



22146008

**BIOLOGY  
HIGHER LEVEL  
PAPER 2**

Candidate session number

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Friday 9 May 2014 (afternoon)

Examination code

2 hours 15 minutes

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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 questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [72 marks].



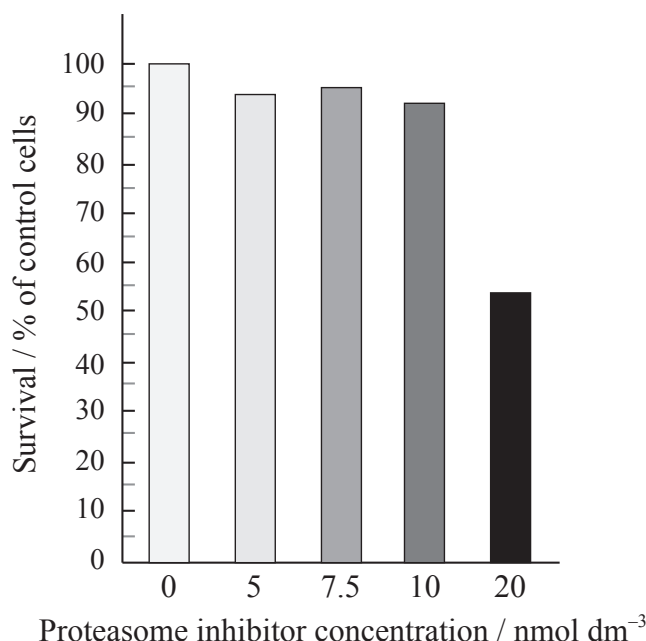
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**SECTION A**

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

- 1. Proteasomes are a group of proteins that destroy unwanted proteins in the cell, thereby maintaining cell health. However, chemical inhibitors can block the action of proteasomes, resulting in a build up of unwanted proteins with negative consequences for the cell.

Rat heart cells were incubated at different concentrations of a proteasome inhibitor in order to test its toxicity. The bar graph shows the percentage survival of these cells compared to untreated control cells.



[Source: Adapted from Nowis *et al.* (2010) *American Journal of Pathology*, 176 (6). Pages 2658--2668. 'Cardiotoxicity of the Anticancer Therapeutic Agent Bortezomib', with permission from Elsevier.]

- (a) State the percentage survival of heart cells treated with 20 nmol dm<sup>-3</sup> proteasome inhibitor. [1]

..... %

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*(Question 1 continued)*

- (b) Outline the effect of increasing concentrations of proteasome inhibitor on rat heart cell survival.

[2]

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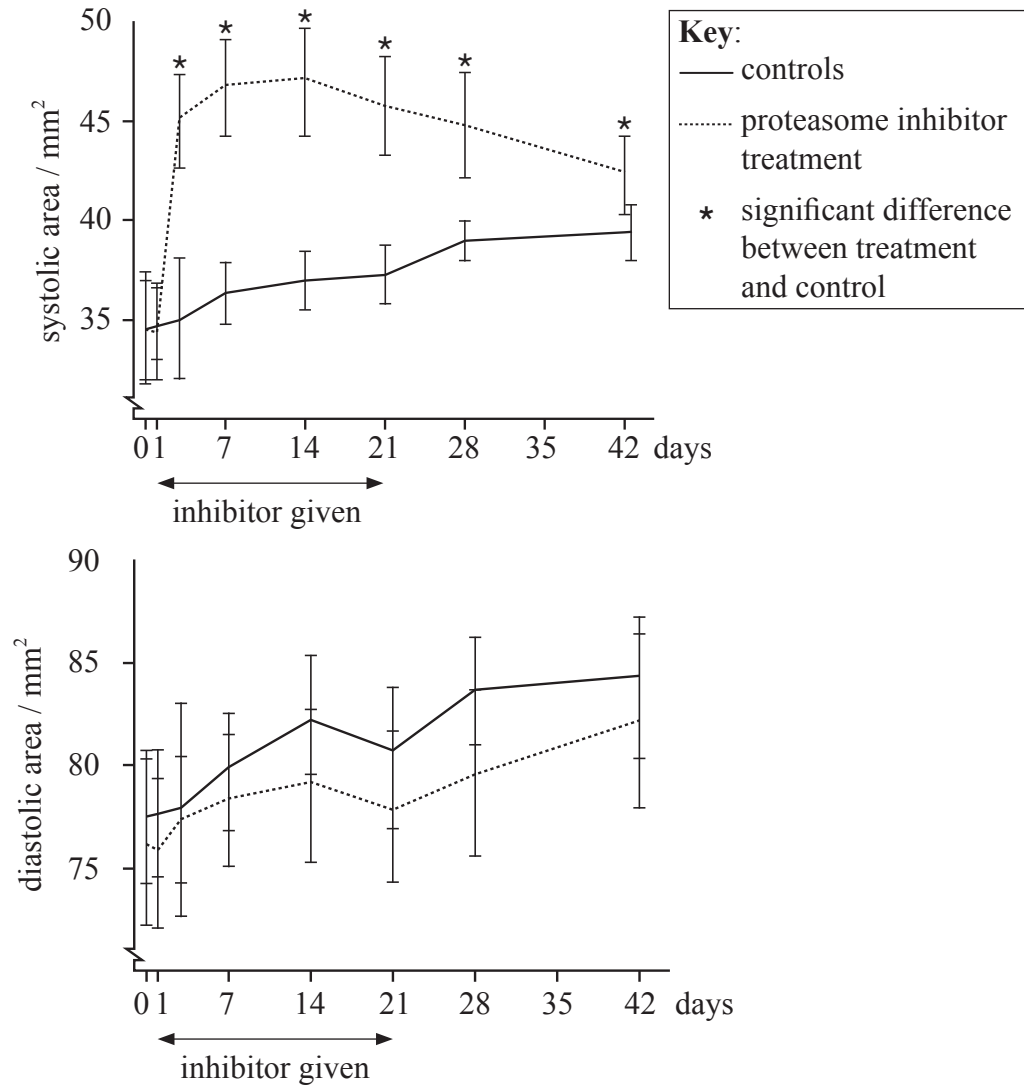
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(Question 1 continued)

In order to further test the effect of the proteasome inhibitor on heart cells, rats were treated with this inhibitor for 21 days (from day 1 to 21). The cross sectional area inside the left ventricle was recorded during contraction (systolic area) and during relaxation (diastolic area).



[Source: Adapted from Nowis *et al.* (2010) *American Journal of Pathology*, 176 (6). Pages 2658--2668. 'Cardiotoxicity of the Anticancer Therapeutic Agent Bortezomib', with permission from Elsevier.]

- (c) (i) State the systolic and diastolic cross sectional areas inside the left ventricle for control rats before the drug treatment. [1]

Systolic area: ..... mm<sup>2</sup>

Diastolic area: ..... mm<sup>2</sup>

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*(Question 1 continued)*

- (ii) Calculate the difference in the systolic cross sectional area of control and treated rats on day 14 of the treatment. [1]

..... mm<sup>2</sup>

- (d) Distinguish between the effect of the proteasome inhibitor on the systolic and diastolic area of the left ventricle. [2]

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- (e) Using the data provided, evaluate the hypothesis that the effects of the proteasome inhibitor on the systolic area are reversible. [2]

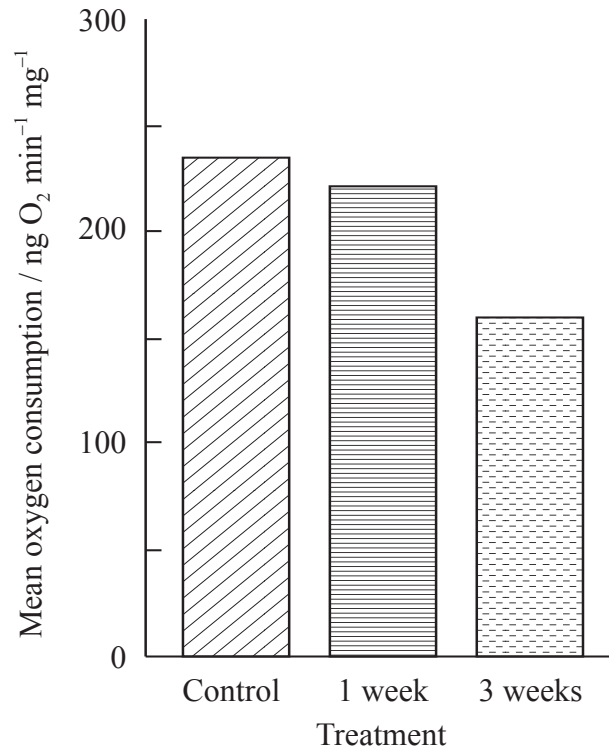
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(Question 1 continued)

Proteasomes are needed to protect mitochondria from unwanted cell proteins. Mean oxygen consumption is a measure of mitochondrial activity. It was recorded in untreated control rats, rats treated for one week and rats treated for three weeks with proteasome inhibitor.



[Source: Adapted from Nowis *et al.* (2010) *American Journal of Pathology*, 176 (6). Pages 2658--2668. 'Cardiotoxicity of the Anticancer Therapeutic Agent Bortezomib', with permission from Elsevier.]

(f) Describe the effect of the two treatments with proteasome inhibitor on mean oxygen consumption. [1]

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*(Question 1 continued)*

- (g) Explain how mean oxygen consumption is related to energy consumption in cells. [2]

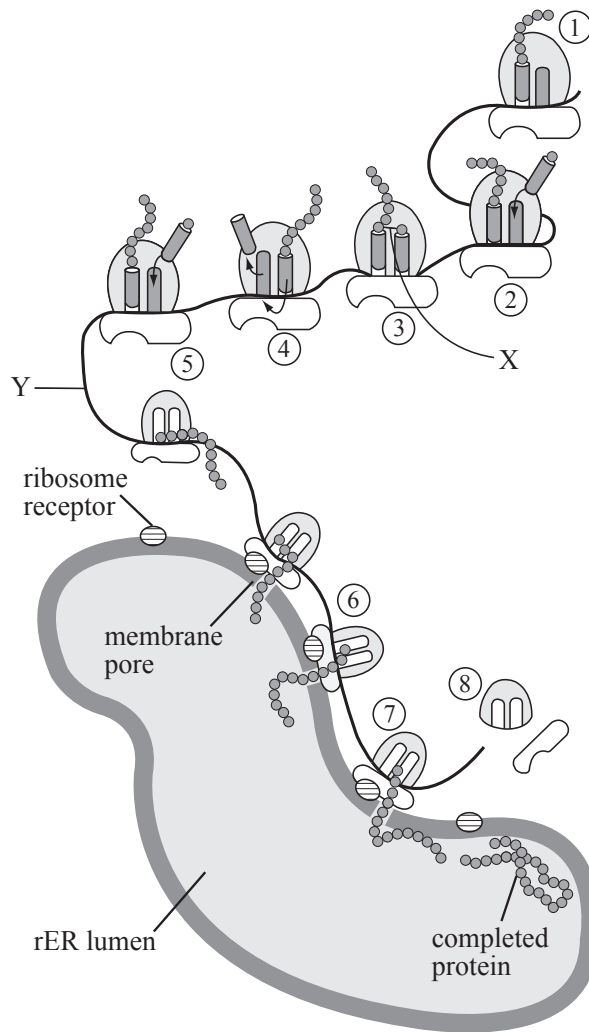
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- (h) Proteasome inhibitors are used to target vital cell pathways in the tumor cells of cancer patients. Using the data provided in all of the graphs, evaluate the risks of proteasome inhibitor treatment for cancer patients. [3]

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2. The diagram shows the summary of events occurring during translation.



[Source: M. Ross and W. Pawlina (2007) *Histology: A Text and Atlas*, 5th edition. Published by Lippincott Williams & Wilkins.]

(a) (i) State the name of the bond labeled X. [1]

.....

*(This question continues on the following page)*





*(Question 2 continued)*

(ii) State the name of the molecule labeled Y. [1]

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(b) Outline the processes occurring in stages 4 and 5. [2]

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(c) Explain the importance of polysomes in protein synthesis. [2]

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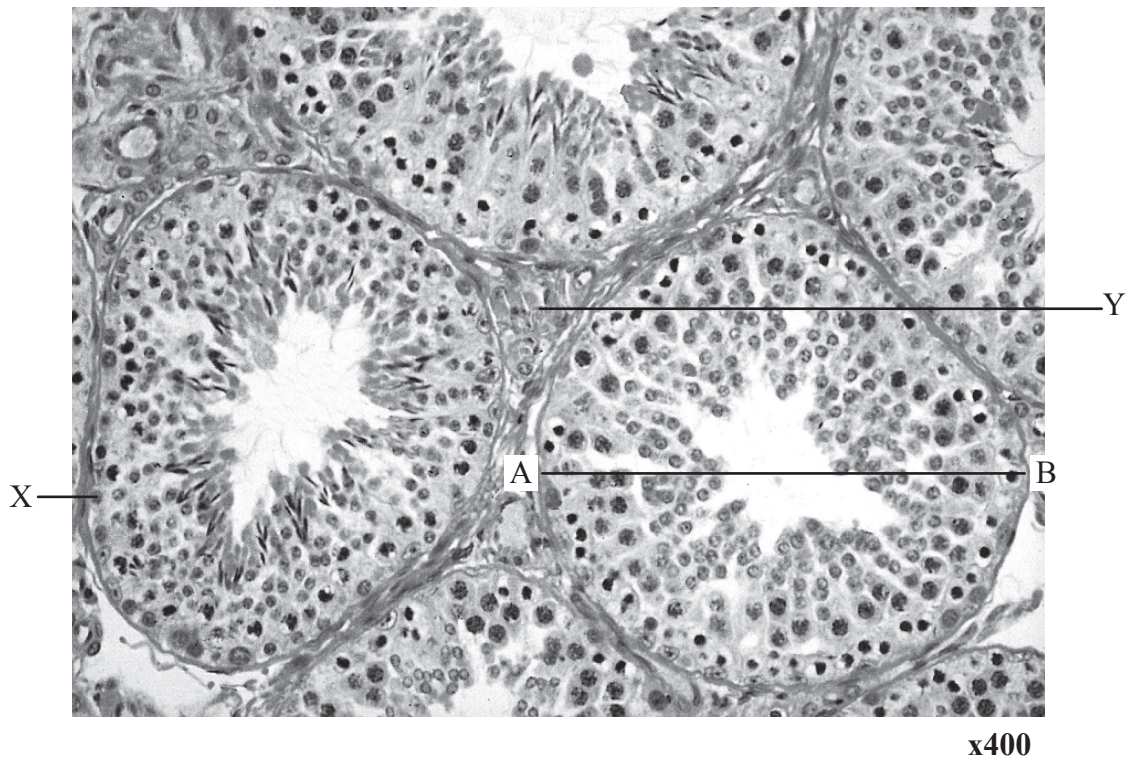
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3. The light micrograph shows the structure of the mammalian testis.



[Source: M. Ross and W. Pawlina (2007) *Histology: A Text and Atlas*, 5th edition. Published by Lippincott Williams & Wilkins.]

(a) (i) Label cells X and Y. [2]

X: .....
Y: .....

(ii) State a function of Y. [1]

.....
.....

(This question continues on the following page)



*(Question 3 continued)*

- (b) State the type of cell division occurring when primary spermatocytes form secondary spermatocytes. [1]

.....

- (c) Calculate the actual size of the diameter shown as AB on the seminiferous tubule. [1]

.....



4. (a) Purple flowers (A) and starchy seeds (B) are dominant to white flowers (a) and waxy seeds (b) in a type of plant. The traits are unlinked. A test cross was carried out on a plant that was heterozygous for both traits. Predict the phenotypic ratio of this test cross using a Punnett square. [3]

Phenotypic ratio: .....

- (b) Explain transport of water in plant stems. [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 in the boxes provided.

5. (a) Draw a labeled diagram to show the structure of a motor neuron. [4]
- (b) Explain how nerve impulses pass from one neuron to another neuron. [8]
- (c) Outline how the rate at which the heart beats is controlled. [6]
6. (a) Draw a simple labeled diagram to show the structure of a double stranded DNA molecule, comprising four nucleotides. [6]
- (b) Describe the use of DNA profiling in forensic investigations. [4]
- (c) Using a named example, discuss the effects of genetically modifying an organism. [8]
7. (a) Draw a labeled diagram of the kidney and associated vessels. [5]
- (b) Outline type II diabetes. [5]
- (c) Explain the presence of glucose in the urine of a diabetic person and its absence in the urine of a person with type I diabetes that is being successfully treated. [8]
8. (a) Draw a labeled diagram of the carbon cycle. [6]
- (b) Outline the effect of carbon dioxide on the rate of photosynthesis and how this can be measured by oxygen release. [4]
- (c) Carbon dioxide is released during cell respiration. Explain anaerobic and aerobic respiration. [8]







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A large rectangular area containing horizontal dotted lines for writing.



20EP17

Turn over

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A large rectangular area containing horizontal dotted lines for writing.



20EP19

Turn over

A large rectangular area containing horizontal dotted lines, intended for student responses.

