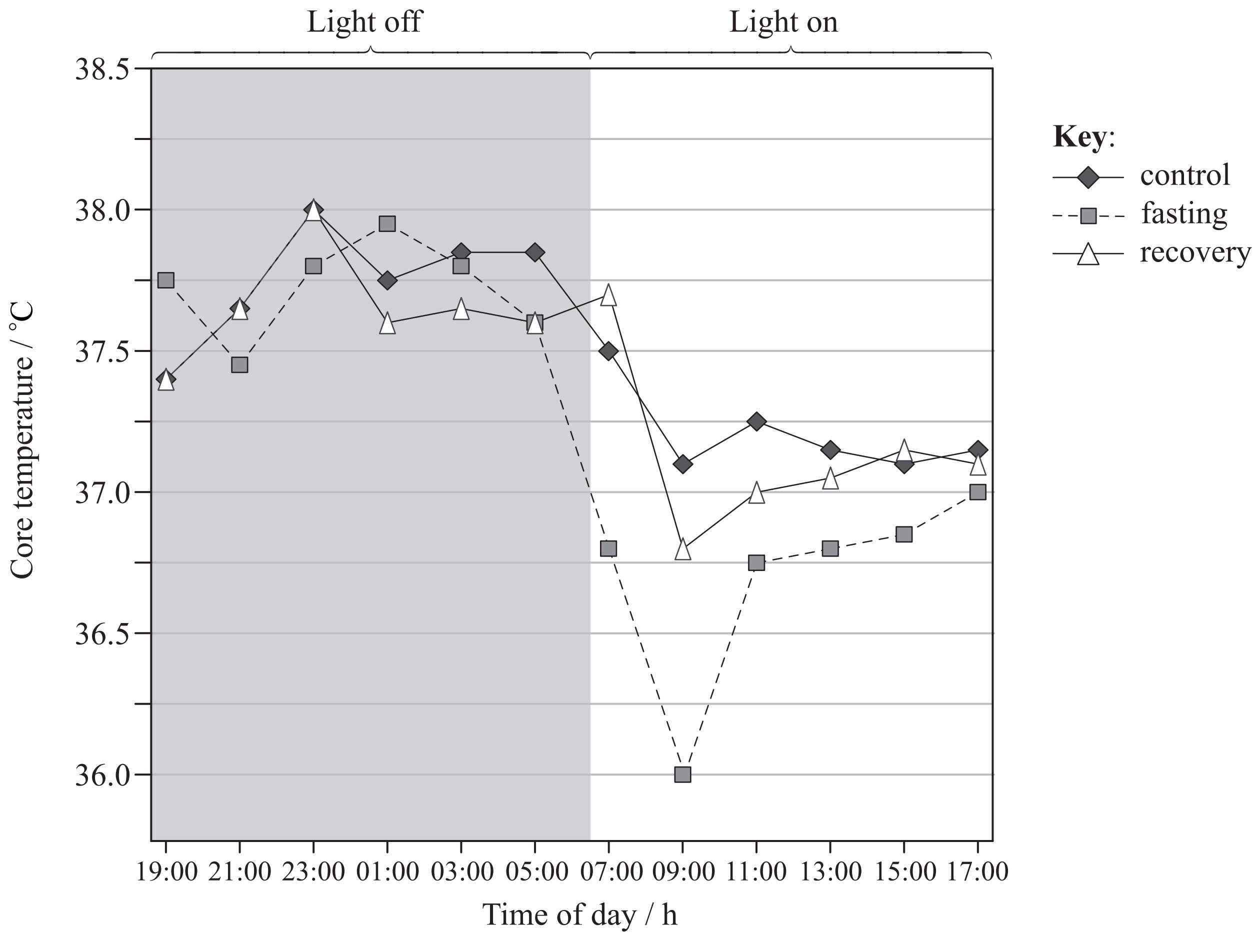
SECTION A

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

1. Body core temperature in mammals varies regularly in a daily cycle. A study was done on rats (*Rattus norvegicus*) to see the effects of different nutritional conditions on the core temperature. The rats were fed a normal diet for several days (control period) and then they were given very little food for the next few days (fasting period). After this, the rats were given a normal diet again to allow them to recover (recovery period).

The following graph shows the core temperature changes during one day in the middle of each of the three nutritional periods. Times when the lights were off and on are indicated.

Figure 1



[Source: Adapted from Kei Nagashima, Sadamu Nakai, Kenta Matsue, Masahiro Konishi, Mutsumi Tanaka, and Kazuyuki Kanosue, Effects of fasting on thermoregulatory processes and the daily oscillations in rats, *American Journal of Physiology - Regulatory Integrative and Comparative Physiology*, 284: R1486-R1493, 2003. American Physiological Society (Figure 1)]

(This question continues on the following page)

(Question 1 continued)

(a) (i) Identify the specific hour during the day with the highest core temperature of rats during the recovery period. *[1]*

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(ii) Identify the lowest core temperature of rats during the control period. *[1]*

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(b) Compare the results in the three nutritional periods during the time when the light was turned on. *[2]*

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(c) Deduce, with a reason, the time of day when the rats are most active. *[2]*

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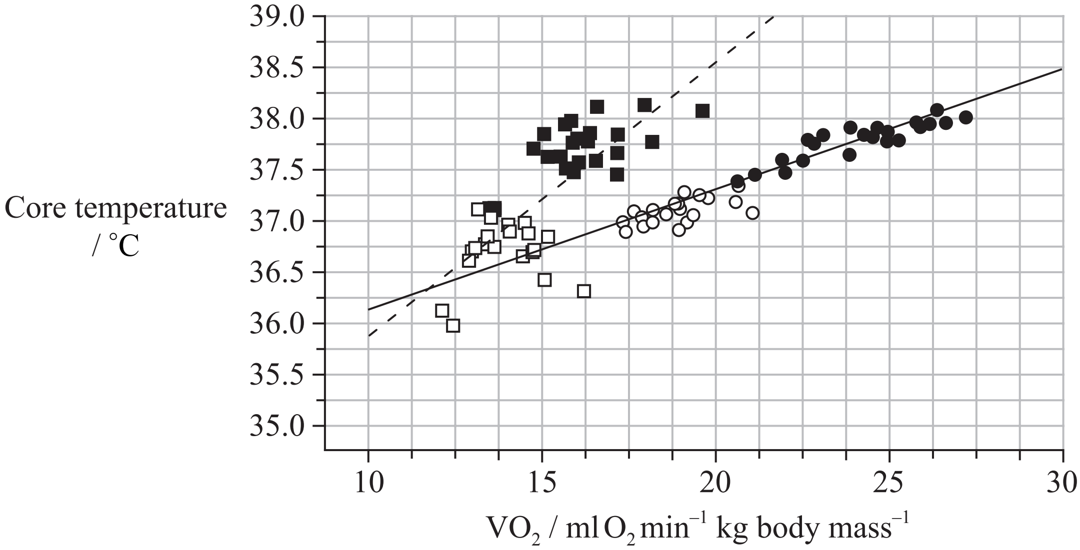
(Question 1 continued)

Oxygen consumption rate (VO_2) was measured for two of the nutritional periods and compared to the core temperature in the same group of rats.

Figure 2



Key: ● control period-dark ■ fasting period-dark
○ control period-light □ fasting period-light

[Source: Adapted from Figure 4 from Kei Nagashima, Sadamu Nakai, Kenta Matsue, Masahiro Konishi, Mutsumi Tanaka, and Kazuyuki Kanosue, Effects of fasting on thermoregulatory processes and the daily oscillations in rats, *American Journal of Physiology - Regulatory Integrative and Comparative Physiology*, 284: R1486-R1493, 2003. American Physiological Society]

(d) (i) Describe the relationship shown in the graph between the oxygen consumption rate and the core temperature in the control periods. *[1]*

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(ii) Explain the reason for this relationship. *[2]*

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(Question 1 continued)

(e) (i) Compare the results of the control and fasting rats in the dark. *[2]*

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(ii) Suggest how fasting rats maintain their core temperature in the dark. *[2]*

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(Question 1 continued)

Leptin is a hormone which controls appetite. A study was done on nocturnal marsupials (*Sminthopsis macroura*) to see the effect of the hormone leptin on body core temperature and oxygen consumption rate (VO_2). Eight animals were injected daily for several days with a control solution. They were then injected daily for the same number of days with a solution of leptin.

The bar graph shows mean results for the final day of the control (C) and leptin (L) treatments.

Figure 3 (a)

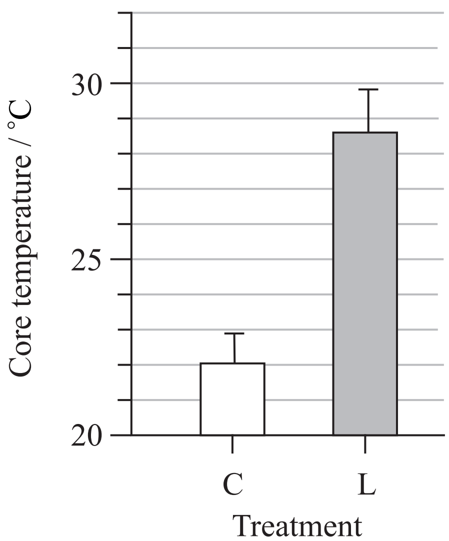
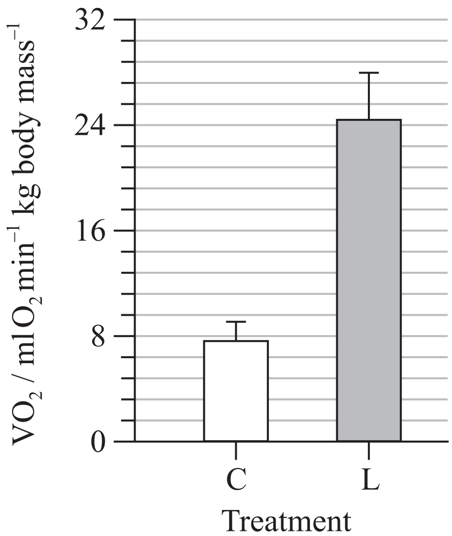


Figure 3 (b)



[Source: Adapted from Figure 2 from Fritz Geiser, Gerhard Körtner, and Ingrid Schmidt, Leptin increases energy expenditure of a marsupial by inhibition of daily torpor, *American Journal of Physiology - Regulatory Integrative and Comparative Physiology*, 275: R1627-R1632, 1998. American Physiological Society]

(f) Calculate the difference between the mean core temperature of animals undergoing C and L treatments. *[1]*

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(g) Analyse the effects of leptin on core temperature and oxygen consumption rate. *[2]*

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(Question 1 continued)

(h) Using **all** the data presented in this question, discuss the effects of the different factors on the core temperature in these two species of mammals. *[3]*

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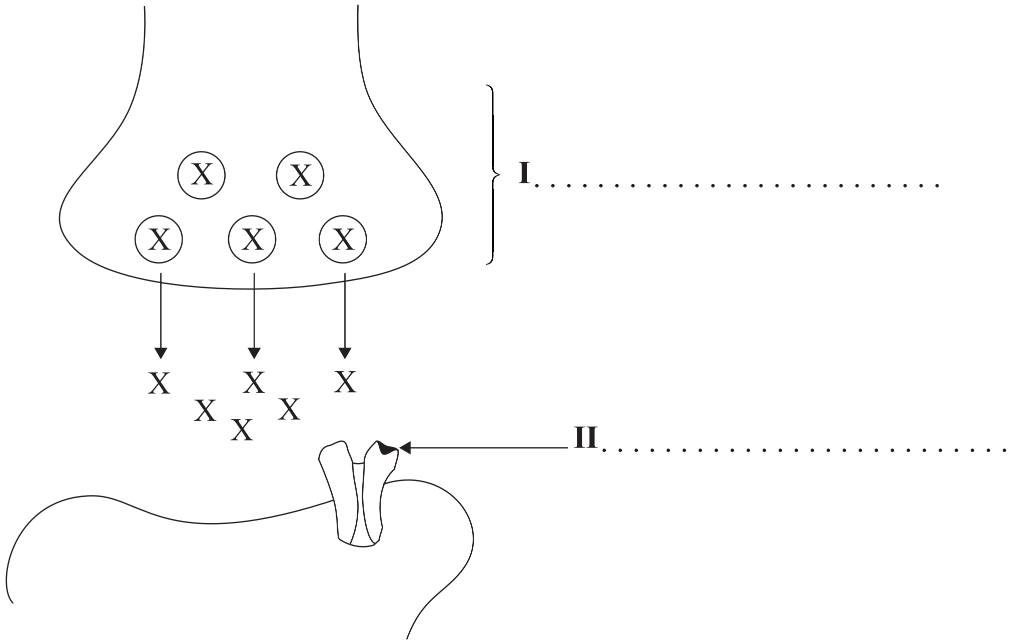
2. (a) Identify the labelled parts in the following diagram of two neurons. *[2]*



(b) Explain the roles of calcium ions in the following activities

(i) in the transmission of nerve impulses. *[2]*

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(ii) in skeletal muscle contraction. *[2]*

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3. (a) (i) Define *allele*. *[1]*

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(ii) Outline the consequences of a base substitution mutation. *[2]*

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(b) (i) Mendel crossed tall, round-seeded plants with short, wrinkled-seeded plants. All F_1 produced were tall, round-seeded plants. When F_1 plants were crossed with other F_1 plants, the F_2 generation produced many more than 1/16 short, wrinkled-seeded plants. Deduce, with reasons, the inheritance of these genes. *[2]*

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(ii) The same cross was later repeated but gave fewer F_2 short, wrinkled-seeded plants although still more than 1/16. Outline a **named** statistical test that could indicate if your deduction about the inheritance of these two genes is likely to be correct. *[2]*

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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 and label a diagram of a dicotyledonous animal-pollinated flower as seen with the naked eye and a hand lens. *[5]*

(b) Describe how meiosis results in an enormous genetic variety in the production of pollen. *[5]*

(c) Using the theory of natural selection, explain how new species of dicotyledonous plants develop. *[8]*

5. (a) Outline the various means of transfer of different types of molecules through the plasma membrane. *[4]*

(b) Describe the transport of water through an angiosperm root system. *[6]*

(c) Explain the homeostatic control of water balance in the human body. *[8]*

6. (a) Outline the first three levels of protein structure, including the types of bonding within each and the significance of each level. *[5]*

(b) Using a table, compare competitive and non-competitive inhibition and give one named example of each. *[5]*

(c) Explain the production of antibodies. *[8]*

7. (a) Describe a pyramid of energy and the reasons for its shape. *[4]*

(b) Outline the conversion of light energy to chemical energy in photosynthesis. *[6]*

(c) Explain the conversion of the chemical energy of organic compounds into ATP in aerobic cell respiration. *[8]*