

ADVANCED SUBSIDIARY GCE
HUMAN BIOLOGY
Molecules, Blood and Gas Exchange

F221

Candidates answer on the question paper.

OCR supplied materials:

- Insert (inserted)

Other materials required:

- Electronic calculator
- Ruler (cm/mm)

Monday 16 May 2011
Morning

Duration: 1 hour




Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- The insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Human cells can be viewed under an electron microscope to observe their ultrastructure.

Fig. 1.1 is a diagram of a leucocyte (white blood cell) as it might appear using an electron microscope.

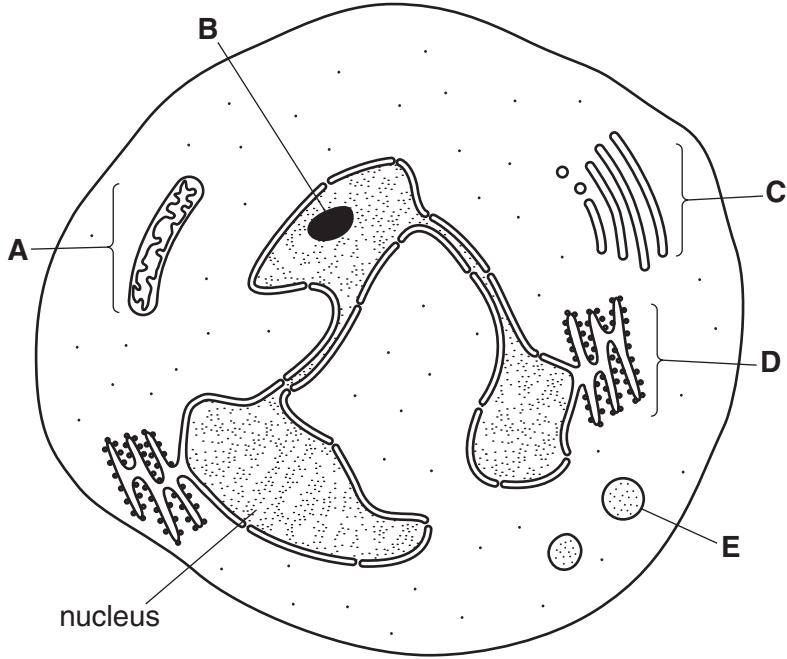


Fig. 1.1

(a) Identify the structures labelled **A** to **E**.

- A
- B
- C
- D
- E [5]

(b) There are different types of leucocyte found in blood.

Identify the type of leucocyte shown in Fig. 1.1 **and** give **one** reason for your answer.

- type of leucocyte
- reason
-
- [2]

(c) Plant cells, such as palisade mesophyll cells, can also be observed using an electron microscope. A palisade mesophyll cell viewed under an electron microscope will show:

- a cellulose cell wall
- fewer mitochondria than a leucocyte.

(i) What is the role of the cellulose cell wall in the palisade mesophyll cell?

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..... [1]

(ii) Suggest why a palisade mesophyll cell has fewer mitochondria than a leucocyte.

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..... [1]

(iii) Name **one** other structure found in a palisade mesophyll cell, other than the cellulose cell wall, that would **not** be present in the leucocyte.

..... [1]

[Total: 10]

2 Human lungs are adapted to ensure efficient exchange of oxygen and carbon dioxide.

The statements **A** to **C** below are all features of a good gas exchange surface.

- A** maintains a steep diffusion gradient
- B** has a large surface area
- C** has a short distance for diffusion

(a) Complete the table below by choosing the appropriate statement, **A**, **B** or **C**, that matches each adaptation of the lungs described. A statement may be used more than once.

adaptation of lungs	statement
air brought into the alveoli by ventilation is rich in oxygen	
endothelium of capillary wall is made of flattened cells	
millions of alveoli are present in each lung	
the wall of each alveolus is folded	

[4]

Fig. 2.1 shows part of an alveolus and a capillary.

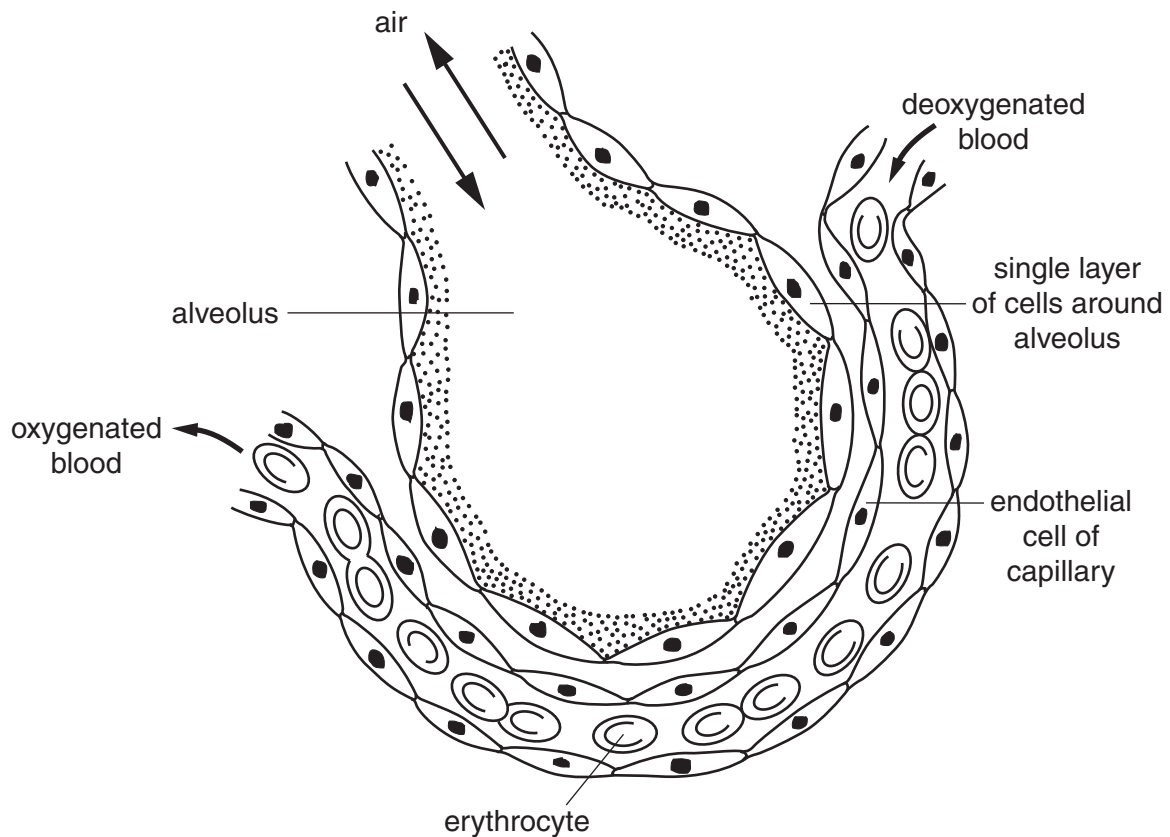


Fig. 2.1

(b) Using the information in Fig. 2.1, describe **and** explain how gas exchange takes place in the alveolus.

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..... [4]

(c) The cells lining the alveoli secrete an important fluid.

(i) State **one** component of this fluid, other than water, **and** explain why this component is important in maintaining the surface area for gas exchange.

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..... [2]

(ii) Infection of the lungs can sometimes lead to an accumulation of the fluid in the alveoli.

Explain why this **excess** fluid could affect the exchange of gases in the alveoli.

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..... [2]

[Total: 12]
Turn over

- (b) A pathology technician tested blood samples from a healthy patient and from a patient with a type of anaemia. Some of the results are shown in Table 3.1.

Table 3.1

	volume of O ₂ per gram of haemoglobin (cm ³)	mass of haemoglobin per 100 cm ³ of blood (g)	volume of O ₂ per 100 cm ³ of blood (cm ³)
healthy patient	1.34	15.00	20.10
patient with anaemia	1.34		16.10

- (i) Using the information in Table 3.1, calculate the mass of haemoglobin per 100 cm³ of blood in the patient with anaemia.

Show your working. **Give your answer to two decimal places.**

Answer = g [2]

- (ii) The technician makes the following statement about the results from the patient with anaemia.

'The anaemia was unlikely to be caused by extreme blood loss.'

Using the information from Table 3.1, suggest a more likely cause for the anaemia in this patient **and** give a reason for your answer.

cause

reason

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..... [2]

(iii) Technicians in pathology laboratories may also prepare blood smears to help diagnose blood disorders in patients.

Fig. 3.1, **on the insert**, shows blood smears, **A** and **B**, from two different patients, as viewed under a light microscope.

Both blood smears:

- have been prepared using the same dilution factor
- have the same magnification.

Using Fig. 3.1, suggest why the technician concluded that blood smear **B** had been obtained from a patient with a type of anaemia.

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..... [2]

[Total: 10]

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QUESTION 4 STARTS ON PAGE 10

- 4 Fig. 4.1 shows some of the structures within the heart which are involved in the initiation and control of the cardiac cycle.

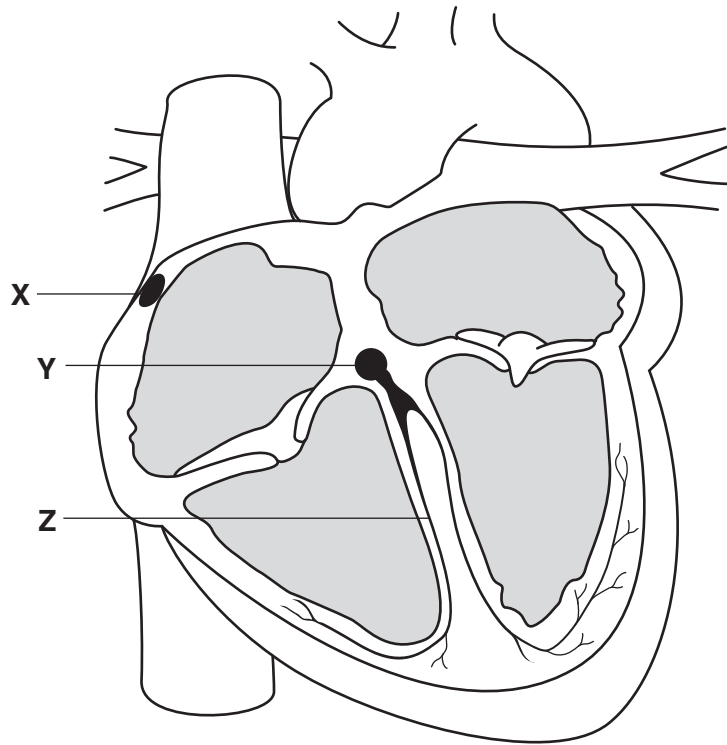


Fig. 4.1

(a) Identify the areas of the heart labelled X, Y and Z in Fig. 4.1.

X

Y

Z [3]

5 External bleeding occurs at the site of a wound and is a result of damage to blood vessels. If the wound is large, it is necessary to prevent excessive blood loss and allow time for the blood to clot.

(a) Describe the First Aid procedure for preventing excessive blood loss.

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..... [3]

(b) A series of chemical reactions in the body will result in blood clotting at the site of the wound.

- One of the chemical reactions involved in blood clotting produces insoluble molecules of fibrin.
- This reaction is catalysed by the enzyme thrombin.
- Thrombin is produced as an inactive molecule, **M**.
- **M** is released into the blood plasma.
- **M** can be converted into thrombin when tissues are damaged.

(i) Name the molecule **M** which is converted into thrombin when tissues are damaged.
..... [1]

(ii) Name the **substrate** in the reaction that is catalysed by thrombin.
..... [1]

(iii) Calcium ions are needed by thrombin in the blood clotting process. Calcium ions are not part of the enzyme molecule, thrombin.

State the term used to describe substances, such as calcium ions, which are required by enzymes to catalyse reactions.
..... [1]

(iv) The inactive molecule, **M**, and the substrate in (ii) are both produced by the liver.

Using your knowledge of enzyme action, **explain** why the blood of a person with liver disease takes longer to clot.

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..... [3]

[Total: 9]

6 (a) Water is a molecule that is essential to living organisms.

- Water is a polar molecule.
- Water is a good solvent for other polar molecules and ions.
- Blood plasma consists of water with many different molecules and ions dissolved in it.
- The concentration of these molecules and ions must be kept constant to maintain the water potential of cells suspended in the blood.

Explain what is meant by the statement 'water is a polar molecule'.

You may use diagrams to support your answer.

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(b) Explain why glucose molecules are soluble in plasma whereas lipid molecules are not.

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..... [2]

(c) Fig. 6.1 shows the appearance of erythrocytes in three blood samples, **A**, **B** and **C**. The concentration of dissolved substances in the plasma of each sample is different.

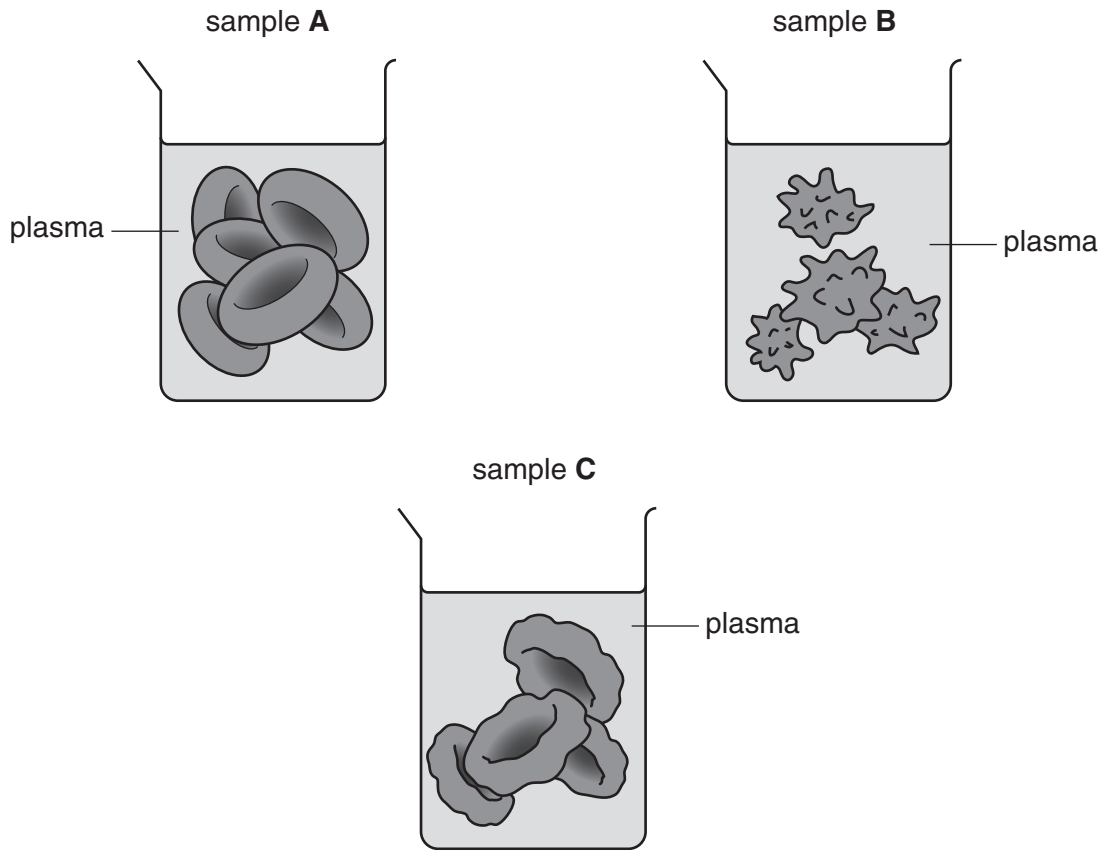


Fig. 6.1

(i) Which blood sample contains plasma that has a **lower** water potential than the erythrocytes?

..... [1]

(ii) Which blood sample contains plasma that has **the same** water potential as the erythrocytes?

..... [1]

(iii) Suggest which blood sample has the most dissolved substances in the plasma.

..... [1]

QUESTION 6(d) STARTS ON PAGE 16

(d) Packed red cells are obtained from donated blood. These cells are separated from the rest of the blood and stored until needed.

(i) Suggest **one** situation where packed red cells may be used as part of medical treatment.

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..... [1]

(ii) Explain why the solution used to dilute the packed red cells before they are used for medical treatment must contain the correct concentration of solutes.

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..... [3]

[Total: 11]

END OF QUESTION PAPER

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