88096002

International Baccalaureate®
Baccalauréat International
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BIOLOGY
HIGHER LEVEL
PAPER 2

Tuesday 10 November 2009 (afternoon)

2 hours 15 minutes

Candidate session number

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INSTRUCTIONS TO CANDIDATES

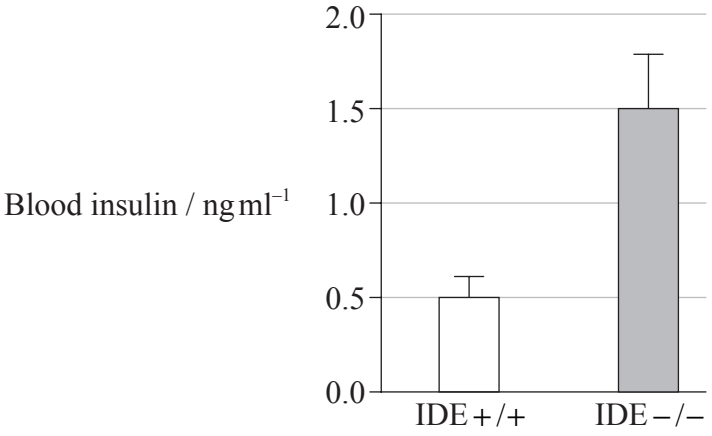
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer two questions from Section B. Write your answers on answer sheets. Write your session number on each answer 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.

0108

SECTION A

*Answer **all** the questions in the spaces provided.*

1. Type II diabetes is having an impact on the health of many individuals worldwide. The condition is characterized by elevated levels of both insulin and glucose in the bloodstream. Some animals produce an insulin-degrading enzyme (IDE) which breaks down the insulin molecule. In an attempt to develop a model of type II diabetes, genetically modified mice have been developed. In these mice, both copies of the IDE gene have been removed (IDE –/–) and the enzyme is not produced. The bar chart below shows the mean concentration of insulin in the bloodstream of IDE –/– mice and that of control mice (IDE +/+).



[Source: Wesley Farris *et al*., "Insulin-degrading enzyme regulates the levels of insulin, amyloid B-protein, and the B-amyloid precursor protein intracellular domain in vivo", *PNAS*, 100 (7), pages 4162-7. Copyright 2003 National Academy of Sciences, U.S.A.]

(a) Calculate the percentage increase between mean blood insulin levels in IDE +/+ mice and those in IDE –/– mice. *[1]*

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(b) Explain the difference in blood insulin concentrations between the two groups of mice. *[2]*

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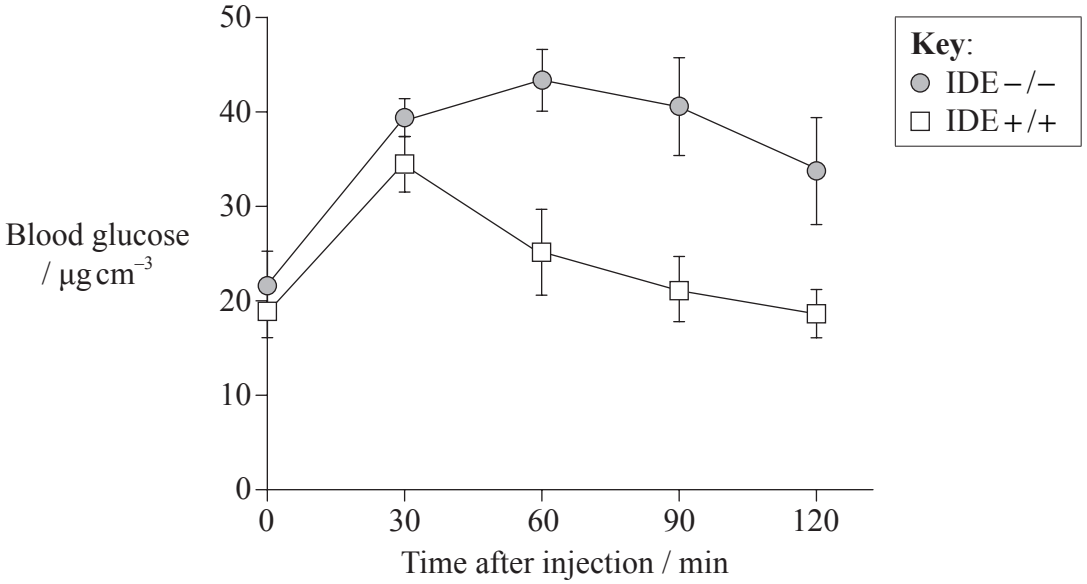
(This question continues on the following page)

(Question 1 continued)

In another experiment, groups of IDE−/− and IDE+/+ mice were injected with a fixed amount of glucose. The levels of blood glucose were measured at various time intervals following glucose injection. The data are shown in the graph below.



[Source: Wesley Farris *et al*., "Insulin-degrading enzyme regulates the levels of insulin, amyloid B-protein, and the B-amyloid precursor protein intracellular domain in vivo", *PNAS*, 100 (7), pages 4162-7. Copyright 2003 National Academy of Sciences, U.S.A.]

(c) Distinguish between the response of the two groups of mice to the injection of glucose. *[2]*

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(d) Deduce, with a reason, whether transgenic IDE−/− mice are an appropriate model of type II diabetes. *[2]*

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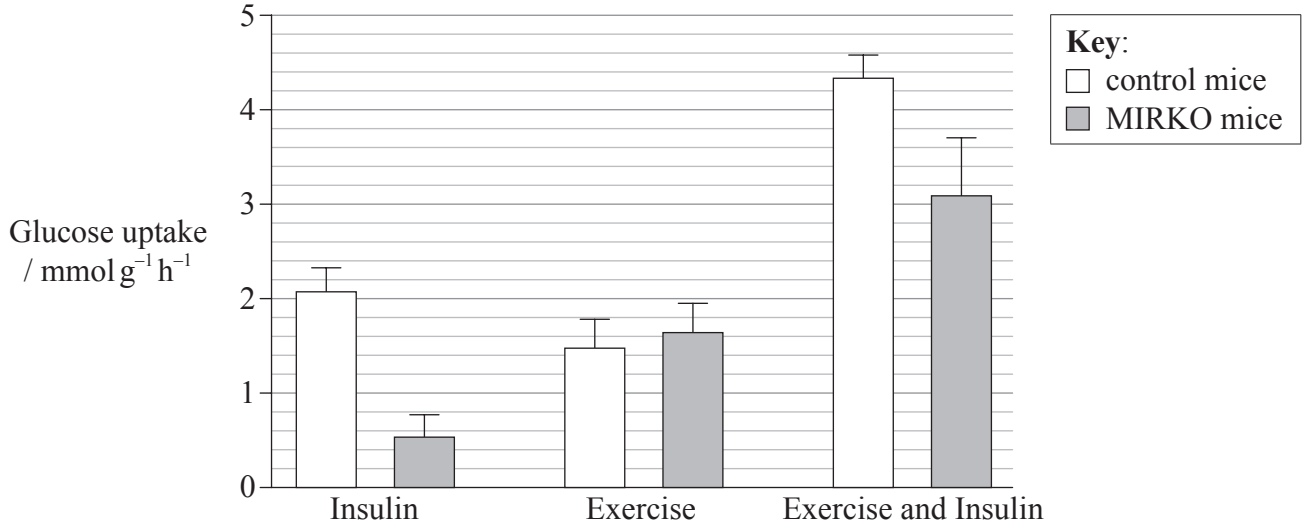
(This question continues on the following page)

(Question 1 continued)

In animals that do not have type II diabetes, insulin stimulates glucose uptake into skeletal muscle. Glucose uptake into skeletal muscle is also stimulated when skeletal muscle is exercised. Genetically modified mice have been developed in which the insulin receptor is not produced in skeletal muscle and these are known as MIRKO mice. In another experiment, the effect of insulin and exercise on glucose uptake in skeletal muscle from control and MIRKO mice was examined. The results are shown in the bar chart below.



[Source: JOURNAL OF CLINICAL INVESTIGATION by J F Wojtaszewski. Copyright 1999 by AMERICAN SOCIETY FOR CLINICAL INVESTIGATION. Reproduced with permission of AMERICAN SOCIETY FOR CLINICAL INVESTIGATION in the format CD ROM via Copyright Clearance Center.]

(e) Explain the reason for the differences in insulin-stimulated glucose uptake between control mice and MIRKO mice. *[2]*

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(f) Distinguish between the effects of insulin alone and exercise alone on glucose uptake in skeletal muscle of MIRKO mice. *[1]*

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(Question 1 continued)

(g) Evaluate, using the data, whether exercise would be an appropriate therapy for human patients with type II diabetes. *[3]*

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(h) State which cells secrete insulin and the organ in which they are located. *[2]*

Cells: . . . . . .

Organ: . . . . . .

(i) State the name of **one** hormone other than insulin involved in the regulation of blood glucose. *[1]*

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2. HIV was discovered in 1981 and is now one of the most serious causes of disease in the world. It causes the immune system to fail, leaving the patient vulnerable to other infections.

(a) Distinguish between active immunity and passive immunity as a defence against disease. *[2]*

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(b) Outline how monoclonal antibodies are produced. *[2]*

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(c) Discuss how the HIV virus is transmitted. *[2]*

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(d) Explain why antibiotics are ineffective against viruses. *[2]*

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3. In the red squirrel (*Tamiasciurus hudsonicus*), the allele for grey fur colour (G) is dominant to the allele for red fur colour (g) and the allele for a fluffy tail (F) is dominant to hairless tail (f).

(a) The genes described above form a linkage group. Define *linkage group*. *[1]*

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(b) A cross is made between squirrels of the following genotypes.

$$\frac{G\ F}{g\ f} \times \frac{g\ f}{g\ f}$$

Using a similar format, identify the genotypes of offspring which are recombinants. *[2]*

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(c) Explain how the recombinants are formed during meiosis. *[3]*

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(d) Explain the role of transfer RNA (tRNA) in the process of translation. *[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 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 to show the ultrastructure of *Escherichia coli*. *[5]*

(b) Distinguish between active and passive movements of materials across plasma membranes, using **named** examples. *[4]*

(c) Explain how chemiosmosis assists in ATP production during oxidative phosphorylation. *[9]*

5. (a) Draw a labelled diagram to show the structure of a sarcomere. *[4]*

(b) Outline how skeletal muscle contracts. *[5]*

(c) Explain how nerve impulses are transmitted along and between neurons. *[9]*

6. (a) Draw a labelled sigmoid population growth curve. *[4]*

(b) Outline the process of spermatogenesis in humans. *[5]*

(c) Explain the structure and function of the placenta during pregnancy. *[9]*

7. (a) Outline the thermal, cohesive and solvent properties of water. *[5]*

(b) Outline adaptations of xerophytes. *[4]*

(c) Explain the role of the kidney in maintaining water balance in humans. *[9]*