UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4268149379

BIOLOGY **9700/21**

Paper 2 Structured Questions AS **October/November 2012**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
Write in dark blue or black ink.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
Total	

This document consists of **14** printed pages and **2** blank pages.

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Answer **all** the questions.

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1 Fig. 1.1 is a drawing made from an electron micrograph of a mammalian liver cell.

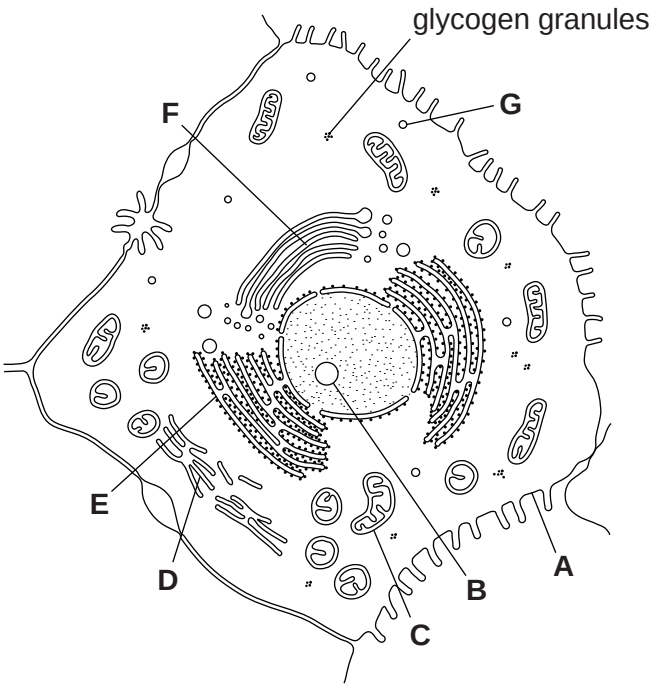


Fig. 1.1

(a) Complete the table by naming the structures **B** to **G** and stating **one** function of each. The first one (**A**) has been completed for you.

	name of organelle	**function**
A	cell surface membrane	controls movement of substances into and out of the cell
B		
C		
D		
E		
F		
G		

[6]

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(b) As shown in Fig. 1.1, liver cells contain many storage granules of glycogen.

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Describe the molecular structure of glycogen **and** explain how this structure makes it suitable for storage.

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.....[4]

[Total: 10]

2 Thale cress, *Arabidopsis thaliana*, is used to study the roles of genes and proteins in plants.

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The cell membranes of the root hairs of *A. thaliana* contain proteins called aquaporins that allow the movement of water between the soil and the cytoplasm as shown in Fig. 2.1.

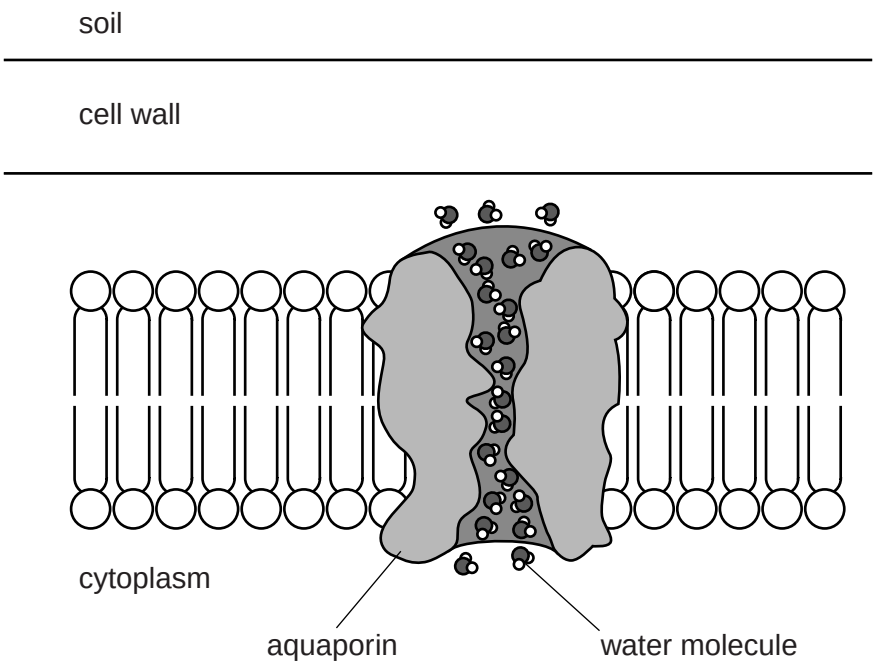


Fig. 2.1

(a) With reference to Fig. 2.1:

(i) explain how water is absorbed by root hairs of *A. thaliana*

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..... [3]

(ii) state why aquaporins are necessary in cell surface membranes.

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..... [1]

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(b) Describe the pathway taken by water from the cytoplasm of the root hair cell to a xylem vessel in the centre of the root.

For Examiner's Use

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.....[3]

For Examiner's Use

An investigation was carried out to find the effect of an enzyme in *A. thaliana* on the composition of the cuticle. The enzyme is involved in the production of lipid that accumulates in the cuticle.

Plants were discovered with a mutation of the gene that codes for the enzyme.

Some of these mutant plants (Group **A**) were grown in pots and their rate of transpiration was determined over three days. They were compared with control plants (Group **B**) in which the gene was switched on and the enzyme present. The results are shown in Fig. 2.2.

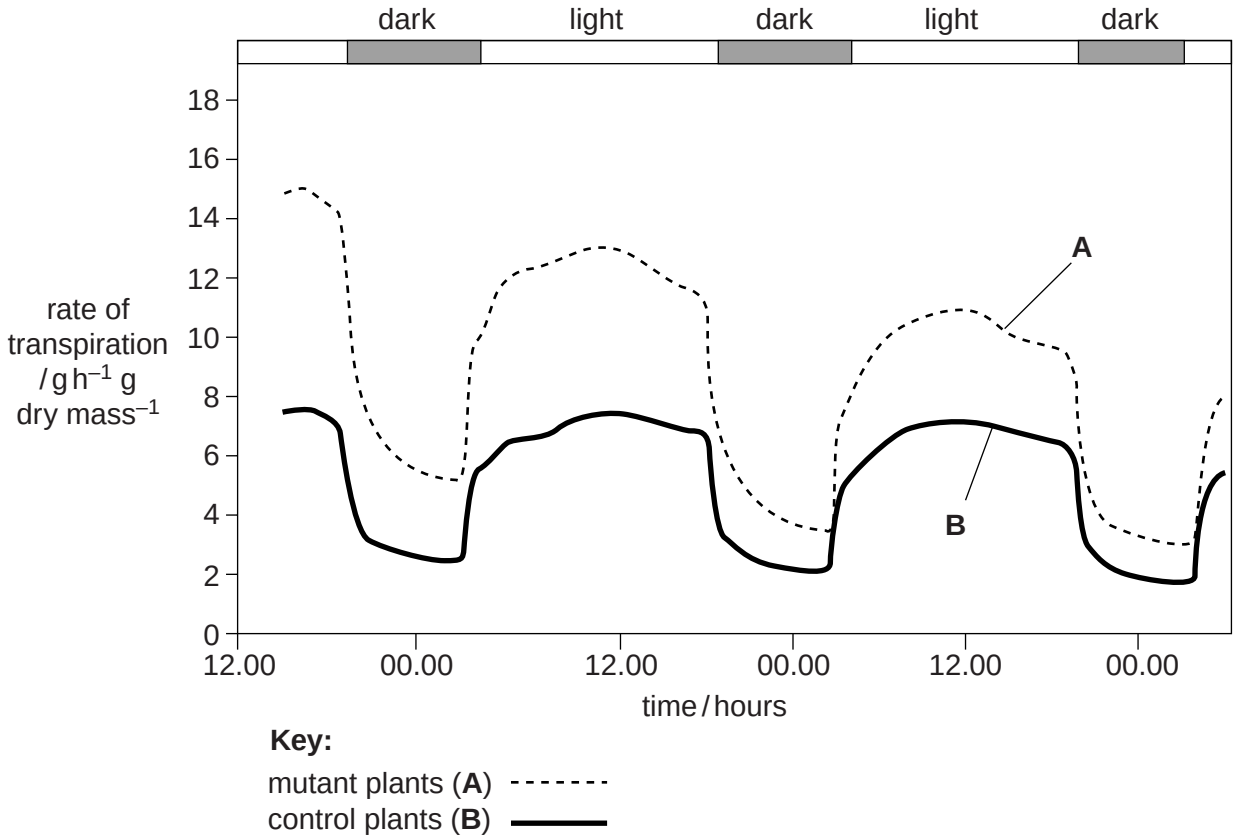


Fig. 2.2

(c) With reference to Fig. 2.2, explain:

(i) why the rate of transpiration is higher during the day than at night in both groups of plants

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.....[1]

(ii) how the results show that the cuticle is less effective in the mutant plants.

For Examiner's Use

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.....[3]

[Total: 11]

For Examiner's Use

3 Bone marrow contains stem cells that divide by mitosis to form blood cells. Each time a stem cell divides it forms a replacement stem cell and a cell that develops into a blood cell.

Fig. 3.1 shows changes in the mass of DNA in a human stem cell from the bone marrow during three cell cycles.

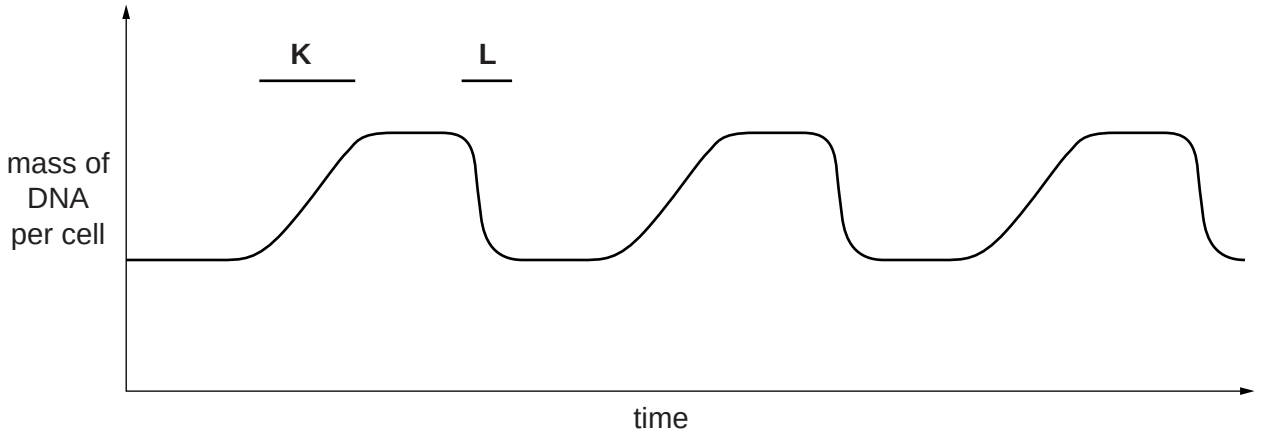


Fig. 3.1

(a) With reference to Fig. 3.1, state:

(i) what happens to bring about the changes in the mass of DNA per cell at **K** and at **L**

K .....

.....

L .....

.....[2]

(ii) how many blood cells are formed from the stem cell in the time shown

.....[1]

(iii) what happens to the number of chromosomes in the stem cell.

.....[1]

Stem cells in bone marrow give rise to phagocytes, B-lymphocytes and T-lymphocytes.

For Examiner's Use

(b) Describe how a red blood cell develops from a stem cell.

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.....[3]

(c) During an immune response, cells divide by mitosis.

Describe how mitosis is involved in an immune response.

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.....[3]

(d) Describe the modes of action of T-lymphocytes during an immune response.

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.....[3]

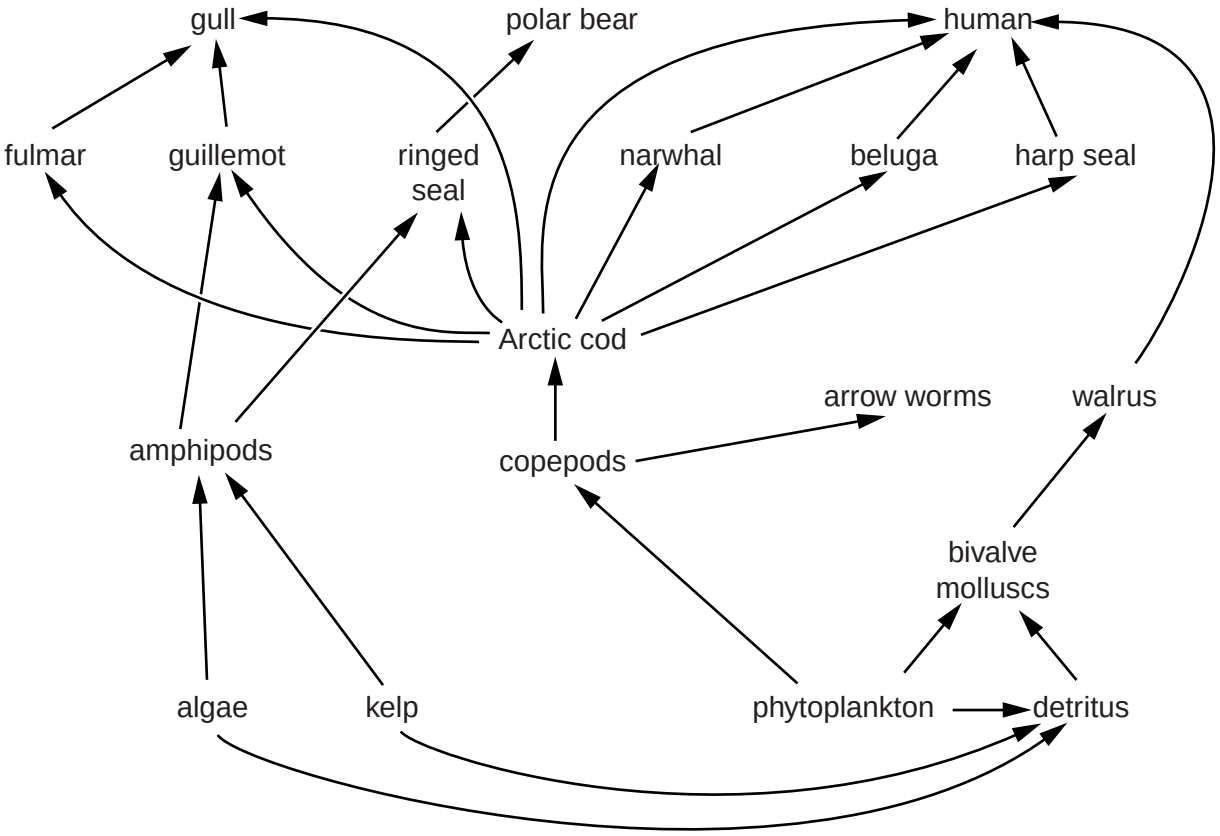
[Total: 13]

4 Lancaster Sound in the Canadian Arctic is a very productive marine environment and supports large populations of sea birds and marine mammals.

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Studies of the area have shown the importance of Arctic cod, *Boreogadus saida*, in the flow of energy to marine birds, such as guillemots and fulmars, and marine mammals, such as narwhals and belugas. Arctic cod forms the main, or only, source of food for many such animals.

The flow of energy through the food web in Lancaster Sound is shown in Fig. 4.1.



Note: detritus is dead and decaying matter

Fig. 4.1

(a) Name the trophic levels occupied by the following organisms in the food web in Fig. 4.1:

kelp .....

arrow worms .....

narwhals. ..... [3]

(b) The population of polar bears in the Lancaster Sound area is quite small in comparison to populations of animals that feed on Arctic cod.

For Examiner's Use

Using **only** the information shown in Fig. 4.1, explain why the population of polar bears is small.

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.....[4]

(c) Populations of many fish species are under threat of extinction as a result of over-fishing.

Explain the likely consequences of over-fishing of Arctic cod.

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.....[3]

[Total: 10]

5 Mammals have closed, double circulatory systems.

For Examiner's Use

(a) Explain what are meant by the terms *closed* and *double* as applied to mammalian circulatory systems.

closed .....

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.....

double .....

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.....[2]

Fig. 5.1 shows a longitudinal section through a mammalian heart.

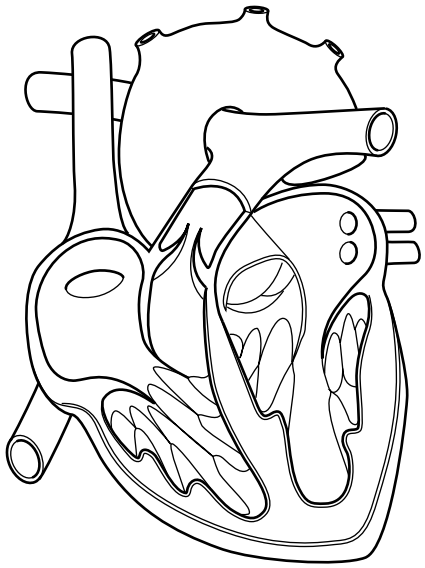


Fig. 5.1

(b) Use label lines and the letters **P**, **Q**, **R** and **S** to label the following on Fig. 5.1:

P the right atrium

Q a semilunar valve

R a blood vessel that carries deoxygenated blood

S the position of Purkyne tissue [4]

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Catheters are small tubes that are inserted into blood vessels. A catheter was inserted into an artery in the arm and then moved into the aorta and then into the left ventricle during a diagnostic investigation. The catheter contained a device to measure the blood pressure in the aorta and in the left ventricle. The results are shown in Fig. 5.2.

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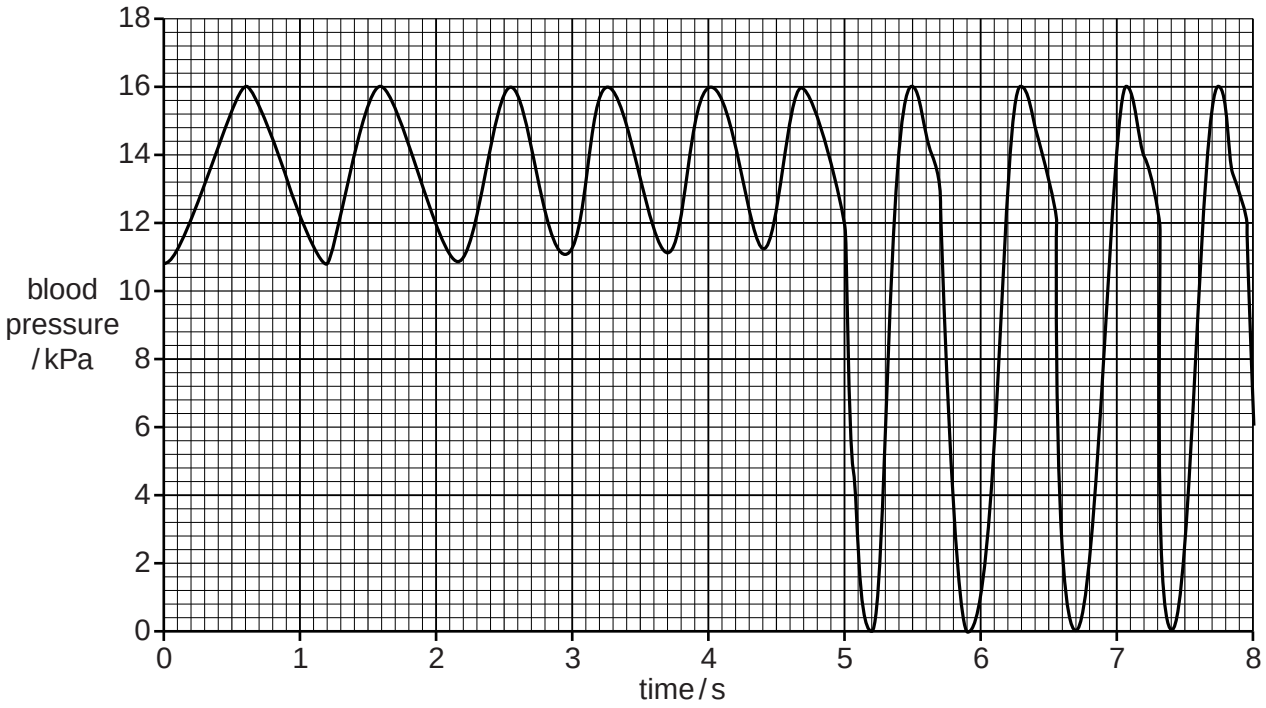


Fig. 5.2

(c) (i) Calculate the heart rate during the period of the investigation.

Show your working.

answer .....[2]

(ii) Describe **and** explain the differences in pressure as the catheter moves from the aorta into the left ventricle.

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.....[4]

Fig. 5.3 is an X-ray showing narrowing in the blood vessels supplying muscles in the heart. A catheter is used to insert a dye into the blood vessels so that they appear clearly in the X-ray. The arrows indicate where there is narrowing of the blood vessels.

For Examiner's Use



Fig. 5.3

(d) (i) Name the blood vessels shown in Fig. 5.3.

.....[1]

(ii) State the likely effect of narrowing of these blood vessels.

.....[1]

(e) Suggest ways in which the condition shown in Fig. 5.3 may be treated.

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.....[2]

[Total: 16]

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Question 5, Fig. 5.3 ZEPHYR / SCIENCE PHOTO LIBRARY

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