



**BIOLOGY
HIGHER LEVEL
PAPER 2**

Monday 14 May 2007 (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

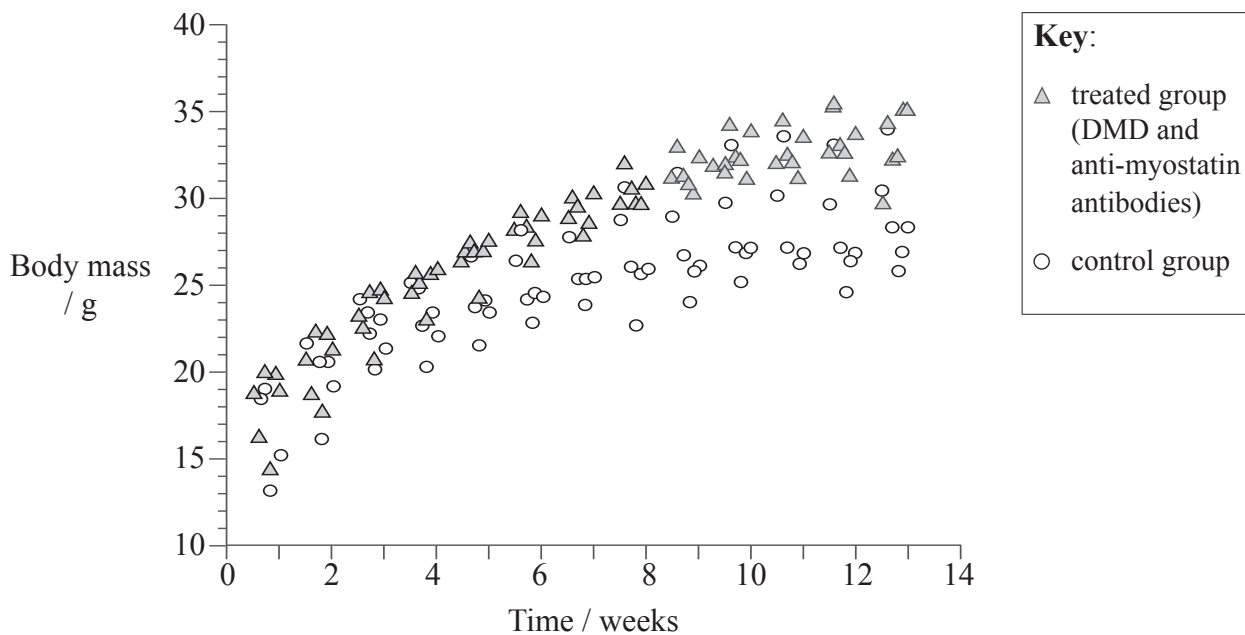
Answer **all** the questions in the spaces provided.

- 1. In humans, Duchenne Muscular Dystrophy (DMD) is a lethal X-linked recessive disorder caused by mutations in the dystrophin gene. Affected individuals show a decline in muscle mass over time along with a decline in muscle strength.

One promising area of research in the treatment of DMD involves inhibiting the activity of myostatin, a naturally occurring protein that regulates muscle growth by limiting the development of new muscle cells.

Researchers investigating the disorder in mice predicted that inhibition of myostatin would increase muscle mass. Over a period of three months one group of DMD mice (treated) were given injections of anti-myostatin antibody that inhibited myostatin. A second group of DMD mice were untreated (control).

Figure 1 below shows the differences in body mass during the test period for both groups.



[Source: S Bogdanovich *et al.* (2002), *Nature*, **420** (6914), pages 418–421]

- (a) Outline the relationship between body mass and time in the treated group of mice. [2]

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(Question 1 continued)

- (b) Compare the changes in body mass in the two groups of mice over the test period. [3]

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- (c) Predict the results that the researchers would have expected if the experiment was continued beyond 13 weeks in

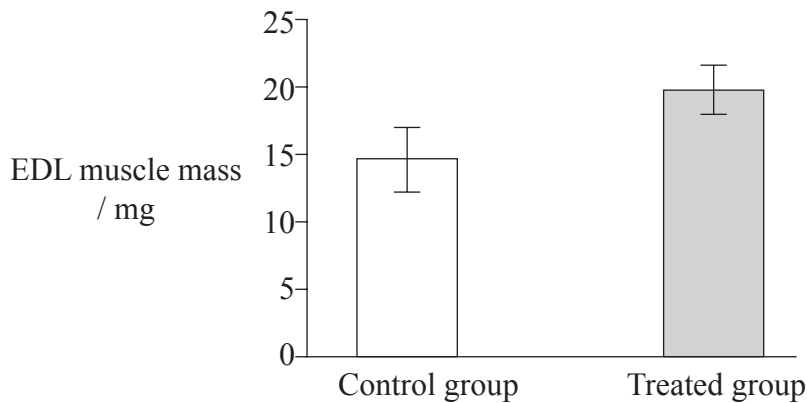
- (i) the treated group. [1]

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- (ii) the control group. [1]

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Figure 2 below shows the change in mass over the course of the experiment on a particular muscle called the EDL muscle in samples of the treated and control groups of mice.



[Source: S Bogdanovich *et al.* (2002), *Nature*, 420 (6914), pages 418–421]

- (d) Calculate the percentage increase in the average mass of the EDL muscle between the treated group and the control group. [2]

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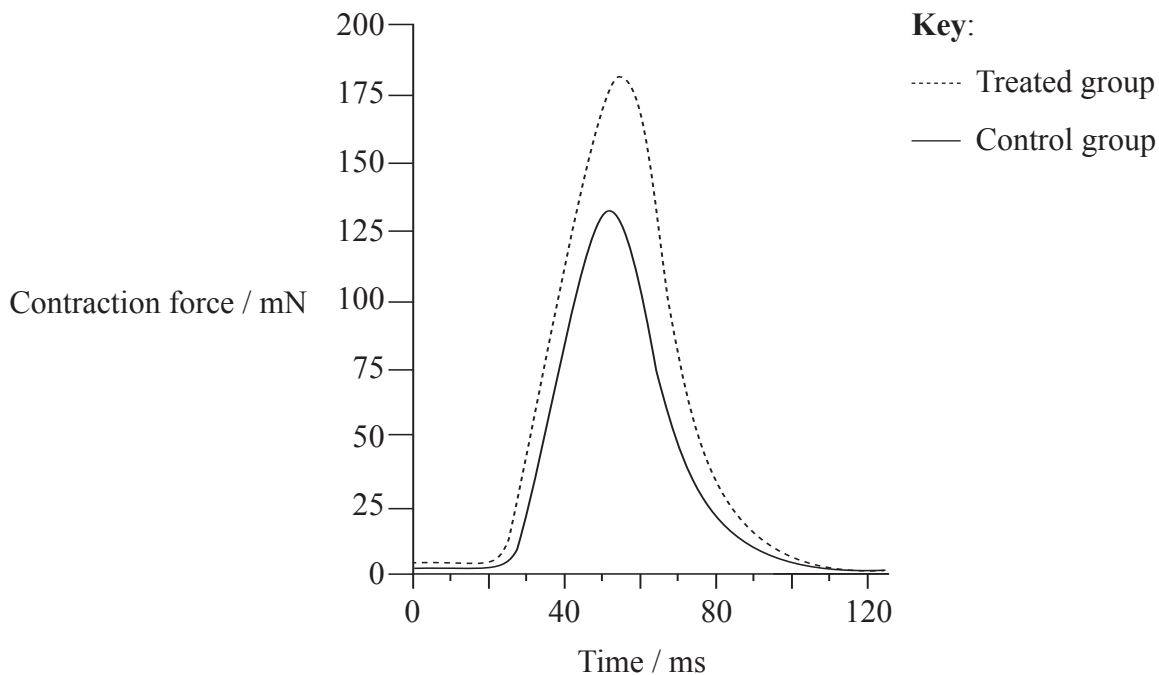
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(Question 1 continued)

Further tests were conducted to see whether myostatin inhibition influenced the muscle function of the mice in the study.

Figure 3 below shows the effect of treatment on muscle strength.



[Source: S Bogdanovich *et al.* (2002), *Nature*, 420 (6914), pages 418–421]

(e) Determine the difference in peak contraction force between the treated group and the control group. [1]

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(f) Evaluate the effectiveness of myostatin inhibition as a treatment for DMD in humans. [3]

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(Question 1 continued)

- (g) Another proposed treatment for DMD in humans is gene therapy using the dystrophin gene. Outline, **in general**, the process of gene therapy. [3]

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- (h) Monoclonal antibodies are laboratory-produced identical antibodies that can target specific antigens, such as the myostatin protein. Describe how monoclonal antibodies are produced. [3]

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2. (a) Define the term *random sample*. [1]

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(b) Explain the usefulness of standard deviation when comparing the means of two sets of data. [2]

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(c) Outline the role of variation in evolution. [3]

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(d) Explain how polygenic inheritance leads to continuous variation. [2]

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3. (a) Explain the significance to organisms of water as a habitat. [4]

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(b) Define the term *community* as it relates to ecosystems. [1]

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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) Describe the four levels of protein structure, including each level's significance. [8]
- (b) Compare the structure and composition of DNA with RNA. [4]
- (c) Explain how the hydrophilic and hydrophobic properties of phospholipids help to maintain the structure of cell membranes. [6]
5. (a) Describe the structure and function of the placenta. [6]
- (b) Draw and label a diagram of the adult male human reproductive system. [5]
- (c) Discuss the implications of genetic screening. [7]
6. (a) Outline the effects of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis. [6]
- (b) Explain the relationship between the distribution of tissues in a typical mesophytic leaf and the functions of these tissues. [8]
- (c) Draw and label a diagram showing the external and internal structure of a **named** dicotyledonous seed. [4]
7. (a) Draw and label a diagram showing the structure of a glomerulus and associated nephron. [4]
- (b) Explain how water balance is maintained in the blood. [8]
- (c) Describe the process of water uptake and movement in roots. [6]
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