The circulatory system

Question Paper 2

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Transport in mammals
Sub Topic	The circulatory system
Booklet	Theory
Paper Type	Question Paper 2

Time Allowed : **74 minutes**

Score : **/ 61**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** Carbon dioxide is transported in the blood in various forms.

Describe how carbon dioxide molecules reach red blood cells from respiring cells.

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.....[2]

Fig. 2.1 shows part of a capillary network and some cells of the surrounding tissue.

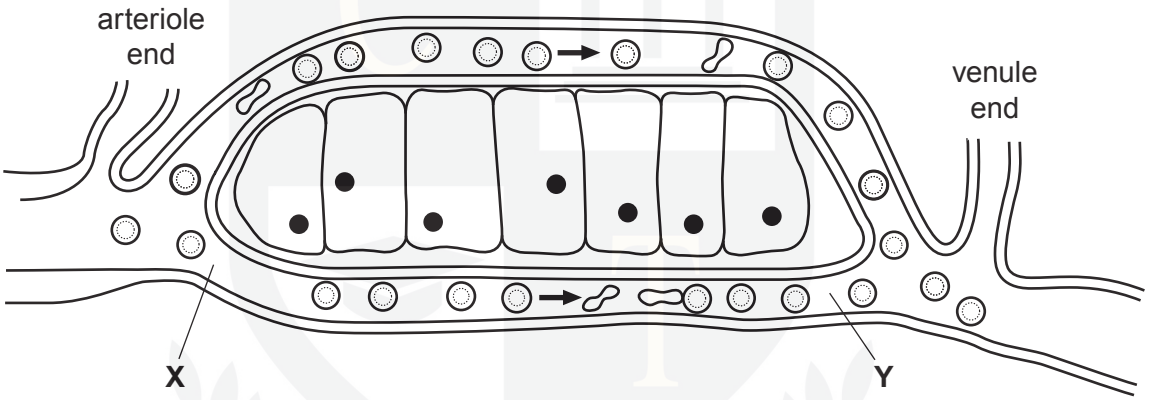

Fig. 2.1

(b) State three ways in which the blood at **Y** differs from the blood at **X other than** in the concentration of carbon dioxide.

1. .....

2. .....

3. .....[3]

An enzyme in red blood cells catalyses the reaction between carbon dioxide and water as blood flows through respiring tissues.

$$CO_2 + H_2O \xrightarrow{\text{enzyme}} H_2CO_3 \longrightarrow H^+ + HCO_3^-$$

(c) (i) Name the enzyme that catalyses this reaction.

.....[1]

(ii) Explain the significance of this reaction in the transport of carbon dioxide.

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(d) Fig. 2.2 shows the effect of increasing the carbon dioxide concentration on the oxygen haemoglobin dissociation curve.

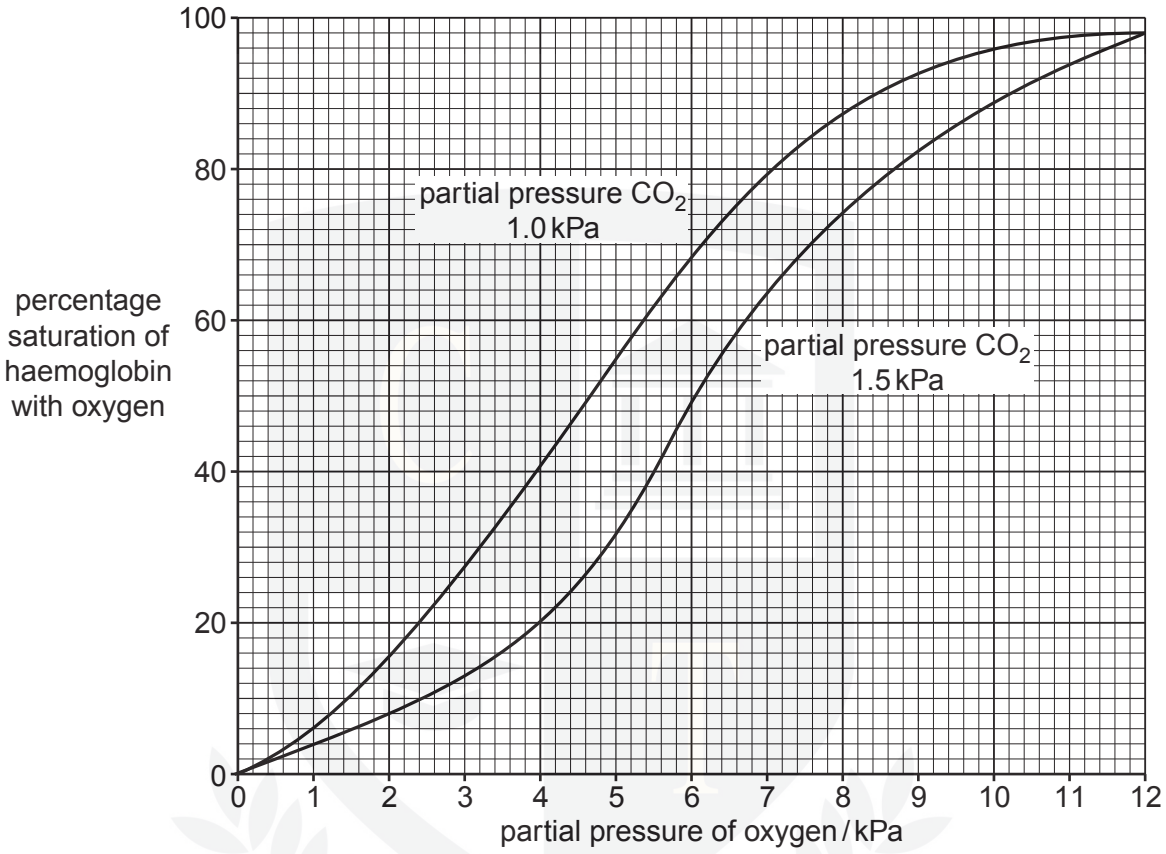

Fig. 2.2

(i) State the percentage saturation of haemoglobin with oxygen at a partial pressure of 5 kPa of oxygen when the partial pressure of carbon dioxide is:

1.0 kPa .....

1.5 kPa .....[1]

(ii) The percentage saturation of haemoglobin with oxygen **decreases** as the partial pressure of carbon dioxide increases.

Explain how this happens.

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.....[2]

(iii) Name the effect of increasing carbon dioxide concentration on the oxygen dissociation curve.

.....[1]

(iv) Explain the importance of the effect of carbon dioxide on haemoglobin as shown in Fig. 2.2.

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.....[3]

[Total: 16]

2 **(a)** Explain how the structure of red blood cells is suited to their function of transporting oxygen to body tissues.

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.....[3]

(b) The circulating red blood cell is metabolically active but only lives for about 120 days. During this time, some important enzymes are gradually broken down and this may contribute to the death of the cell.

Explain why the red blood cell is **not** able to replace important enzymes that have been broken down.

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.....[2]

(c) Red blood cells are broken down by phagocytic cells in the liver and spleen. The haemoglobin is broken down into haem and globin before further processing. Some of the components of haemoglobin are re-used in the body.

(i) Name the mineral ion released from the breakdown of haem.

.....[1]

(ii) State the products of globin hydrolysis.

.....[1]

Haemoglobin plays an important role in carrying oxygen and carbon dioxide.

Fig. 3.1 summarises some of the events that occur as blood enters a capillary located in an area of actively respiring cells.

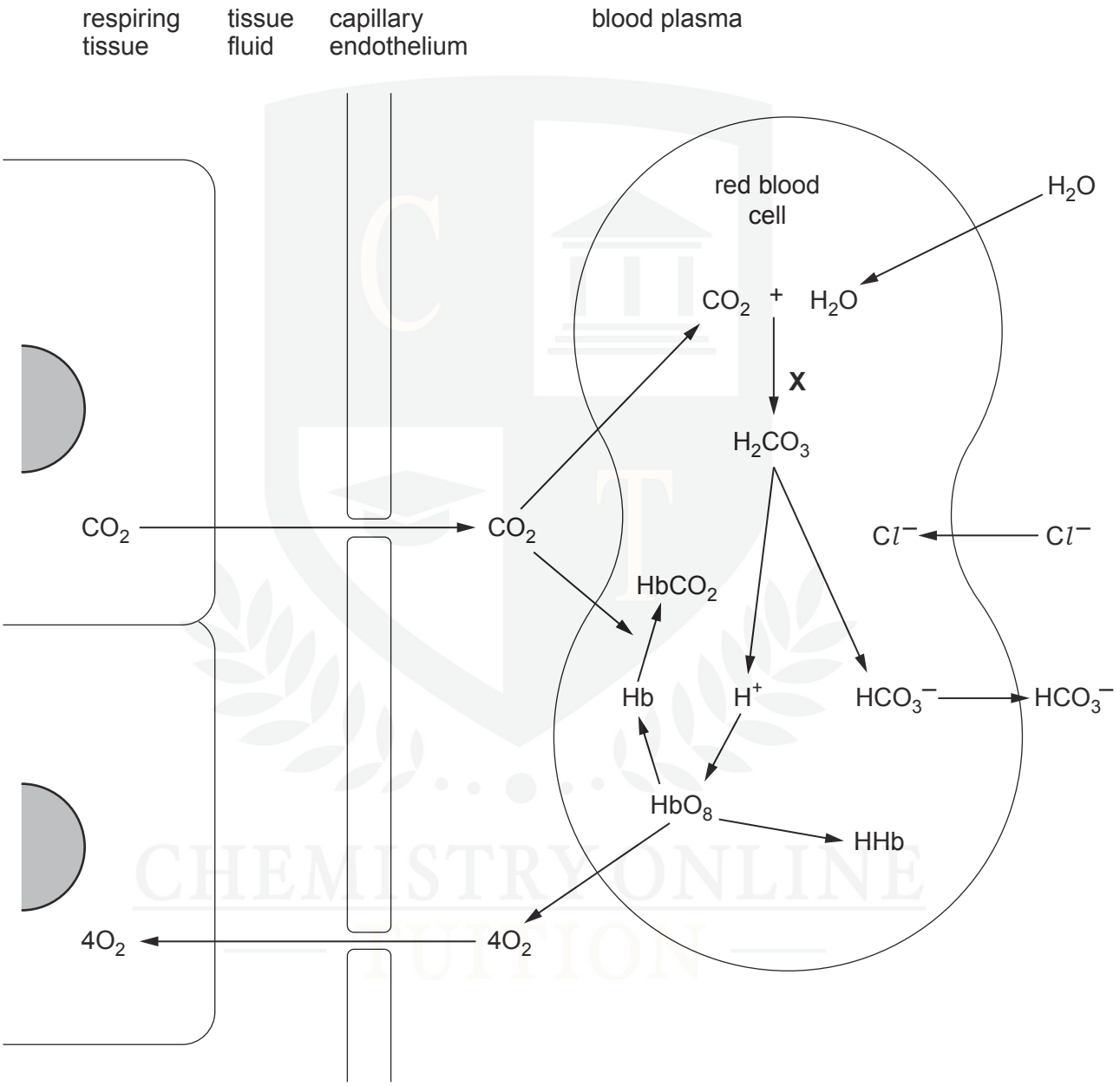

Fig. 3.1

(d) State the name of the enzyme that catalyses the reaction occurring at **X**.

.....[1]

(e) With reference to Fig. 3.1, describe **and** explain how carbon dioxide (CO_2) and hydrogen ions (H^+) play a role in the unloading of oxygen from haemoglobin.

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.....[5]

[Total: 13]

3 In mammals, haemoglobin is used to transport oxygen and myoglobin is used to store oxygen in muscles.

Fig. 4.1 shows the oxygen dissociation curves for myoglobin, fetal haemoglobin and adult haemoglobin.

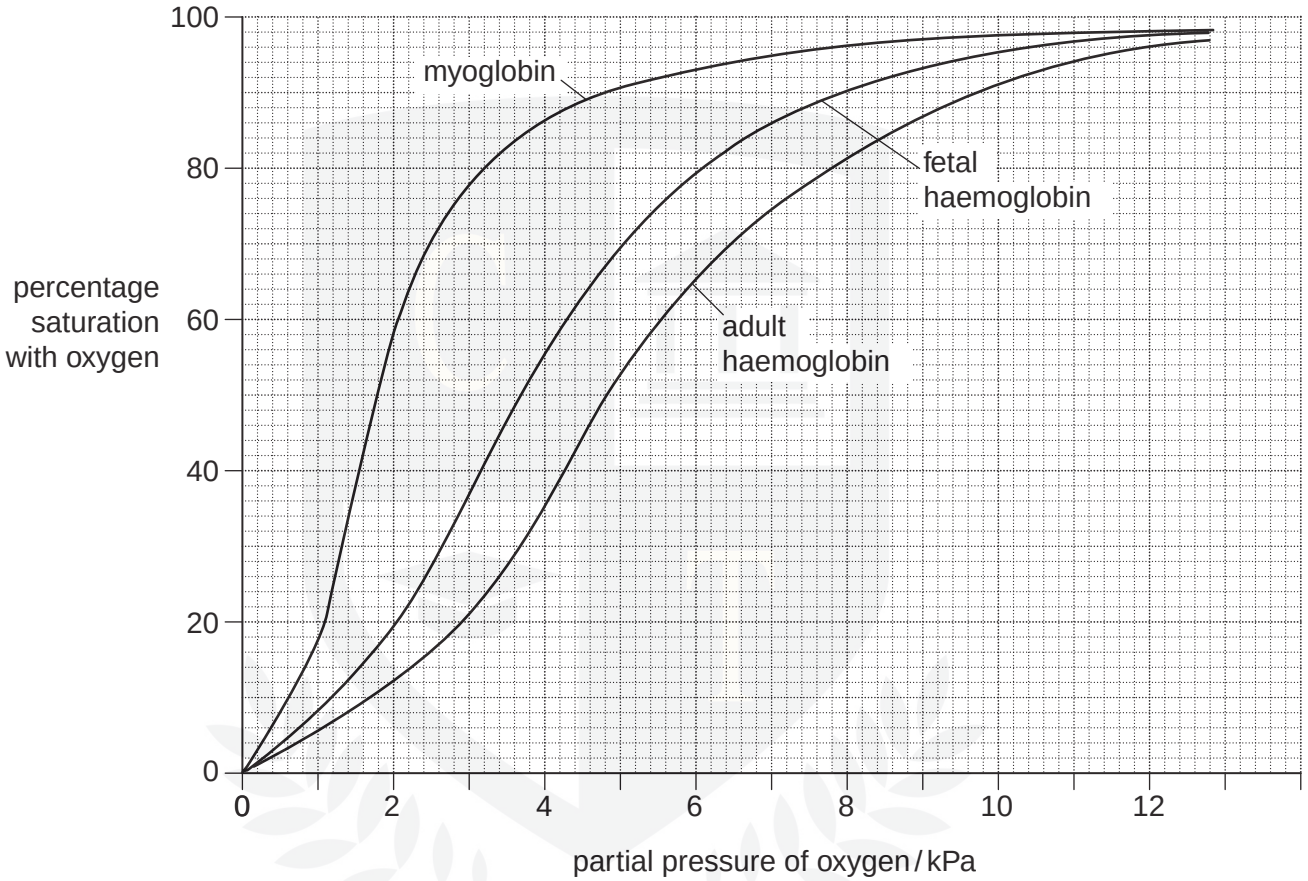

Fig. 4.1

(a) **(i)** Name the cells in which haemoglobin is found.

..... [1]

(ii) Use Fig. 4.1 to determine the percentage saturation of **myoglobin** and **adult haemoglobin** when the partial pressure of oxygen is 3 kPa.

myoglobin .....

adult haemoglobin ..... [1]

(iii) There is a large difference between the percentage saturation of myoglobin and that of adult haemoglobin at **low** partial pressures of oxygen. Suggest reasons for this.

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..... [2]

(b) Fetal haemoglobin has a different oxygen binding affinity to that of adult haemoglobin, as shown in Fig. 4.1. Normally, after birth, the production of the fetal form stops and the adult form is produced.

In a rare condition known as Hereditary Persistence of Fetal Haemoglobin (HPFH), fetal haemoglobin continues to be produced well into adulthood in addition to adult haemoglobin. This condition, however, usually lacks any symptoms.

(i) Explain, with reference to Fig. 4.1, the significance of the difference in oxygen binding affinity between fetal and adult haemoglobin.

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..... [2]

(ii) Suggest why HPFH usually lacks symptoms.

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..... [1]

(c) Sketch on Fig. 4.2 the dissociation curve you would expect for adult haemoglobin if the concentration of carbon dioxide is increased. [2]

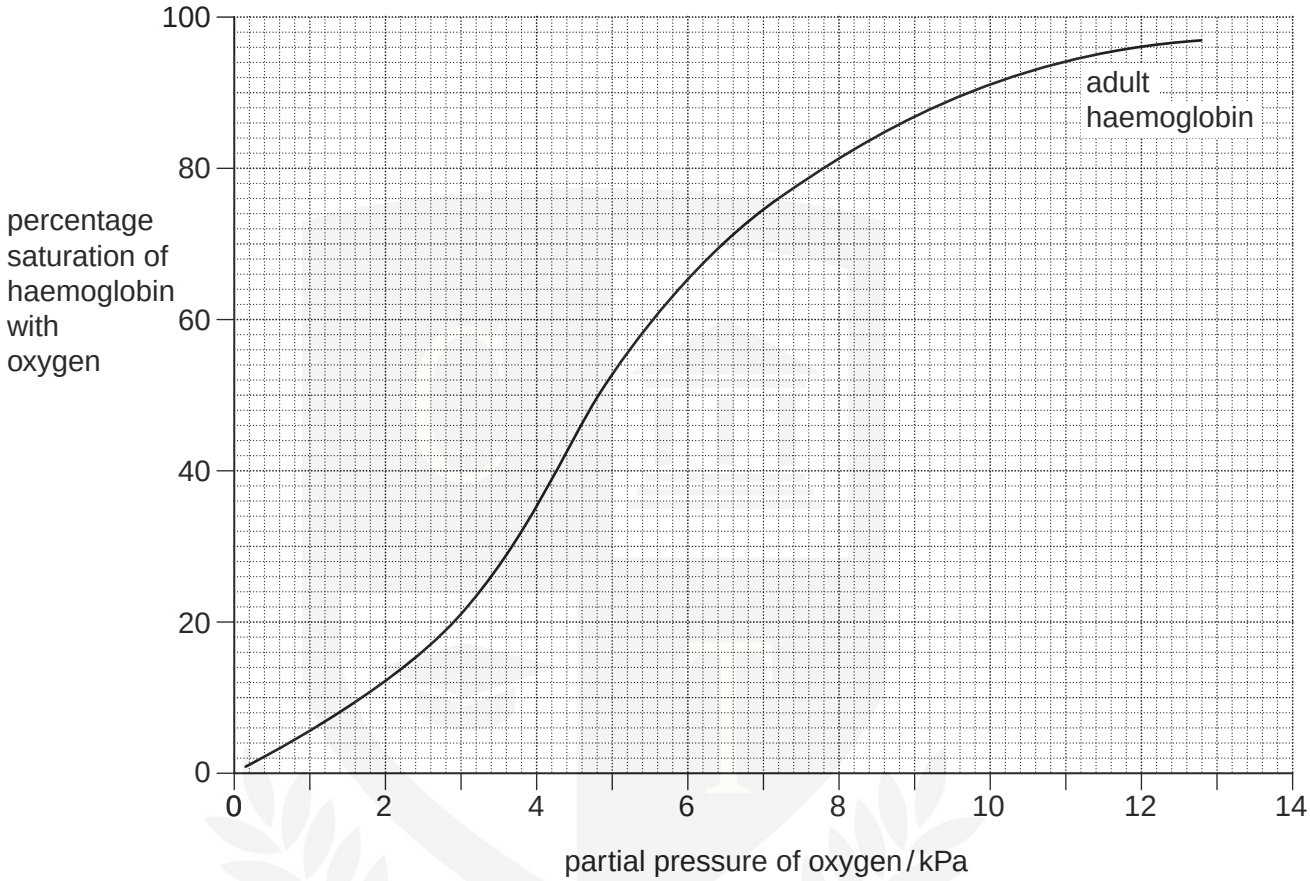

Fig. 4.2

[Total: 9]

4 Fig. 1.1 is a drawing made from an electron micrograph of a longitudinal section of a capillary in muscle tissue.

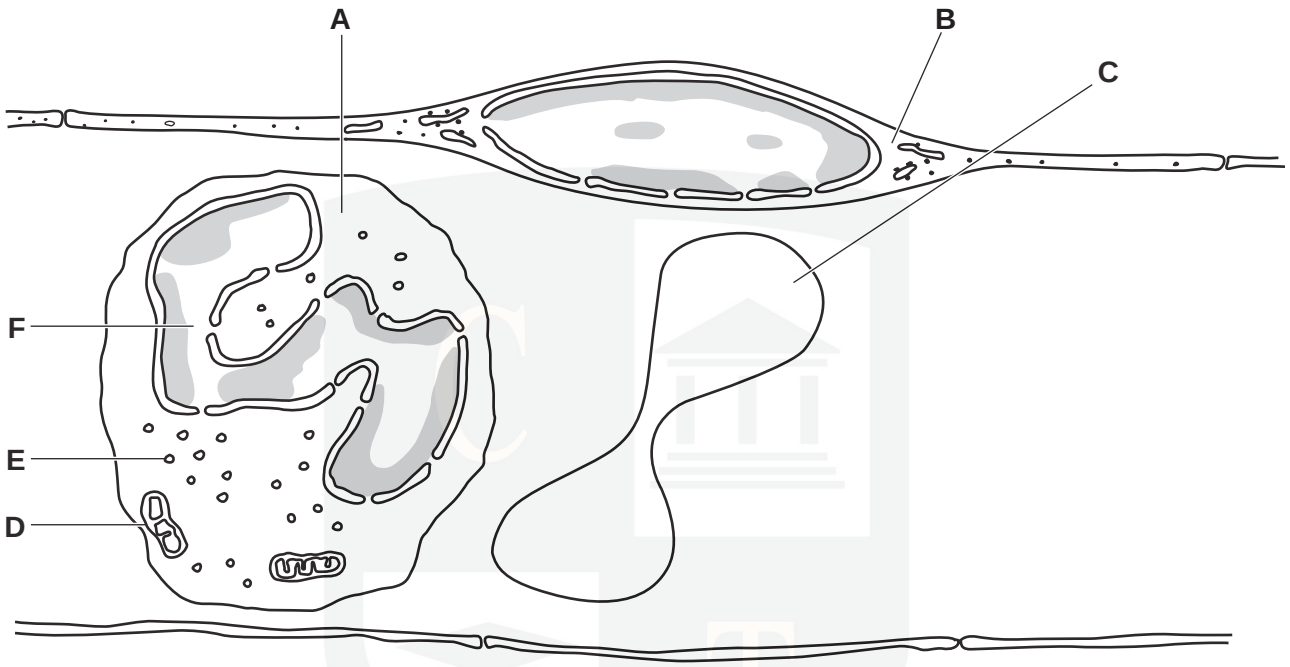

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Fig. 1.1

(a) Complete the table below using the information in Fig. 1.1 to help you.

	cell **A**	cell **B**	cell **C**
name of cell			red blood cell
function of cell	ingest bacteria	permit exchange of gases	
diameter / µm		20	7

[4]

(b) Name the organelles **D**, **E** and **F**.

D .....

E .....

F .....[3]

(c) Explain how oxygen and glucose move from the blood inside the capillary to the tissue fluid in the muscle.

oxygen .....

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glucose .....

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.....[3]

(d) Describe how the **structure** of the **wall** of a vein differs from that of a capillary.

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.....[3]

[Total: 13]

5 During the process of the excretion of nitrogenous waste in mammals, blood passes from the renal artery into networks of capillaries called glomeruli.
Fig. 3.1 is an electronmicrograph showing the relationship between the capillaries and the renal capsule cells, called podocytes.

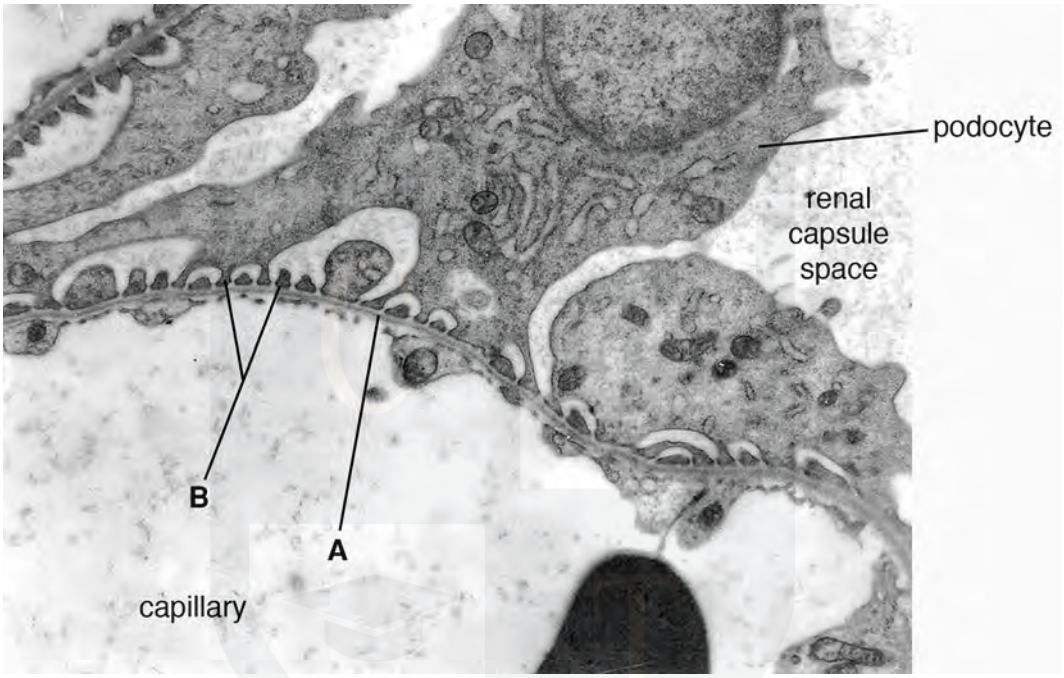

Fig. 3.1

(a) Name structures **A** and **B**.

A .....

B ..... [2]

(b) Draw an arrow, on Fig. 3.1, to show the passage of fluid out of the capillary. [2]

(c) **(i)** Name the fluid that collects in the capsular space.

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.....[1]

(ii) Describe how the composition of this fluid differs from blood plasma.

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(d) Ultrafiltration involves the removal of small molecules, including urea, from the blood into the renal capsule. Explain what is required for ultrafiltration to occur.

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[Total: 10]