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BIOLOGY
HIGHER LEVEL
PAPER 2

Candidate session number

Monday 10 November 2014 (afternoon)

2 hours 15 minutes

Examination code

8	8	1	4	–	6	0	0	2

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 questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[72 marks]*.

16 pages

SECTION A

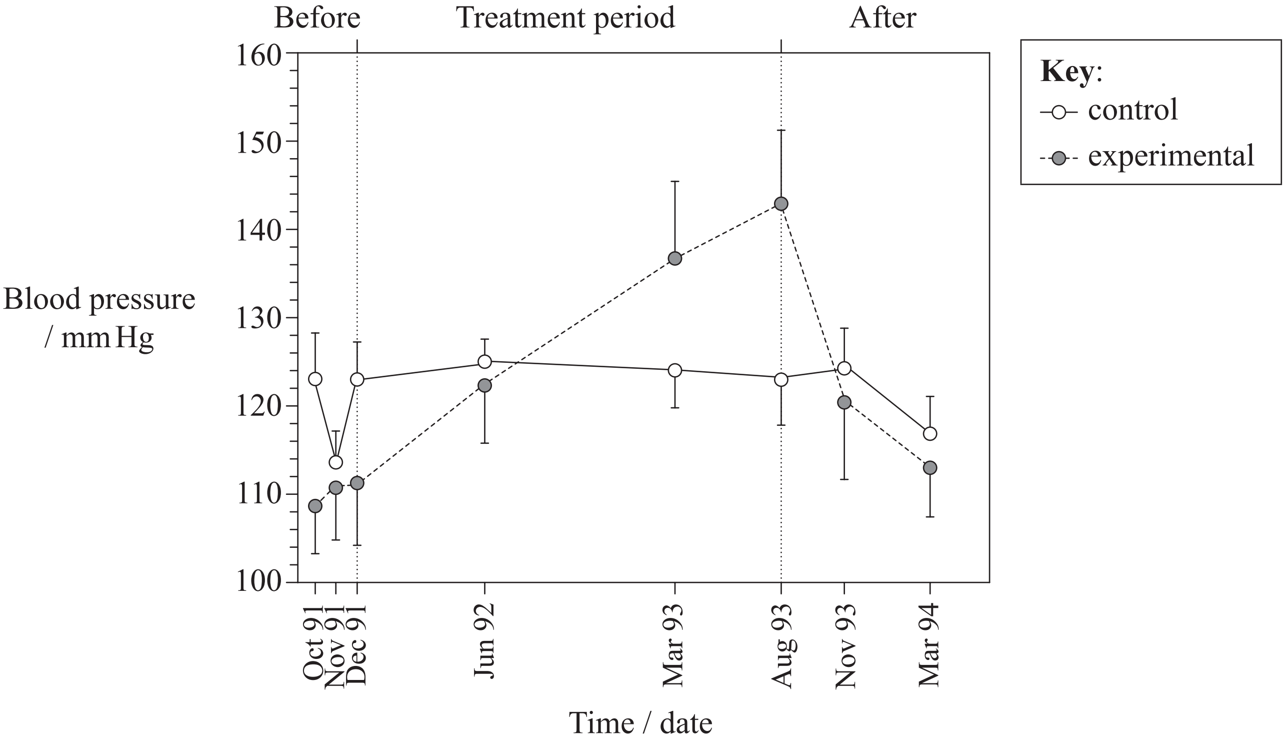
*Answer **all** questions. Write your answers in the boxes provided.*

1. Hypertension (blood pressure exceeding 140 mm Hg) affects millions of people worldwide. Many modern societies consume more sodium in the form of salt (NaCl) than is required for normal physiology. The effect of changing the levels of dietary sodium has been studied in various organisms.

Scientists recorded the blood pressure changes in chimpanzees (*Pan troglodytes*) fed a diet without added sodium (control) or a sodium supplemented diet (experimental) as follows

- 5 grams of salt per day from December 1991 until May 1992
- 10 grams of salt per day until June 1992
- 15 grams of salt per day until August 1993

after which no more salt was added to the diet until the experiment ended.



[Source: Republished with the permission of the American Society for Clinical Investigation, from K. M. O'Shaughnessy and F. E. Karet (2004) *Journal of Clinical Investigation*, **113** (8); permission conveyed through Copyright Clearance Center, Inc.]

(This question continues on the following page)

(Question 1 continued)

(a) Outline the effect shown in the graph of increasing the sodium in the diet of chimpanzees. *[2]*

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(b) Suggest reasons for the changes in blood pressure in the experimental chimpanzees occurring between

(i) August 1993 and November 1993. *[1]*

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(ii) November 1993 and March 1994. *[1]*

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(c) Blood pressure is measured in the arteries. Explain how arteries are adapted to withstand increases in blood pressure. *[2]*

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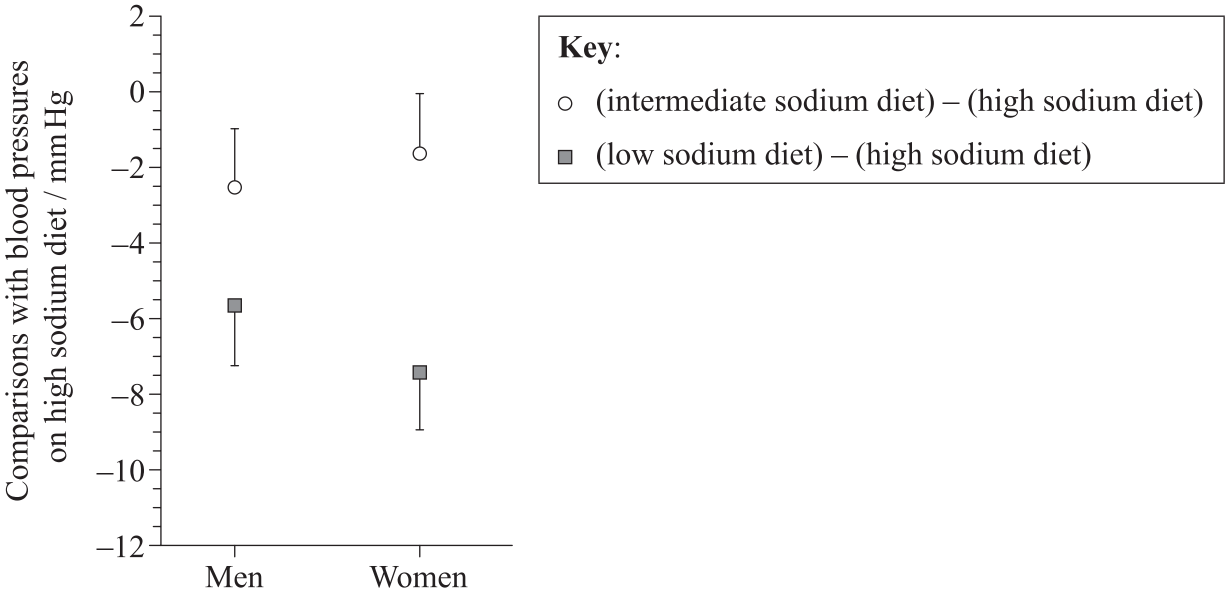
(Question 1 continued)

In order to assess the effect of dietary sodium in humans, participants in a trial were randomly assigned either a diet with high (140 mmol day^{-1}), intermediate (100 mmol day^{-1}) or low levels (50 mmol day^{-1}) of sodium. After 30 days, the blood pressures of the participants consuming the intermediate and low sodium diets were compared to the blood pressures of the participants consuming the high sodium diet. The results are shown in the graph.



[Source: From Frank M. Sacks, Laura P. Svetkey, William M. Vollmer, Lawrence J. Appel, George A. Bray, David Harsha, Eva Obarzanek, Paul R. Conlin, Denise G. Simons-Morton, Njeri Karanja, Pao-Hwa Lin, Mikel Aickin, Marlene M. Most-Windhauser, Thomas J. Moore, Michael A. Proschan and Jeffrey A. Cutler (2001) Effects on Blood Pressure of Reduced Dietary Sodium and the Dietary Approaches to Stop Hypertension (DASH) Diet. *New England Journal of Medicine*, **344**, pp. 3–10. Copyright © 2001 Massachusetts Medical Society.]

(d) Identify the sex and type of diet that showed the greatest difference in blood pressure in comparison to the high sodium diet. *[1]*

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(Question 1 continued)

(e) Compare the effect of reducing sodium intake in men and women. *[2]*

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(f) Suggest **one** reason for the difference in the effect of dietary sodium on blood pressure between men and women. *[1]*

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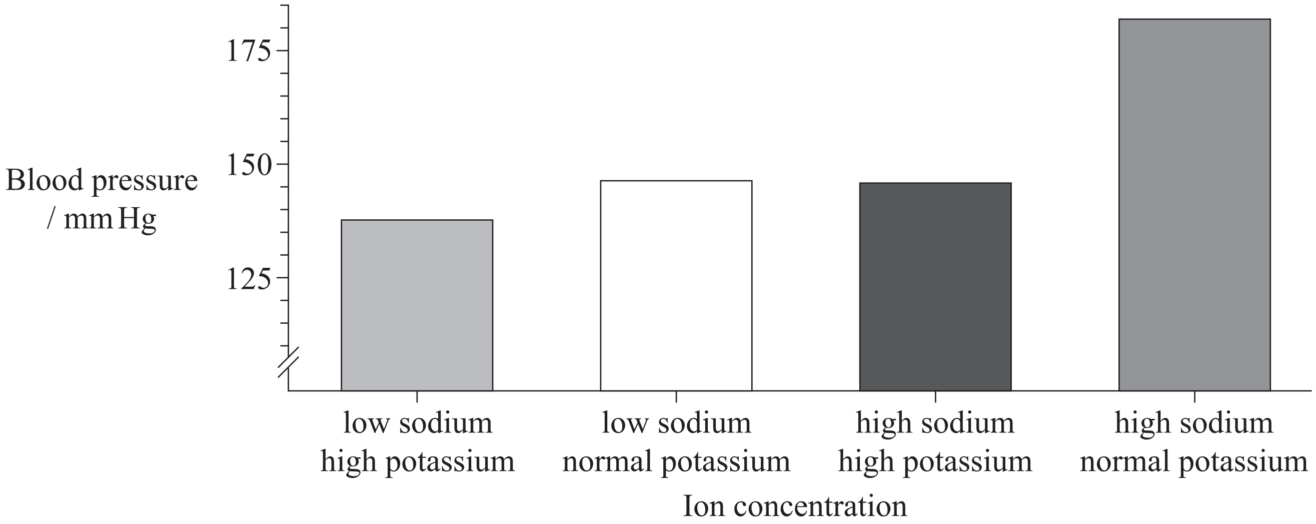
Turn over

(Question 1 continued)

A study was undertaken to test the effect of dietary potassium on high blood pressure in Brown rats (*Rattus norvegicus*). The rats used were a hypertensive strain whose mean blood pressure was 146 mm Hg. The rats were fed with a diet of either low (0.24 %) or high (8.00 %) sodium ion concentration and high (2.10 %) or normal (0.50 %) potassium ion concentration. The results are shown in the graph.



[Source: Republished with permission of the American Society for Nutrition from Louis Tobian (1997) 'Dietary sodium chloride and potassium have effects on the pathophysiology of hypertension in humans and animals'. *American Journal of Clinical Nutrition*, **65** (supplement): 6065-lIS; permission conveyed through Copyright Clearance Center, Inc.]

(g) Analyse the effect of different dietary levels of potassium on blood pressure. *[2]*

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(Question 1 continued)

(h) Suggest how sodium-potassium pumps in the membranes of nephron cells in the kidney could allow blood sodium concentrations to be reduced, if there is sufficient potassium in the diet. *[1]*

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(i) The US Institute of Medicine has issued a strong recommendation that sodium consumption should be lowered and dietary potassium increased because of the effect on blood pressure. Evaluate this recommendation using all the data provided. *[3]*

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2. The diagram shows a section through the surface of an animal cell.

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(a) On the diagram label the membrane components I and II. *[2]*

(b) (i) On the diagram label III. *[1]*

(ii) State **one** function of III. *[1]*

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3. (a) Explain how the following influence the enhanced greenhouse effect.

(i) Reforestation of desert *[1]*

. . . .

(ii) Change in energy source from fossil fuel to solar energy *[1]*

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(iii) Increase in the production of methane *[1]*

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(b) (i) State **two** processes that could increase population size. *[2]*

1. . . . .
2. . . . .

(ii) Outline **two** reasons for a plateau phase in population growth curves. *[2]*

1. . . . .
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2. . . . .
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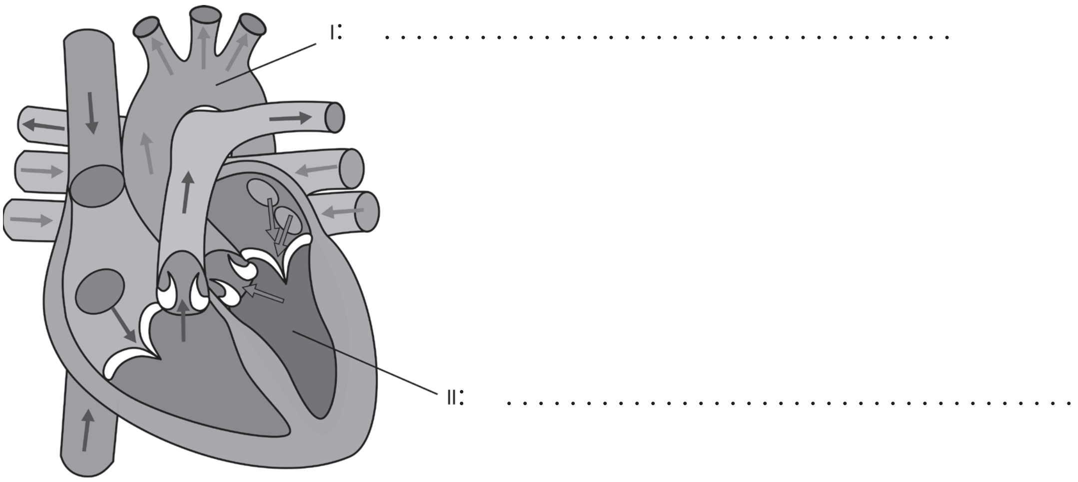
Turn over

4. (a) On the diagram label the structures I and II. *[2]*



[Source: http://commons.wikimedia.org/wiki/File:Diagram_of_the_human_heart_hu_it.svg]

(b) State the function of the semilunar valves. *[1]*

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(c) Describe how heartbeat rate is controlled. *[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 in the boxes provided.*

5. (a) State **four** functions of proteins, giving a **named** example of each. *[4]*

(b) Explain the process of translation. *[8]*

(c) In a given population some variations of a protein are expressed more frequently than others. Outline how evolution through natural selection can lead to the expression of one version of a protein rather than another. *[6]*

6. (a) Distinguish between the absorption of red light, blue light and green light by plants. *[4]*

(b) Outline how light intensity and concentration of carbon dioxide affect photosynthesis. *[6]*

(c) Explain how the distribution of tissues in the leaf of a dicotyledonous plant is adapted to production and distribution of products of photosynthesis. *[8]*

7. (a) Draw the stages of mitosis. *[4]*

(b) Describe codominance and multiple alleles using inheritance of ABO blood groups as an example of them. *[6]*

(c) Research is being undertaken by scientists in some countries to develop methods of therapeutic cloning. Discuss the ethical issues of therapeutic cloning in humans. *[8]*

8. (a) Draw a labelled diagram of the male reproductive system. *[4]*

(b) Outline the process of *in vitro* fertilization (IVF). *[6]*

(c) Explain how the structure and functions of the placenta maintain pregnancy. *[8]*