

22056014

**BIOLOGY
HIGHER LEVEL
PAPER 2**

Wednesday 11 May 2005 (afternoon)

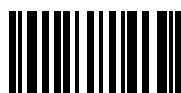
2 hours 15 minutes

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.

- Rats were bred for several generations to prefer alcohol (ethanol) consumption. When tested, it was discovered that the brains of these rats possessed lower quantities of the chemical neuropeptide Y (NPY).

To test the hypothesis that lower quantities of NPY leads to a preference for alcohol, rats were genetically engineered to be NPY deficient (genotype NPY $-/-$), or to produce an excess of NPY (NPY-EX). In separate experiments, the two groups were compared to normal rats (in terms of their alcohol preference) possessing the genotype NPY $+/+$. The groups were offered solutions of increasing alcohol concentration. The quantity of each solution consumed per day was measured.

Figure 1

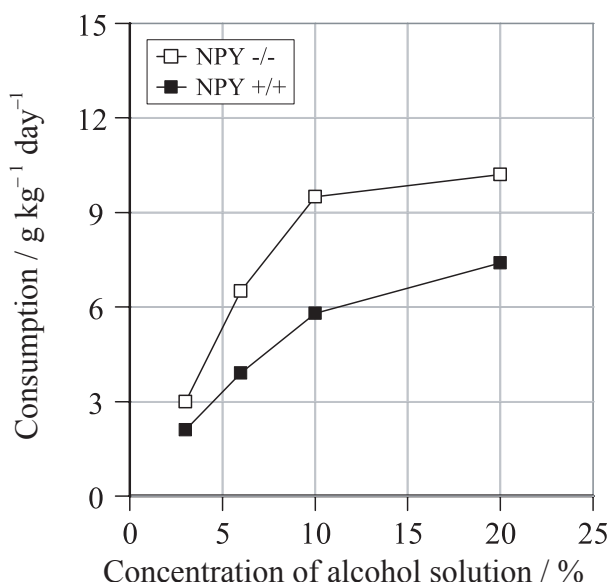
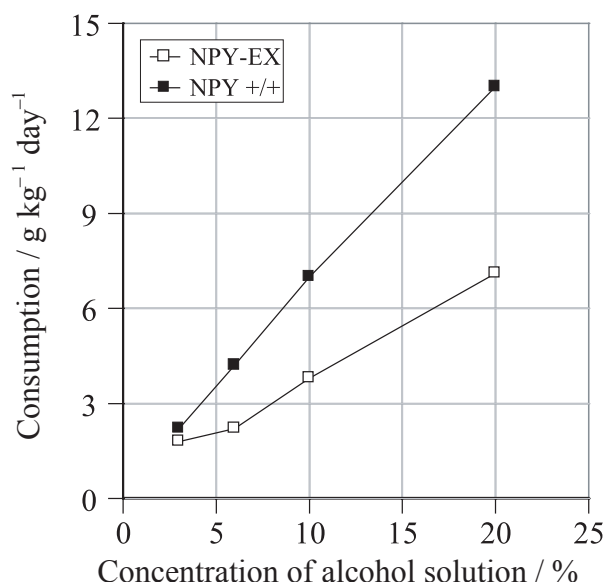


Figure 2



[Source: adapted from Thiele *et al.*, *Nature*, (1998), 396 pages 366–369]

- Calculate the difference in consumption of the 6 % alcohol solution between the

- NPY $-/-$ and NPY $+/+$ rats (figure 1).

[1]

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- NPY-EX and NPY $+/+$ rats (figure 2).

[1]

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(Question 1 continued)

- (b) Compare the alcohol consumption of the NPY $-/-$ rats with the NPY-EX rats. [3]

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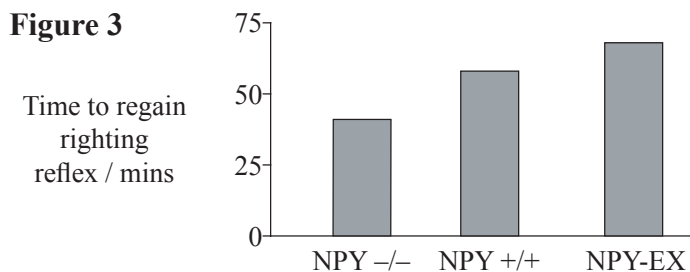
- (c) Identify the relationship between NPY levels and alcohol consumption. [1]

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An experiment was carried out to test the hypothesis that an increase in preference for alcohol might be related to a decrease in sensitivity to its effects.

Rats were injected with a sample of alcohol and then assessed for the length of time it took for them to regain the righting reflex. (The righting reflex refers to the ability of the rat to return to its feet after being placed on its back.)



[Source: adapted from Thiele *et al.*, *Nature*, (1998), 396 pages 366–369]

- (d) Deduce the relationship between NPY levels and the time required to regain the righting reflex. [3]

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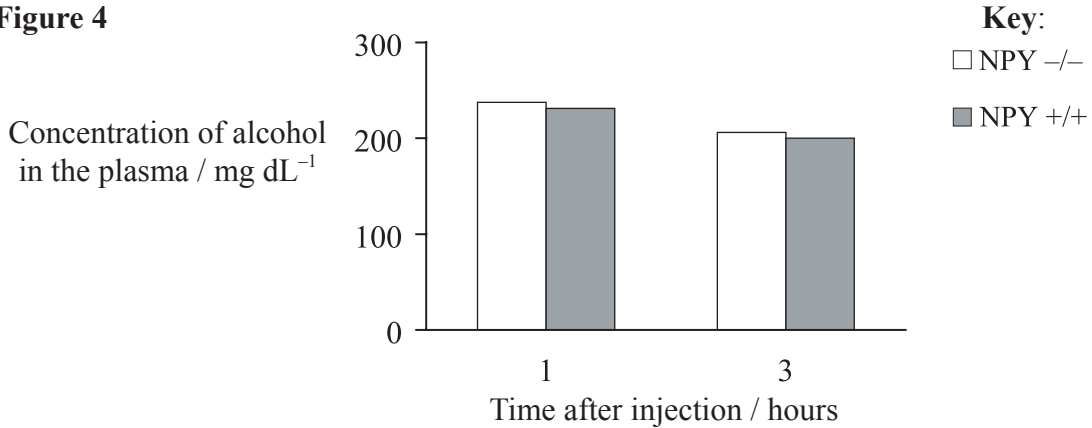
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(Question 1 continued)

An additional experiment was carried out to determine whether differences in sensitivity to the effects of alcohol might be related to differences in the rats' ability to remove alcohol from their blood. Rats were injected with alcohol and blood samples were taken one hour and three hours later to determine alcohol levels. The results are shown below.

Figure 4



[Source: adapted from Thiele *et al.*, *Nature*, (1998), 396 pages 366–369]

- (e) Evaluate the hypothesis that differences in sensitivity to the effects of alcohol might be related to differences in the ability of the rats to remove alcohol from their blood. [2]

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- (f) Using all the data, outline the relationship between preference for alcohol and sensitivity to the effects of alcohol. [2]

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(Question 1 continued)

(g) (i) Define the term *homozygous*. [1]

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(ii) State the phenotype of a rat with the genotype NPY +/+ . [1]

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(iii) Using a Punnett grid, predict the fraction of offspring that would have the genotype NPY +/- if two rats were crossed, one homozygous for the NPY+ allele and one homozygous for the NPY- allele. [2]

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2. (a) State **two** processes which involve mitosis. [2]

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(b) Explain the importance of the surface area to volume ratio as a factor limiting cell size. [3]

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(c) State **one** difference between the proteins produced by free ribosomes and those produced by ribosomes attached to the endoplasmic reticulum. [1]

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3. (a) Describe the role of skin arterioles in the regulation of body temperature. [3]

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(b) Explain how temperature affects the rate of transpiration from a typical mesophytic plant. [3]

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(c) Explain the role of temperature on enzyme activity. [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 labelled diagram of the heart showing all four chambers, associated blood vessels and valves. [5]
- (b) Describe the mechanism of ventilation in the human lung. [5]
- (c) Explain the process of water uptake and transport by a plant. [8]
5. (a) Describe **one** method for determining the population of a motile animal species and **one** different method for determining the population of a plant species. [7]
- (b) State **one** structural feature of each of the following plant groups: bryophytes, angiospermophytes and coniferophytes. [3]
- (c) Discuss the theory of evolution by natural selection. [8]
6. (a) State the source, substrate, products and optimum pH for any **two named** digestive enzymes. [4]
- (b) Outline **two** examples of the commercial application of named enzymes in biotechnology. [6]
- (c) Explain competitive and non-competitive inhibition, including allostery. [8]
7. (a) Describe the flow of energy in an ecosystem. [5]
- (b) Outline the use of carbohydrates and lipids in energy storage. [5]
- (c) Explain the process of aerobic cellular respiration. [8]

