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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
ADVANCED SUBSIDIARY GCE**

F221

HUMAN BIOLOGY

Molecules, Blood and Gas Exchange

MONDAY 16 MAY 2011: Morning

DURATION: 1 hour

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper.

OCR SUPPLIED MATERIALS:

Insert (inserted)

OTHER MATERIALS REQUIRED:

Electronic calculator

Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. 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.

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.

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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.

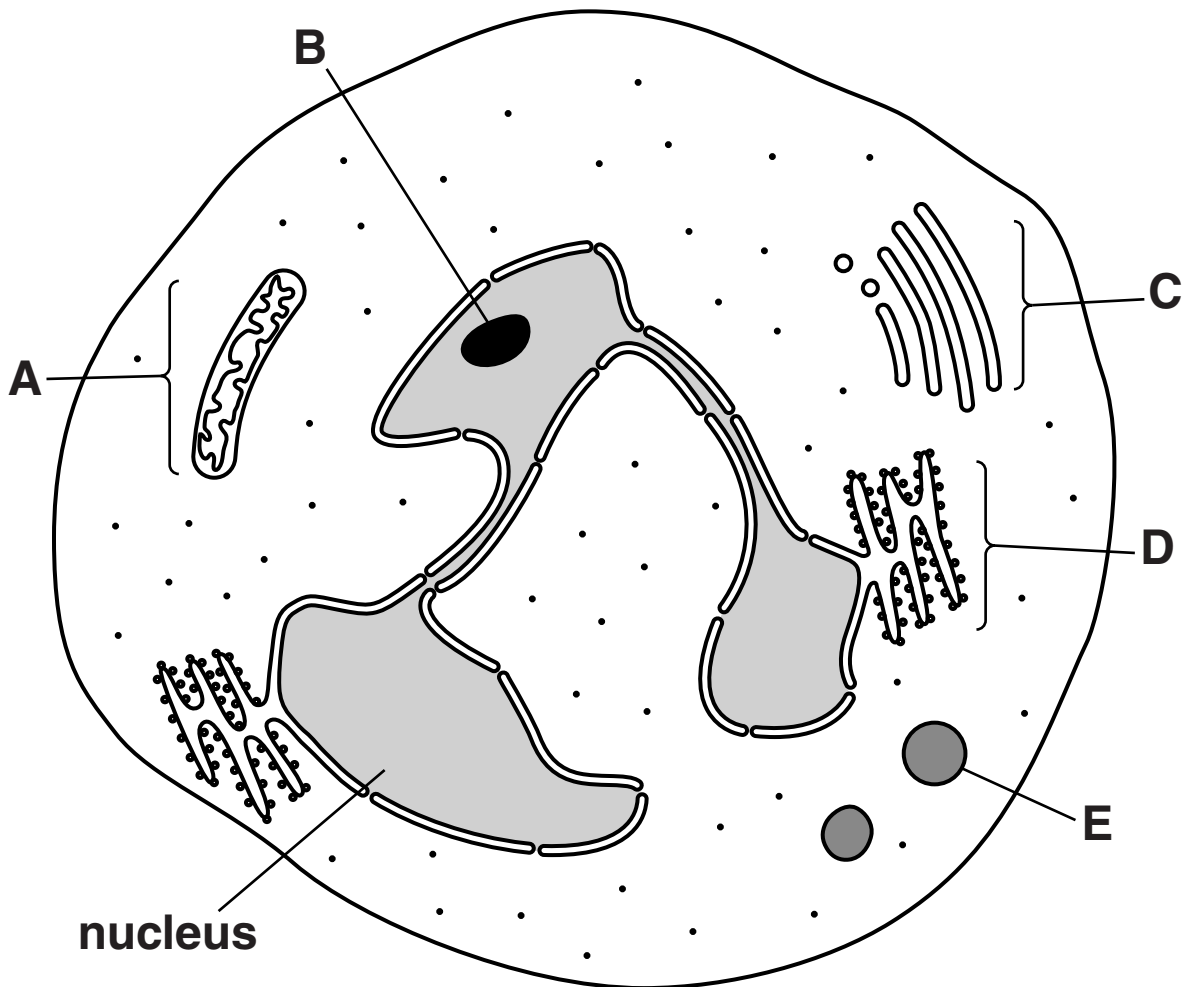


Fig. 1.1

(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?

[1]

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

[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.

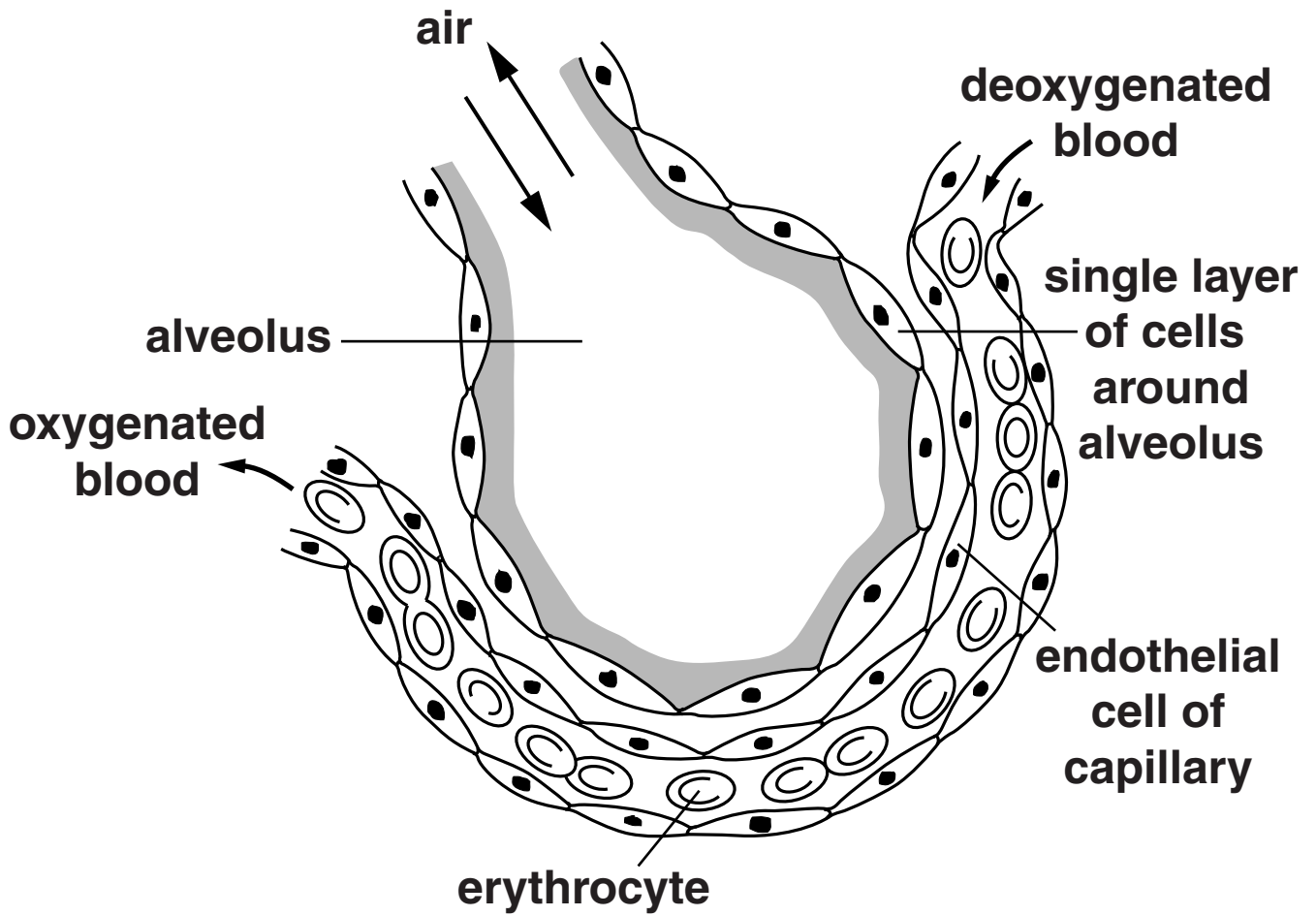


Fig. 2.1

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

[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.

[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.

[2]

[Total: 12]

3 Blood transports oxygen around the body. The main carrier of oxygen in blood is the molecule haemoglobin. Haemoglobin is a complex protein molecule found in erythrocytes (red blood cells).

(a) Describe the structure of a haemoglobin molecule.



In your answer, you should use appropriate technical terms, spelt correctly.

[4]

- (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 _____

_____ [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.

[2]

[Total: 10]

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QUESTION 4 STARTS ON PAGE 16

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

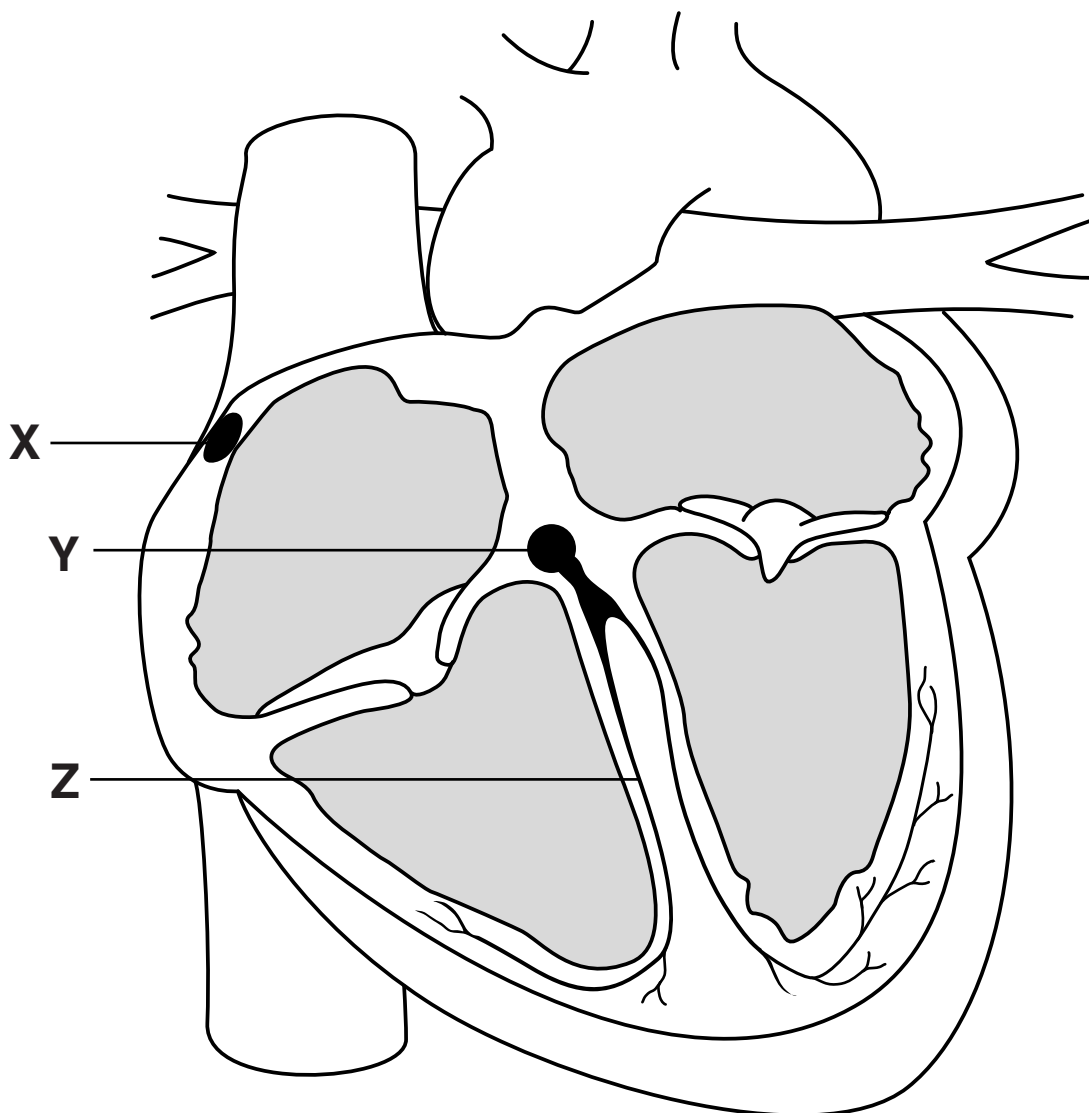


Fig. 4.1

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

X _____

Y _____

Z _____ [3]

(b) The sequence of events which take place in the heart during one beat is called the cardiac cycle. Each cardiac cycle is initiated by structure X.

Using Fig. 4.1, describe how electrical impulses are transmitted from structure X through the rest of the heart tissue.



In your answer, you should use appropriate technical terms, spelt correctly.

[5]

[Total: 8]

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.

[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.

[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.

[2]

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

[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.

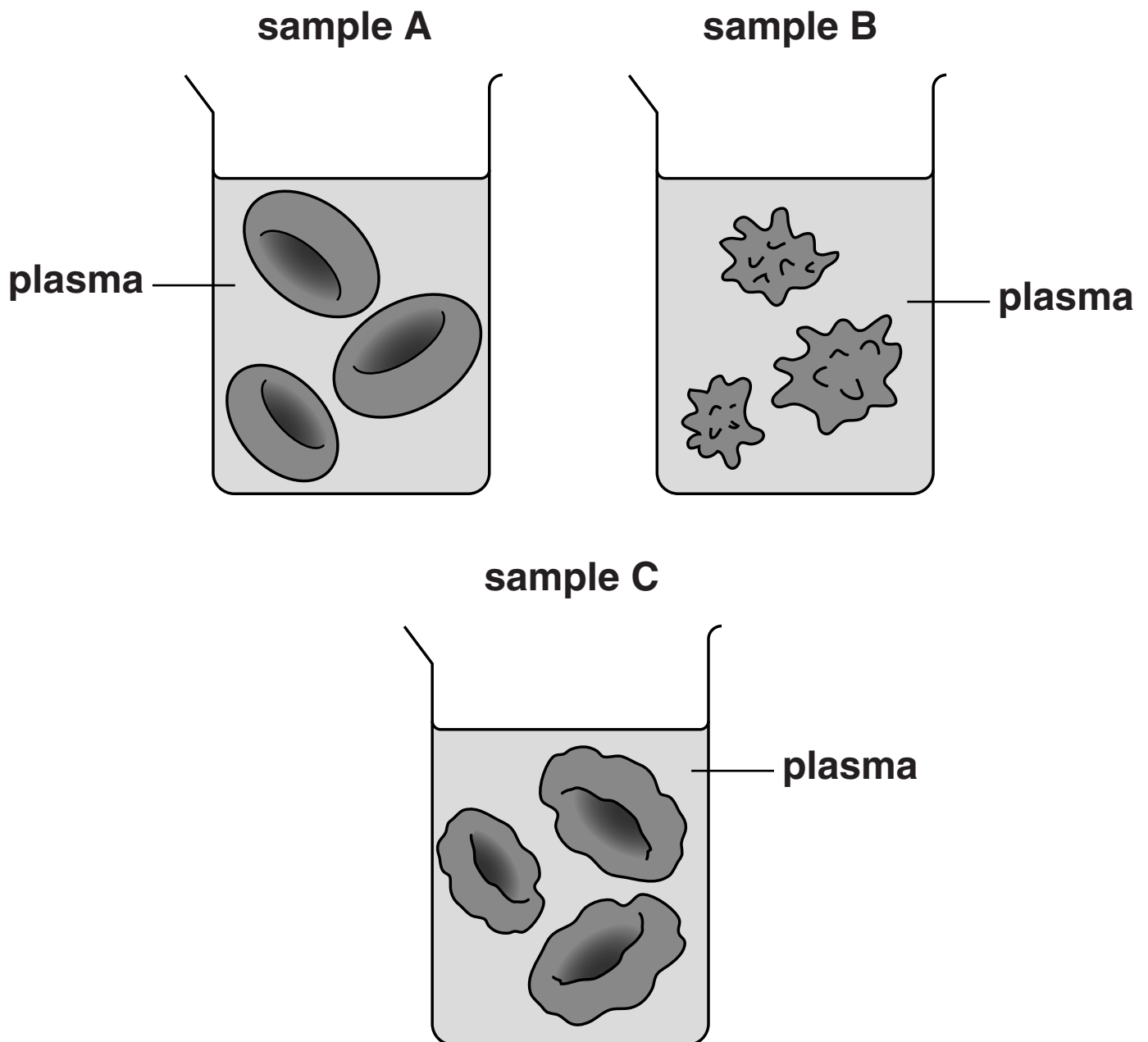


Fig. 6.1

- (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 26

(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.

_____ [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.

_____ [3]

[Total: 11]

END OF QUESTION PAPER

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