



88116005

**BIOLOGY
STANDARD LEVEL
PAPER 2**

Wednesday 16 November 2011 (afternoon)

1 hour 15 minutes

Candidate session number

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Examination code

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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 one question.
- Write your answers in the boxes provided.



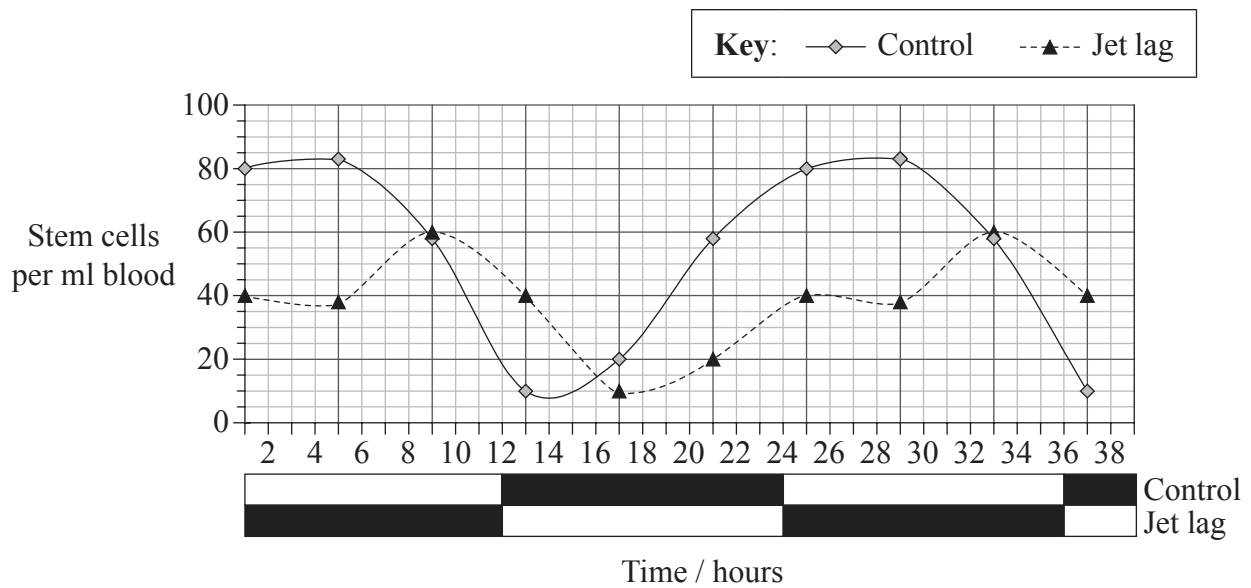
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SECTION A

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

- 1. Stem cells in the bone marrow can be forced into blood vessels in a process called mobilization. Mobilization of stem cells from the bone marrow into the blood vessels represents the basis for modern bone marrow transplantation procedures.

To test the effect of light on the mobilization of stem cells, mice were subjected to a simulated “jet lag” by advancing the light-dark cycle by 12 hours. This was done by subjecting mice to a 24-hour light period before the results shown in the graph were recorded. The results were compared to the stem cells in control mice under normal conditions of 12 hours of light (□) and 12 hours of darkness (■).



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- (a) (i) State the maximum number of stem cells per ml blood in the control mice. [1]

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- (ii) Determine the number of hours of light needed to release the maximum number of stem cells in blood in control mice. [1]

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(Question 1 continued)

- (b) Distinguish between the trends shown in the number of stem cells per ml blood by the mice subjected to jet lag and the control mice. [2]

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- (c) Other studies suggest that a greater number of blood stem cells for transplantation may be obtained if they are harvested during darkness. Evaluate this hypothesis. [2]

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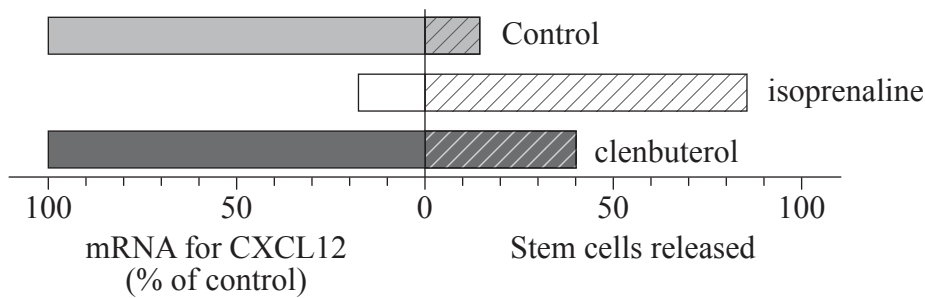
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(Question 1 continued)

One important chemical in the mobilization of stem cells is a protein, CXCL12, which maintains the stem cells inside the bone marrow. The breakdown of CXCL12 causes the mobilization of stem cells to the blood vessels.

The graph below shows the mobilization of stem cells and the production of mRNA for CXCL12 when the bone marrow is treated with two different chemicals (isoprenaline and clenbuterol).



Méndez-Ferrer, S., Lucas, D., Battista, M. and Frenette, P.S. (2008) 'Haematopoietic stem cell release is regulated by circadian oscillations'. Nature 452: 442-447.

- (d) Explain how the amount of mRNA for CXCL12 gives an indication of the amount of protein CXCL12 produced. [1]

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- (e) Compare the effect of isoprenaline and clenbuterol with the normal release of stem cells and the production of mRNA for CXCL12. [3]

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(Question 1 continued)

- (f) Research is being conducted into treatment for diabetes based on stem cells. Discuss the ethical issues involved in stem cell research. [3]

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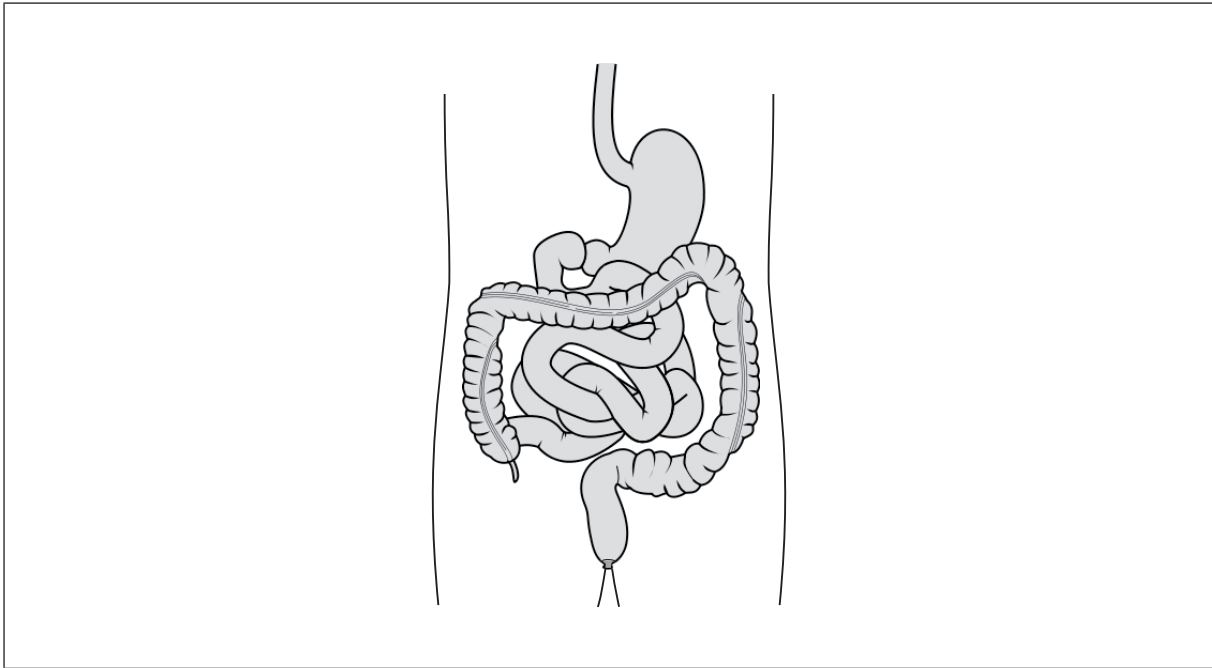
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2. The structure of part of the digestive system is shown in the diagram below.



[Source: <http://commons.wikimedia.org/wiki/File:Intestinesall.svg>
Created by Wikipedia user: Madhero88.]

- (a) Label the diagram to show the structure
- (i) that is involved in digestion of proteins in acid conditions (using the letter A). [1]
 - (ii) where **most** absorption of water to prevent dehydration occurs (using the letter B). [1]
 - (iii) where **most** absorption of nutrients occurs (using the letter C). [1]

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0616

(Question 2 continued)

- (b) (i) Explain how the structure of veins is adapted to their function. [2]

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- (ii) Cells defend the body against pathogens. Outline how some of these cells ingest pathogens in the blood and in body tissues. [2]

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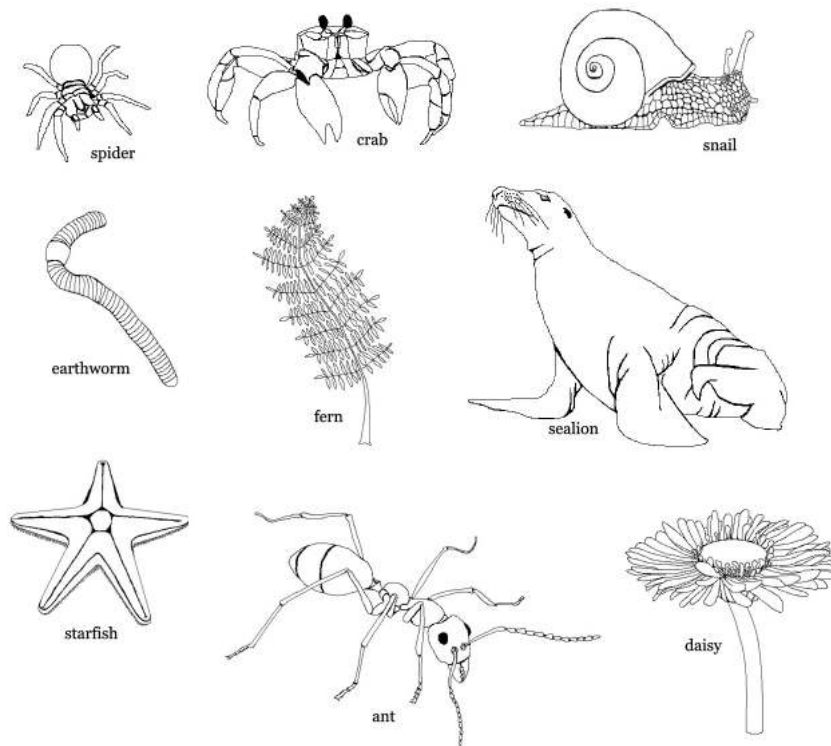
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3. The diagrams below show different organisms (not drawn to scale).



(a) State **all** the organisms shown above that belong to the following phyla.

[3]

Filicinophyta:
Arthropoda:
Mollusca:

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(Question 3 continued)

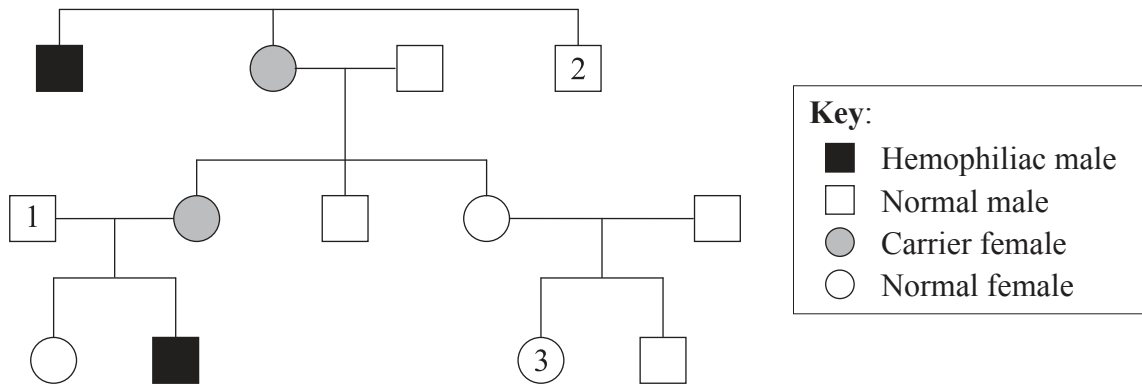
- (b) (i) Construct a possible food chain using **three** of the organisms shown opposite, stating the trophic level to which they belong. [2]

- (ii) State the initial energy source of the food chain constructed in (b)(i). [1]

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4. Hemophilia is a disease where the blood does not clot properly. The pedigree chart below shows the inheritance of this condition in a family.



(a) (i) Determine the genotype of person 1. [1]

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(ii) Deduce the genotype of the mother of person 2. [1]

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(iii) If person 3 has a son, and the father is a hemophiliac male, predict the son's phenotype. [1]

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(b) Suggest how sheep could be genetically modified to help the treatment of hemophilia in humans. [1]

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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 to show the structure of membranes. [6]
- (b) Some tissues contain extracellular components. Outline **two** roles of extracellular components. [4]
- (c) Explain passive transport and active transport across membranes. [8]

- 6. (a) State **one** role in living organisms for each of the following: sulfur, calcium, phosphorus and iron. [4]
- (b) Outline the role of condensation and hydrolysis in the relationship between fatty acids, glycerol and triglycerides. [6]
- (c) Explain the relationship between the properties of water and its uses in living organisms as a coolant, a medium for metabolic reactions and a transport medium. [8]

- 7. (a) Distinguish between ventilation, gas exchange and cell respiration. [4]
- (b) Outline the process of aerobic respiration. [6]
- (c) Respiration and other processes in cells involve enzymes. Explain the factors that can affect enzymes. [8]

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1316

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1516

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