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

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*9843463998*

**BIOLOGY** **9700/21**

Paper 2 Structured Questions AS **October/November 2010**

**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 pen.
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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**1** **(a)** Complete the passage with the most appropriate term.

*For Examiner's Use*

Within each ecosystem there is a ..... of organisms that interact with each other and with their environment. Each species fills a particular ..... within the ecosystem. Feeding relationships in food webs are an example of the interactions species have with each other. In old field ecosystems in North America, producers, such as blue grass, provide energy for grazing animals. These animals form the ..... ..... ..... in the food chain. [3]

**(b)** Very little of the energy consumed by grazing animals is available to carnivores.

State two reasons why this is so.

1. .....

.....

2. .....

.....[2]

[Total: 5]

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**2** **(a)** Table 2.1 shows some of the structures in different parts of the gas exchange system.

Complete Table 2.1 by indicating with a tick (✓) if the structure is present in each part of the gas exchange system or a cross (✗) if it is not.

**Table 2.1**

| structure | trachea | bronchus | bronchiole | alveolus |
|---|---|---|---|---|
| ciliated epithelium | | | | |
| goblet cells | | | | |
| cartilage | | | | |
| smooth muscle | | | | |

[4]

**(b)** An exercise physiologist investigated aspects of breathing in an athlete.

The minute volume is the volume of air breathed in during one minute.

The data recorded is in Table 2.2.

**Table 2.2**

| vital capacity / $dm^3$ | breathing rate at rest / breaths $min^{-1}$ | minute volume / $dm^3$ |
|---|---|---|
| 5.8 | 11 | 5.5 |

**(i)** Explain how the physiologist would determine the vital capacity of the athlete.

.....

.....

.....

.....

.....[2]

**(ii)** Calculate the athlete's tidal volume.

Answer = .....[1]

**(c)** Fig. 2.1 shows a cross section of a coronary artery partially blocked by plaque causing atherosclerosis.

*For Examiner's Use*

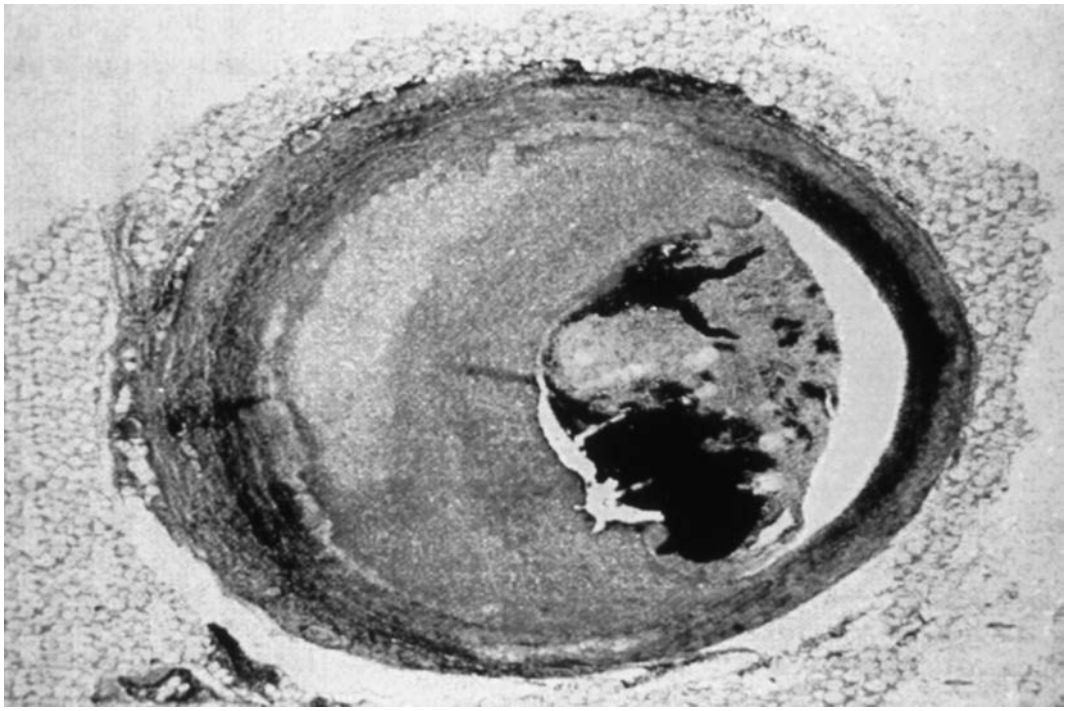


**Fig. 2.1**

Explain why atherosclerosis in coronary arteries may limit the ability of people to take vigorous exercise.

.....

.....

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.....

.....

.....[3]

**(d)** Describe the effects of nicotine and carbon monoxide in cigarette smoke on the cardiovascular system.

*For Examiner's Use*

*nicotine* .....

.....

.....

.....

.....

.....

*carbon monoxide* .....

.....

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.....

.....

.....[3]

[Total: 13]

**3** Red blood cells are suspended in plasma which has a concentration equivalent to that of 0.9% sodium chloride (NaC$l$) solution.

*For Examiner's Use*

A student investigated what happens to red blood cells when placed into sodium chloride solutions of different concentration.

A small drop of blood was added to 10 $cm^3$ of each sodium chloride solution. Samples were taken from each mixture and observed under the microscope. The number of red blood cells remaining in each sample was calculated as a percentage of the number in the 0.9% solution. The results are shown in Fig. 3.1.

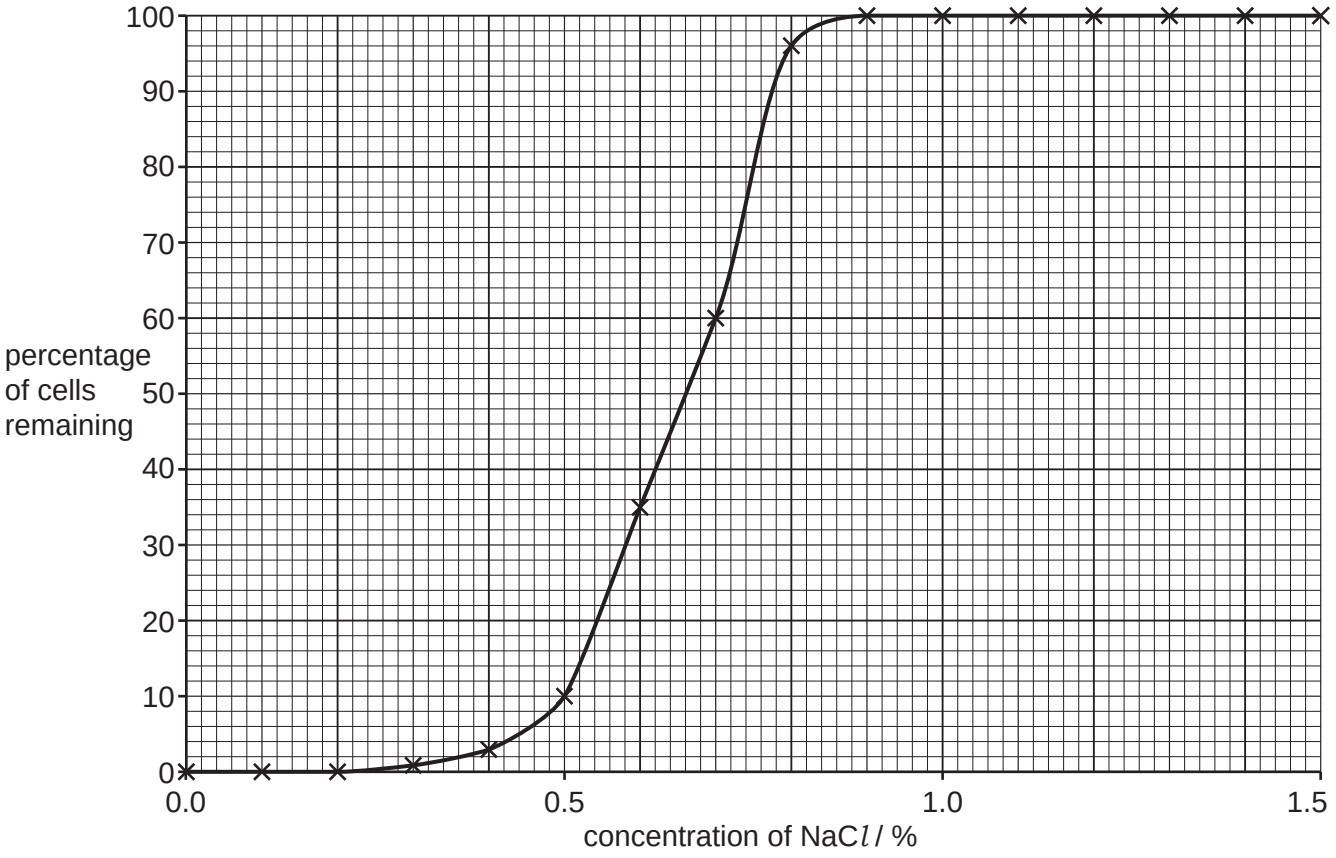



**Fig. 3.1**

**(a)** With reference to Fig. 3.1, describe the student's results.

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.....[3]

The student also measured the cell volumes of the red blood cells in three of the sodium chloride solutions. The results are shown in Table 3.1.

*For Examiner's Use*

**Table 3.1**

| concentration of sodium chloride /% | mean red cell volume / $\mu m^3$ |
|---|---|
| 0.7 | 120 |
| 0.9 | 90 |
| 1.5 | 65 |

Fig. 3.2 shows the appearance of some red blood cells removed from the 1.5% sodium chloride solution.

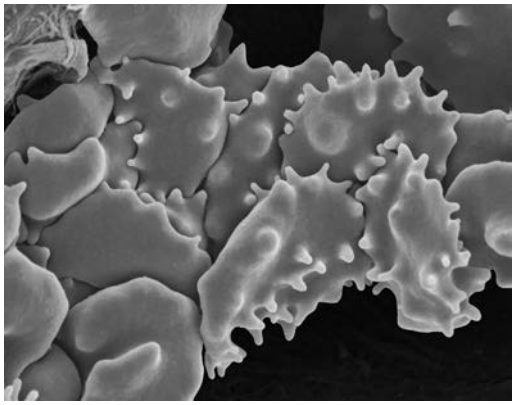


**Fig. 3.2**

**(b)** Explain the results shown in Fig. 3.1, Table 3.1 and Fig. 3.2, in terms of **water potential**.

*0% NaCl solution* .....

.....

.....

.....

.....

*0.7% NaCl solution* .....

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.....

.....

*1.5% NaCl solution* .....

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.....

.....

.....[6]

Red blood cells each contain about 240 million molecules of haemoglobin that transport oxygen and carbon dioxide.

*For Examiner's Use*

**(c)** Describe the role of haemoglobin in the **transport** of oxygen and carbon dioxide.

*oxygen* .....

.....

.....

.....

*carbon dioxide* .....

.....

.....

.....[4]

**(d)** The haematocrit is the proportion of the blood that is composed of red blood cells. Samples of blood were taken from an athlete who lived at sea level since birth and moved to live and train at an altitude of 5000 m for three weeks. The haematocrit and the number of red blood cells per $mm^3$ were determined before moving to high altitude and after three weeks at that altitude. The results are shown in Table 3.2.

**Table 3.2**

| altitude | haematocrit | number of red blood cells × $10^6$ per $mm^3$ |
|---|---|---|
| sea level | 0.45 | 6.1 |
| 5000 m (after three weeks) | 0.53 | 7.3 |

**(i)** Calculate the percentage increase in the number of red blood cells per $mm^3$ after three weeks at 5000 m. Show your working.

Answer = ..... % [2]

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**(ii)** Explain why the haematocrit increases at altitude.

*For Examiner's Use*

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.....

.....

.....[3]

[Total: 18]

**4** Cholera bacteria release the enzyme neuraminidase which alters some of the surface proteins on the membranes of epithelial cells in the small intestine.

*For Examiner's Use*

These surface molecules become receptors for the toxin, choleragen, released by cholera bacteria. The toxin stimulates the cells to secrete large quantities of chloride ions into the lumen of the small intestine. Sodium ions and water follow the loss of chloride ions.

**(a) (i)** Name the pathogen that causes cholera.

.....[1]

**(ii)** Suggest how chloride ions are moved from the epithelial cells into the lumen of the small intestine.

.....

.....[1]

**(iii)** Explain how cholera bacteria are transmitted from one person to another.

.....

.....

.....

.....

.....[3]

A potential vaccine for choleragen was trialled on volunteers. Fig. 4.1 shows the concentration of antibodies against choleragen in the blood of a volunteer who received a first injection at week 0, followed by a booster injection at week 15.

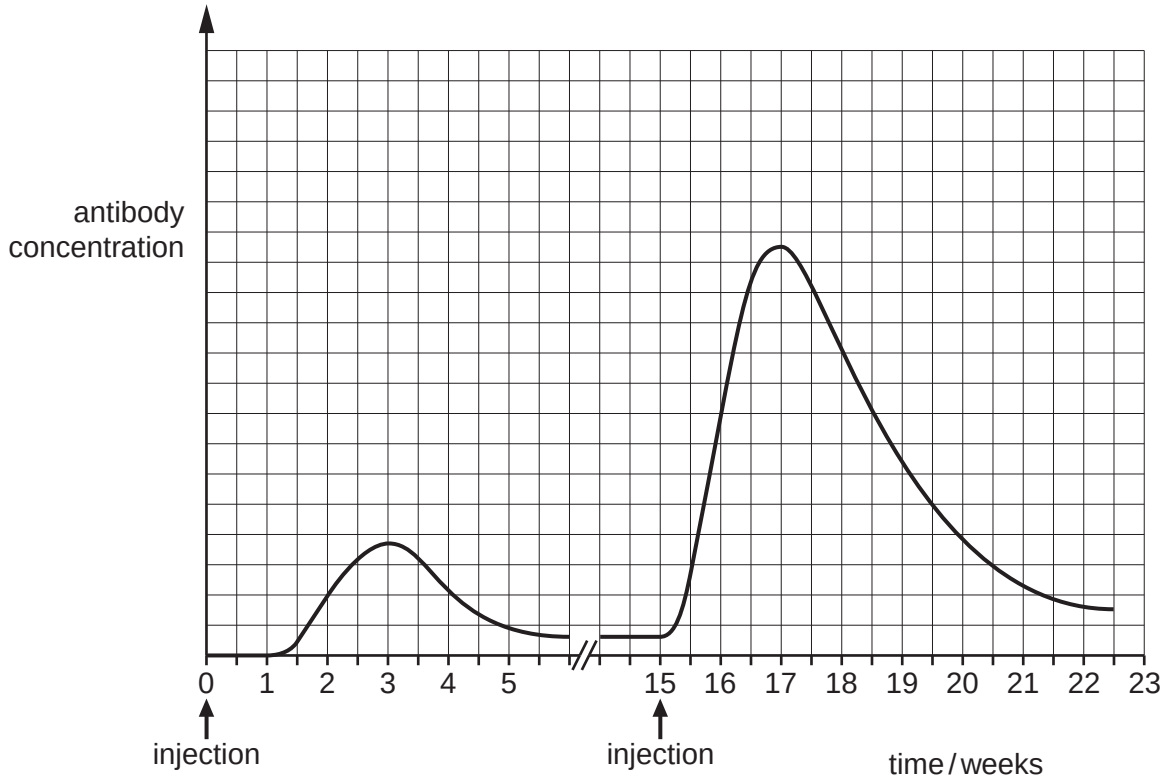



**Fig. 4.1**

**(b)** Using the information in Fig. 4.1, explain the differences between the responses to the first injection and the booster injection.

*For Examiner's Use*

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.....[4]

**(c)** Discuss the problems involved in preventing the spread of cholera.

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.....[4]

[Total: 13]

For Examiner's Use

**5** **(a)** Cellulose is a polysaccharide.

Fig. 5.1 shows three sub-units from a molecule of cellulose.

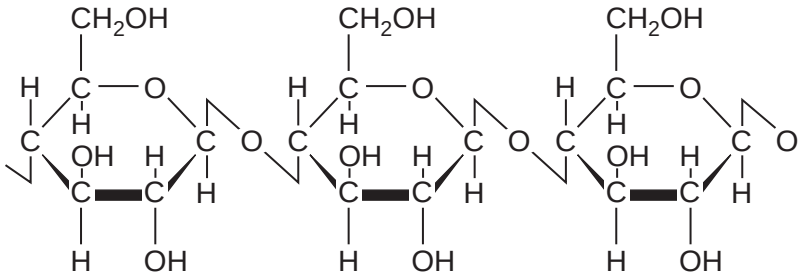


**Fig. 5.1**

**(i)** Name the sub-unit molecule of cellulose.

.....[1]

**(ii)** Name the bonds that attach the sub-unit molecules together within cellulose.

.....[1]

**(b)** Cellulose has high mechanical strength which makes it suitable for the cell walls of plants.

Explain how cellulose has such a high mechanical strength making it suitable for the cell walls of plants.

.....

.....

.....

.....[2]

Plant cell walls consist of cellulose that is embedded in a matrix of compounds, such as pectins and proteins.

*For Examiner's Use*

Cell wall material is synthesised inside the cell and transported to the cell surface membrane as shown in the drawing made from an electron micrograph in Fig. 5.2.

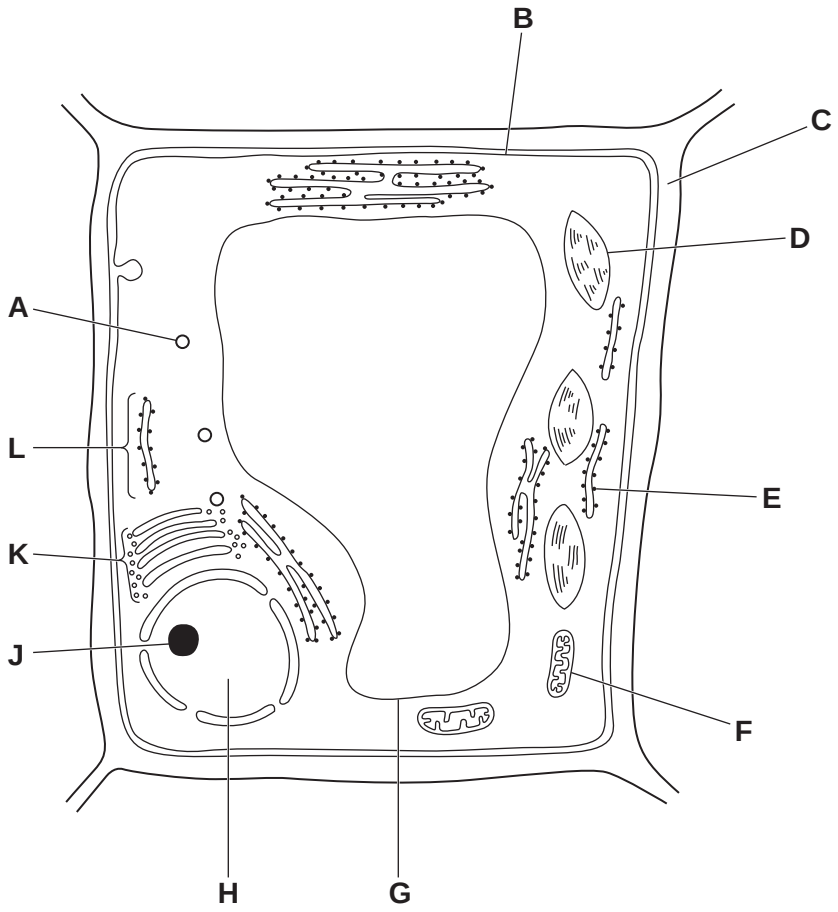



**Fig. 5.2**

**(c)** Locate the parts of the cell labelled in Fig. 5.2 which apply to each of the following statements. You must only give one letter in each case. You may use each letter once, more than once or not at all. The first answer has been completed for you.

| statement | letter from Fig. 5.2 |
|---|---|
| organelle that contains DNA | **H** |
| transports cell wall material to the cell surface membrane | |
| site of transcription | |
| site of ribosome synthesis | |
| site of photosynthesis | |

[4]

**(d)** Enzymes known as expansins are found in the matrix of cell walls to help the growth of cells.

*For Examiner's Use*

Use the information in Fig. 5.2 to describe how proteins made by the ribosomes reach the matrix of the cell wall.

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.....[3]

[Total: 11]

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*Copyright Acknowledgements:*

Fig. 2.1 GJLF / Science Photo Library
Fig. 3.2 Steve Gschmeissner / Science Photo Library

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