Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 2

Wednesday 14 November 2018 (afternoon)

Candidate session number

2 hours 15 minutes

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.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[72 marks]**.

20 pages

8818 – 6002

Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Tobacco smoke contains a number of mutagens that are known to induce lung tumours in rodents, including NNK, a nitrosamine. The graph shows the relationship between NNK and lung tumour incidence in male rats. NNK was administered by subcutaneous injection for 20 weeks. Data points on the graph show percentage incidence of lung cancer in treatment groups of between 20 and 80 rats.

Graph removed for copyright reasons

(a) State the relationship between the dose of NNK and lung tumour incidence. [1]

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(b) Explain the effects of mutagens such as NNK. [2]

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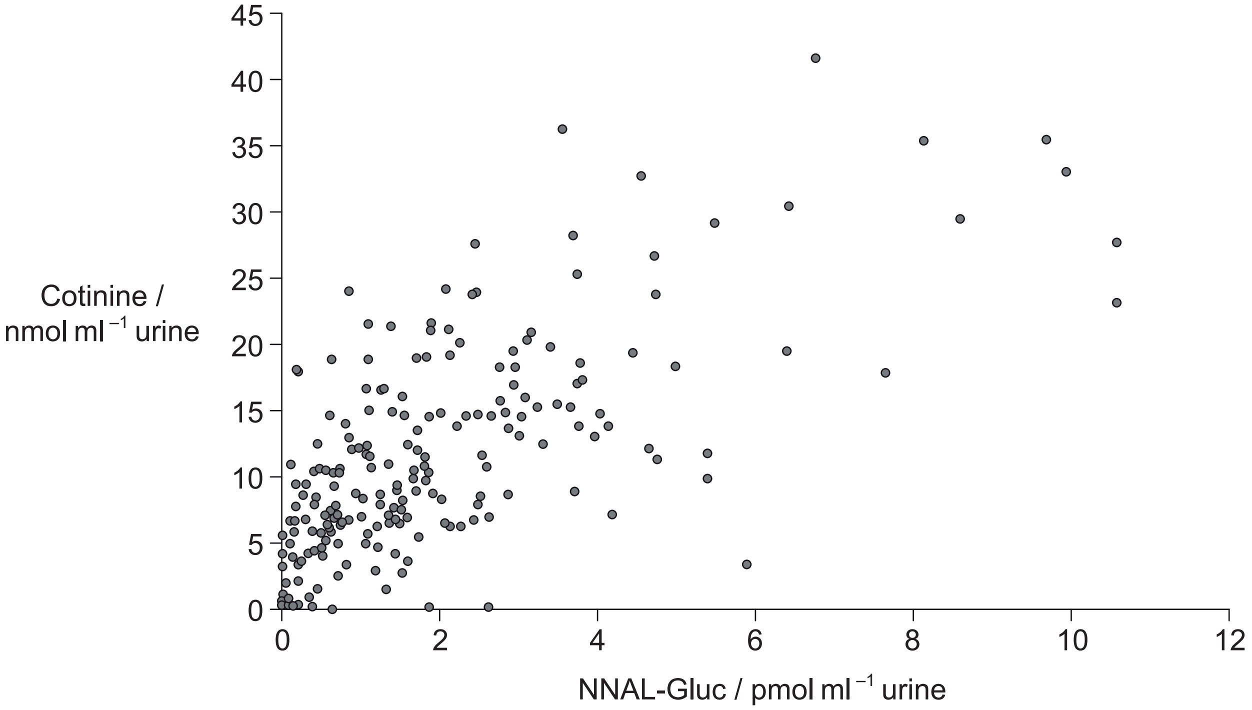
(Question 1 continued)

Mutagens can be removed from the body by converting them to readily excreted metabolites. NNK is converted to a metabolite, NNAL-Gluc, which can be used as a biomarker for the uptake of NNK. Cotinine, a metabolite of nicotine, is an indicator of tobacco smoke uptake. The graph shows the relationship between these two metabolites in the urine of 233 smokers.



[Source: Stephen S. Hecht; Tobacco Smoke Carcinogens and Lung Cancer, *JNCI: Journal of the National Cancer Institute* 1999; **91** (14): 1194–1210, doi:10.1093/jnci/91.14.1194. Reproduced by permission of Oxford University Press. OUP is not responsible or in any way liable for the accuracy of the translation. The International Baccalaureate Organization is solely responsible for the translation in this publication.]

(c) State the highest concentration of cotinine in the urine, giving the units. [1]

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(This question continues on the following page)

(Question 1 continued)

(d) (i) Deduce, with a reason, whether the concentrations of cotinine and NNAL-Gluc would be higher in the urine or in the blood plasma of a smoker. [1]

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(ii) Suggest **one** advantage of using the urine concentration of cotinine rather than NNAL-Gluc to give a measure of the amount of tobacco smoke inhaled by a person. [1]

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(e) Rates of lung cancer in smokers are high. Discuss whether it can be concluded from the evidence in the two graphs that NNK causes lung cancer in smokers. [3]

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Turn over

(Question 1 continued)

Nicotine addiction is the reason that people continue to smoke. Nicotine replacement therapy (NRT) is often used to help people quit smoking. Concerns about the safety of NRT led to a study where mice were given nicotine in drinking water and NNK was administered by subcutaneous injection. The table shows the effect of nicotine consumption on NNK-induced lung tumours in the mice.

Table removed for copyright reasons

(f) Describe the results when the mice were injected with NNK. [2]

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(g) Evaluate the hypothesis that nicotine is not a mutagen. [3]

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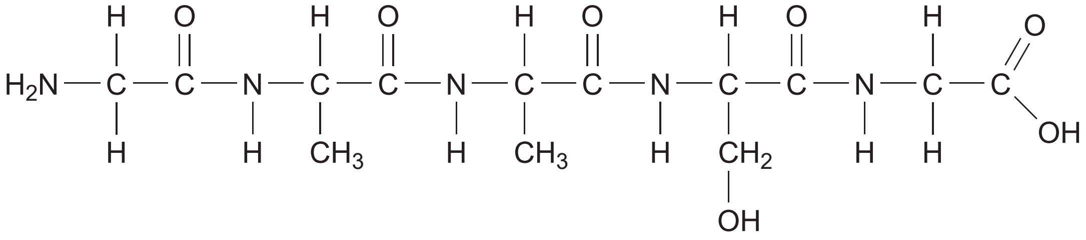
(Question 1 continued)

(h) Discuss the concerns about the safety of NRT. [2]

2. (a) (i) Label a peptide bond in the diagram of a polypeptide. [1]



(ii) Outline the primary structure of proteins. [1]

(b) Identify **two** hydrolysis reactions that occur in the small intestine. [2]

3. (a) State **one** similarity and **one** difference between the structure of genes and short tandem repeats. [2]

Similarity: . . . .

Difference: . . . .

(b) Outline the role of short tandem repeats in DNA profiling. [2]

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4. Boreal forests stretch across Canada, Russia and Scandinavia. This northern ecosystem accounts for 29 % of the world's forest areas. The long, cold winters favour tall evergreen trees with either needles or scale-like leaves. These trees are wind-pollinated and their seeds are not enclosed in a fruit. The photograph shows a typical boreal forest in winter.

[Source: TTphoto /Shutterstock]

(a) Identify the dominant plant phylum in the boreal forest. [1]

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(b) In some areas there are gaps in the boreal forest where trees fail to grow and peat tends to accumulate. Suggest reasons for this. [2]

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(Question 4 continued)

(c) An increase in global temperatures poses a critical threat to boreal forests. Explain the consequences of climate change to this northern ecosystem. [2]

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(d) (i) Suggest **one** advantage for the evergreen trees of the boreal forest being pollinated by wind. [1]

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(ii) Discuss the advantages of the production of seeds enclosed in fruit. [2]

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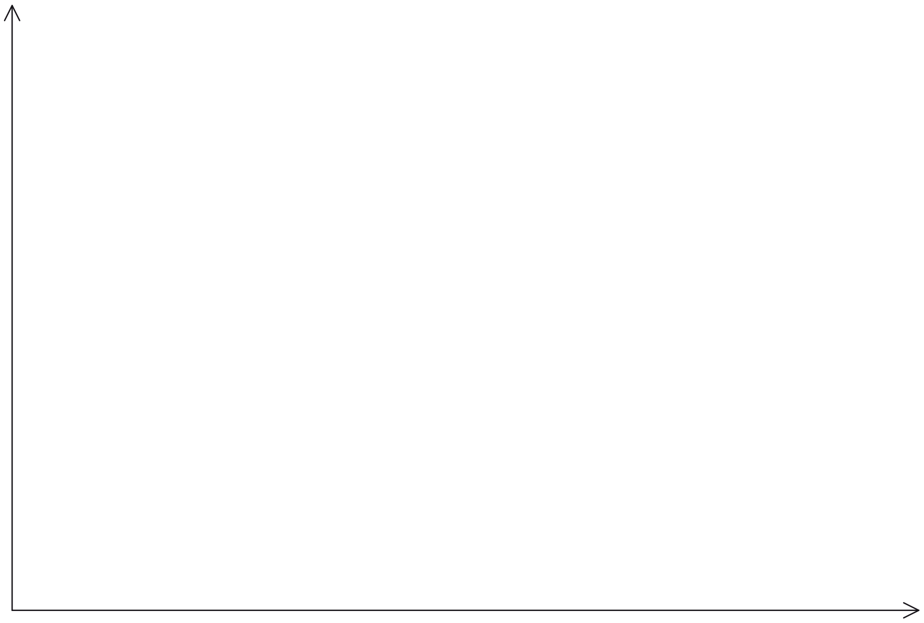
(Question 4 continued)

(e) (i) The boreal forests are situated close to the north pole and even in summer the intensity of sunlight is lower than at the equator. Sketch a graph showing the effect of light on the rate of photosynthesis, labelling the axes. [2]



(ii) In some boreal species, Rubisco is down-regulated during the winter months. Describe the role of Rubisco in photosynthesis. [2]

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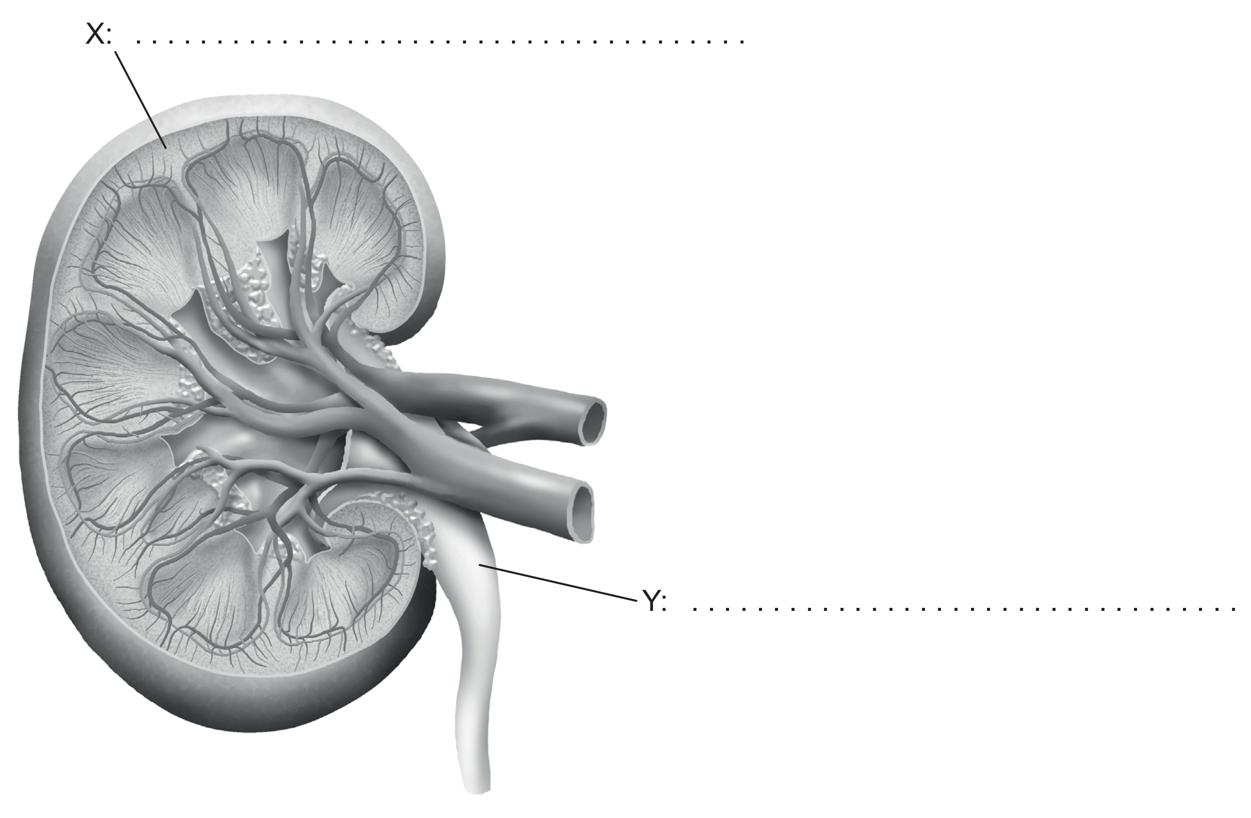
Turn over

5. (a) Label region X and structure Y on the diagram of the kidney. [2]



[Source: PeterHermesFurian/iStock]

(b) Distinguish between osmoregulators and osmoconformers. [2]

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Section B

Answer **two** questions. Up to one additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

6. (a) Calcium is absorbed from food in the human gut by both active and passive processes. Outline active transport, including the benefits of the process. [3]

(b) Describe the role of oxygen in aerobic cell respiration. [5]

(c) Adult humans may absorb more than five hundred litres of oxygen per day. Explain how gas exchange is maintained in the human respiratory system. [7]

7. (a) Isolated communities in rural Finland, Hungary and some of the Scottish islands have a high incidence of red-green colour blindness. Describe the inheritance of red-green colour blindness. [3]

(b) Outline the causes of variation in **one** example of continuous variation in humans. [5]

(c) Explain how evolution occurs and which factors can cause the process to be rapid. [7]

8. (a) Extensive areas of the rainforest in Cambodia are being cleared for large-scale rubber plantations. Distinguish between the sustainability of natural ecosystems such as rainforests and the sustainability of areas used for agriculture. [3]

(b) Describe the roles of the shoot apex in the growth of plants. [5]

(c) Research suggests that many living plant species are polyploid. Explain how polyploidy occurs and, using a **named** example, how polyploidy can lead to speciation. [7]