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BIOLOGY
HIGHER LEVEL
PAPER 2

Wednesday 14 May 2008 (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.

0110

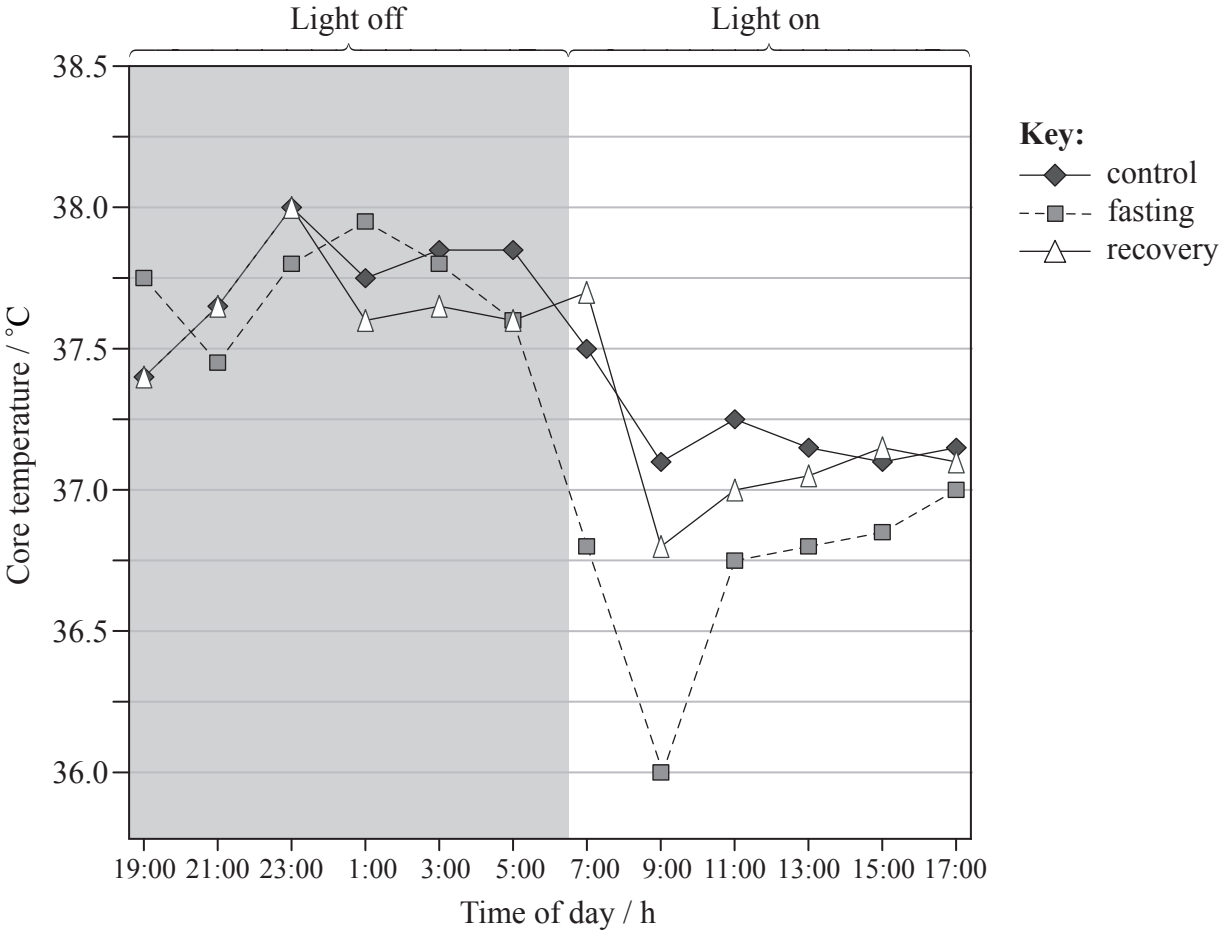
SECTION A

*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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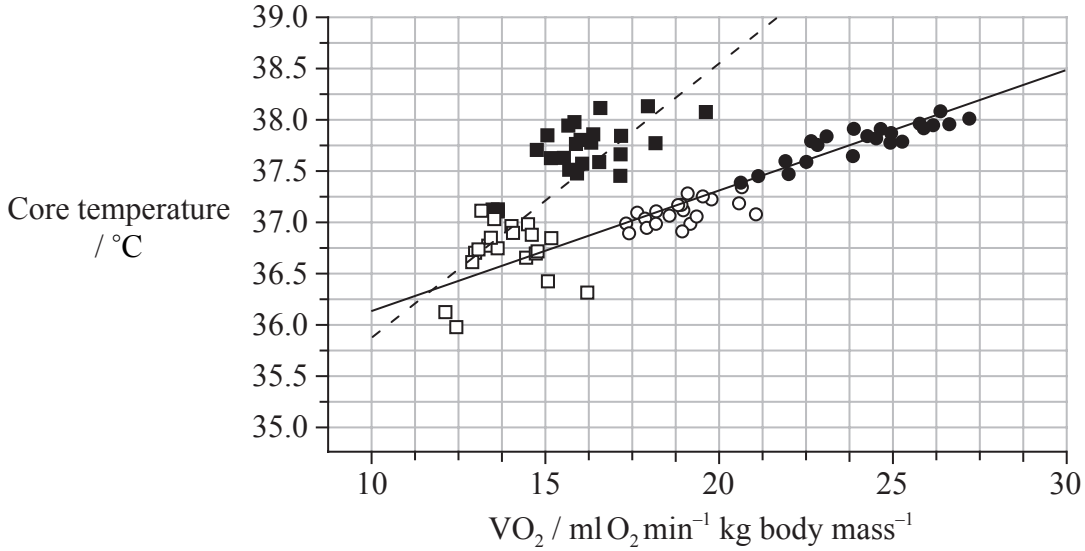
(Question 1 continued)

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

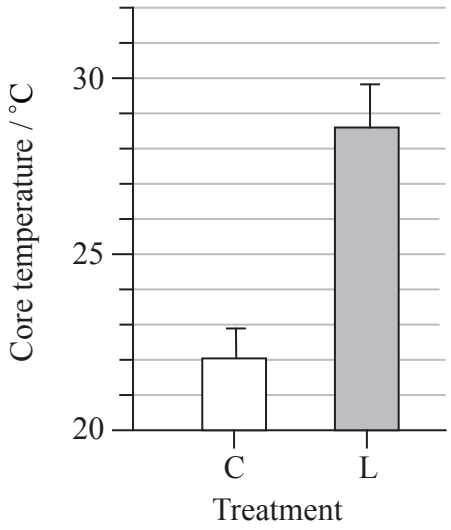
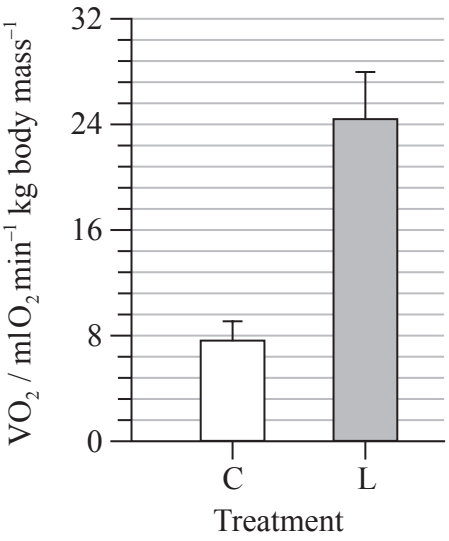


Figure 3 (b)



[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 stage of meiosis indicated on each of the micrographs below.

(i) 

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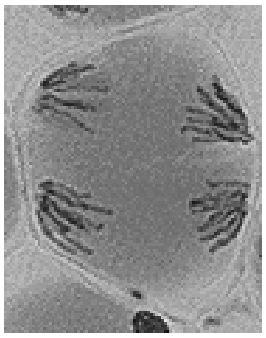
(ii) 

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(b) (i) Define the term *polygenic inheritance*. *[1]*

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(ii) Outline the inheritance of human skin colour as an example of polygenic inheritance. *[2]*

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3. (a) Outline **three** adaptations of xerophytes that allow them to conserve water. *[3]*

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(b) (i) Name **one** nitrogenous waste product of birds. *[1]*

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(ii) Suggest an adaptive advantage of this waste product in relation to their habitat. *[1]*

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(c) Explain the main role of each of the following in maintaining the water balance of the body.

(i) Loop of Henlé *[1]*

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(ii) Collecting duct *[1]*

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(iii) ADH *[1]*

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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 simple diagram showing how DNA nucleotides are linked together in a single strand. *[4]*

(b) Outline a basic technique for gene transfer involving plasmids. *[6]*

(c) Explain the process of DNA replication. *[8]*

5. (a) Draw and label a mitochondrion as seen in electron micrographs. *[4]*

(b) Outline the cellular locations of different **named** processes in both photosynthesis and cell respiration. *[6]*

(c) Explain the energy flow in a food chain as exemplified by a pyramid of energy. *[8]*

6. (a) Draw the external and internal structure of a **named** dicotyledonous seed. *[4]*

(b) Using a table, compare the processes of spermatogenesis and oogenesis in humans. *[6]*

(c) Explain how sexual reproduction promotes variation in a species. *[8]*

7. (a) Outline the effects of factors that increase or decrease the size of a population. *[4]*

(b) Describe the production of antibodies as the response of the immune system to the entry of pathogens into the body. *[6]*

(c) Explain the control of glucose levels in the blood. *[8]*