Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 2

Wednesday 6 May 2015 (morning)

1 hour 15 minutes

Candidate session number

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 one question.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

16 pages

2215 – 6011

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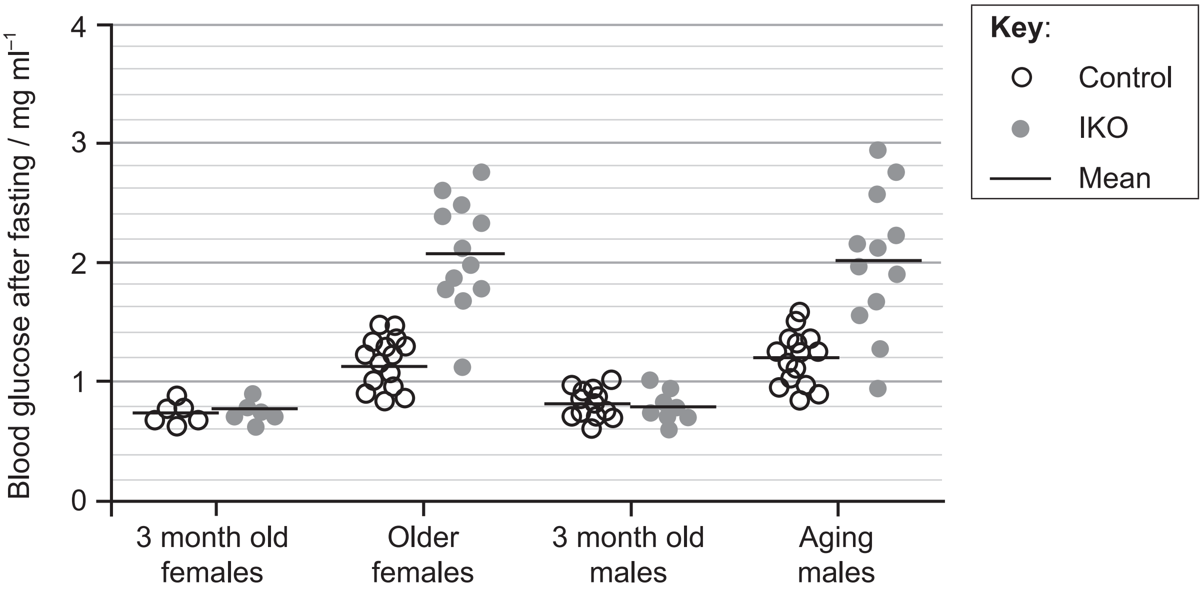
Section A

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

1. Diabetes is often associated with the failure of the β (beta) cells in the pancreas, but it is unclear what actually causes this failure. FoxO1 is a protein which acts as a transcription factor to regulate the expression of genes involved in cell growth. FoxO1 also regulates increase in number and differentiation in cells such as pancreatic β cells.

A study was conducted using mice lacking the gene for FoxO1 in β cells (IKO) as well as normal (control) mice. Blood glucose levels after fasting were compared for four groups of mice: young (3 months old) male mice, young (3 months old) female mice, older females (who have had several pregnancies) and aging males (16–20 months).



[Source: Chutima Talchai, Shouhong Xuan, Hua V. Lin, Lori Sussel, Domenico Accili, “Pancreatic β Cell Dedifferentiation as a Mechanism of Diabetic β Cell Failure”, *Cell*, Volume 150, Issue 6, 14 September 2012, Pages 1223–1234.]

(a) Compare blood glucose levels after fasting in young control mice and young IKO mice without FoxO1. [2]

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(Question 1 continued)

(b) (i) Estimate the difference between mean blood glucose levels in control and IKO older female mice. [1]

. . . . .mg ml^{-1}

(ii) Aging and having pregnancies are considered to be physiological stresses. Deduce the effect of stress on blood glucose levels. [2]

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(c) Outline the relationship between blood glucose levels after fasting and lack of FoxO1 in the mice studied. [2]

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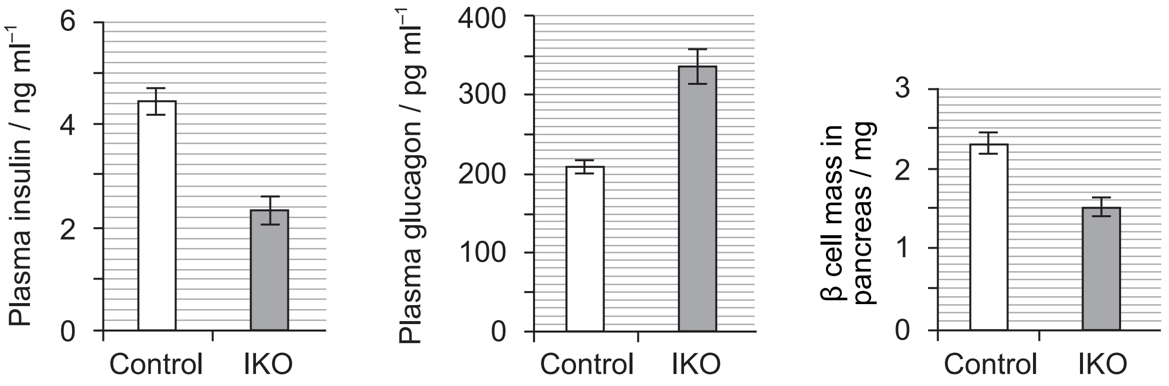
Turn over

(Question 1 continued)

The levels of pancreatic hormones and β cell mass in older female control mice and older female IKO mice lacking FoxO1 were then investigated.



[Source: Chutima Talchai, Shouhong Xuan, Hua V. Lin, Lori Sussel, Domenico Accili, "Pancreatic β Cell Dedifferentiation as a Mechanism of Diabetic β Cell Failure", *Cell*, Volume 150, Issue 6, 14 September 2012, Pages 1223–1234]

(d) Calculate the percentage difference in β cell mass of the IKO mice compared to the control mice. [2]

. . . .%

(e) State the correlation between lack of FoxO1 and pancreatic hormones in mice. [1]

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(This question continues on the following page)

(Question 1 continued)

(f) Referring to the functions of insulin and glucagon, suggest how the differences in hormone levels help to explain the blood glucose levels. [3]

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Turn over

2. Milk contains lactose which some people can digest but some cannot.

(a) State what type of sugar lactose is. [1]

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(b) State a function of lactose. [1]

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(c) Explain the production of lactose-free milk. [3]

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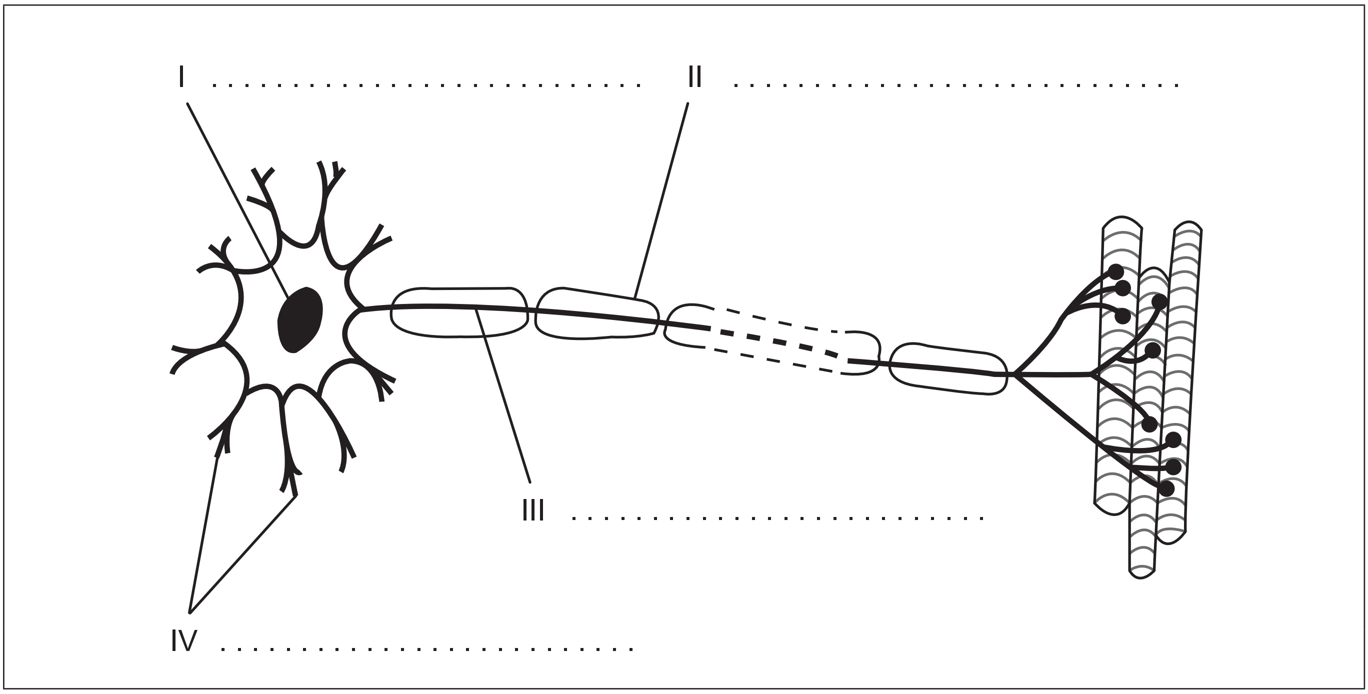
3. The diagram below shows a motor neuron.



[Source: © International Baccalaureate Organization 2015]

(a) Label the structures indicated by the numbers I–IV. [2]

(b) State a function of motor neurons. [1]

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(c) Define *resting potential*. [1]

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(This question continues on the following page)

(Question 3 continued)

(d) Outline how nerve impulses are transmitted along a nerve fibre. [3]

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4. (a) Distinguish between absorption of red, green and blue light by chlorophyll. [2]

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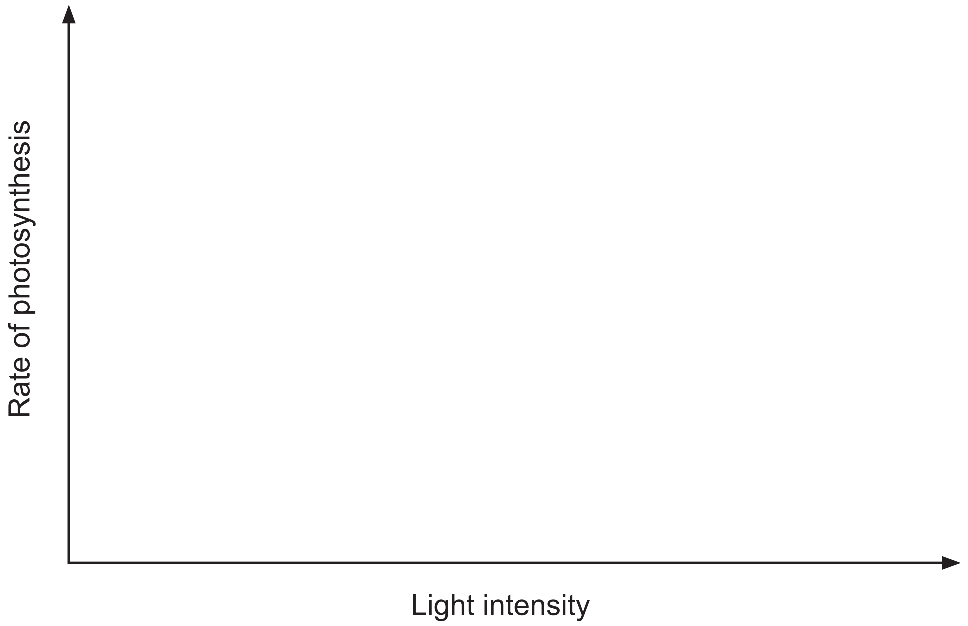
(b) (i) Draw a graph to show the effect of increasing light intensity on the rate of photosynthesis. [1]



(ii) Explain **one** way of directly measuring the rate of photosynthesis. [2]

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Section B

Answer **one** question. Up to two additional marks are available for the construction of your answer. Write your answers in the boxes provided.

5. (a) Draw a labelled diagram of a prokaryotic cell. [5]

(b) Bacteria are prokaryotes that sometimes act as pathogens. Describe how the body can defend itself against pathogens. [7]

(c) Explain the evolution of antibiotic resistance in bacteria. [6]

6. (a) Draw a labelled diagram of the human adult male reproductive system. [5]

(b) Describe the application of DNA profiling to determine paternity. [5]

(c) Explain the inheritance of colour blindness. [8]

7. (a) Draw a labelled diagram showing the structure of three water molecules and how they interact. [4]

(b) Aquatic and other environments are being affected by a global rise in temperature. Outline the consequences of this on arctic ecosystems. [6]

(c) Cell membranes separate aqueous environments in cells. Explain how the properties of phospholipids help to maintain the structure of cell membranes. [8]