

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary GCE**

**BIOLOGY**

**2803/01**

Transport

Monday

**6 JUNE 2005**

Morning

45 minutes

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Ruler (cm/mm)

|                |   |                  |  |  |  |  |  |  |  |  |  |
|----------------|---|------------------|--|--|--|--|--|--|--|--|--|
| Candidate Name | Centre Number   | Candidate Number |  |  |  |  |  |  |  |  |  |
|                | <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> </tr> </table> |                  |  |  |  |  | <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> </tr> </table> |  |  |  |  |
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**TIME** 45 minutes

**INSTRUCTIONS TO CANDIDATES**

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read the questions carefully before starting your answer.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

| FOR EXAMINER'S USE |           |      |
|--------------------|-----------|------|
| Qu.                | Max.      | Mark |
| 1                  | 11        |      |
| 2                  | 7         |      |
| 3                  | 14        |      |
| 4                  | 6         |      |
| 5                  | 7         |      |
| <b>TOTAL</b>       | <b>45</b> |      |

**This question paper consists of 12 printed pages.**

Answer all the questions.

- 1 (a) Transpiration is the loss of water from plants by evaporation. Fig. 1.1 shows a potometer, an apparatus used to estimate transpiration rates.

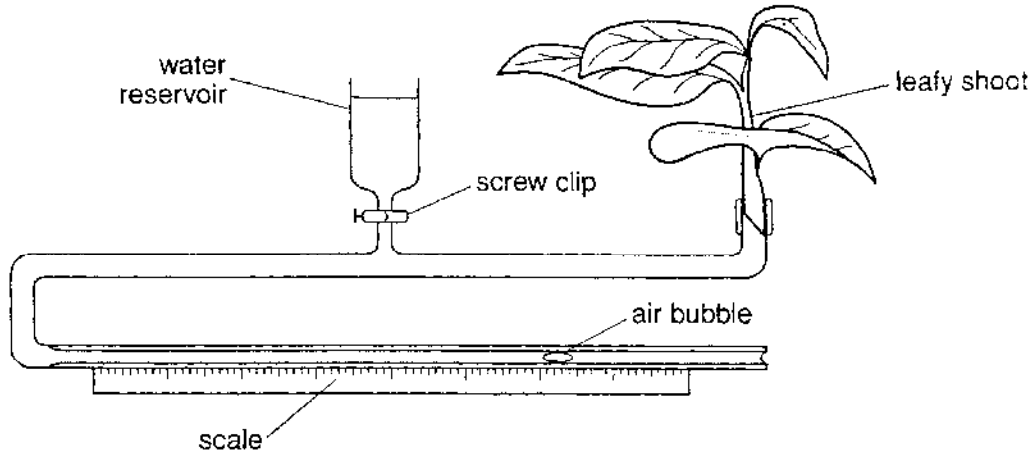


Fig. 1.1

- (i) Describe how the apparatus should be set up to ensure that valid measurements can be obtained.

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[4]

- (ii) Transpiration itself is not measured by the potometer. State precisely what is measured by using the apparatus.

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[1]

- (b) A student investigated transpiration rates of a plant under two conditions, **A** and **B**, in the laboratory using a potometer. In both cases the temperature, the humidity, and the duration were the same. A fan was placed next to the potometer and was turned on for condition **B**, but not for condition **A**.

The results are shown in Table 1.1.

**Table 1.1**

| reading | estimate of transpiration rate / arbitrary units |                    |
|---------|--|--------------------|
|         | condition <b>A</b>                               | condition <b>B</b> |
| 1       | 45   | 107                |
| 2       | 39   | 99                 |
| 3       | 41   | 106                |
| 4       | 46   | 101                |
| 5       | 38   | 103                |
| mean    | 42   |                    |

- (i) Calculate the mean estimated transpiration rate for condition **B**. Express your answer **to the nearest whole number** and write it in Table 1.1. [1]
- (ii) Explain why the mean estimated transpiration rate for condition **B** is greater than that for condition **A**.

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- (c) The student wanted to compare the rates of transpiration of two species of plant using the potometer shown in Fig. 1.1.

Suggest what the student would need to do in order to get a valid comparison of the rates of transpiration of the two species.

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[Total: 11]

- 2 (a) Oxygen is carried around the bodies of mammals, bound reversibly to the pigment haemoglobin. The pigment is found in both adult and fetal red blood cells.

Fig. 2.1 shows the dissociation curves for maternal and fetal oxyhaemoglobin.

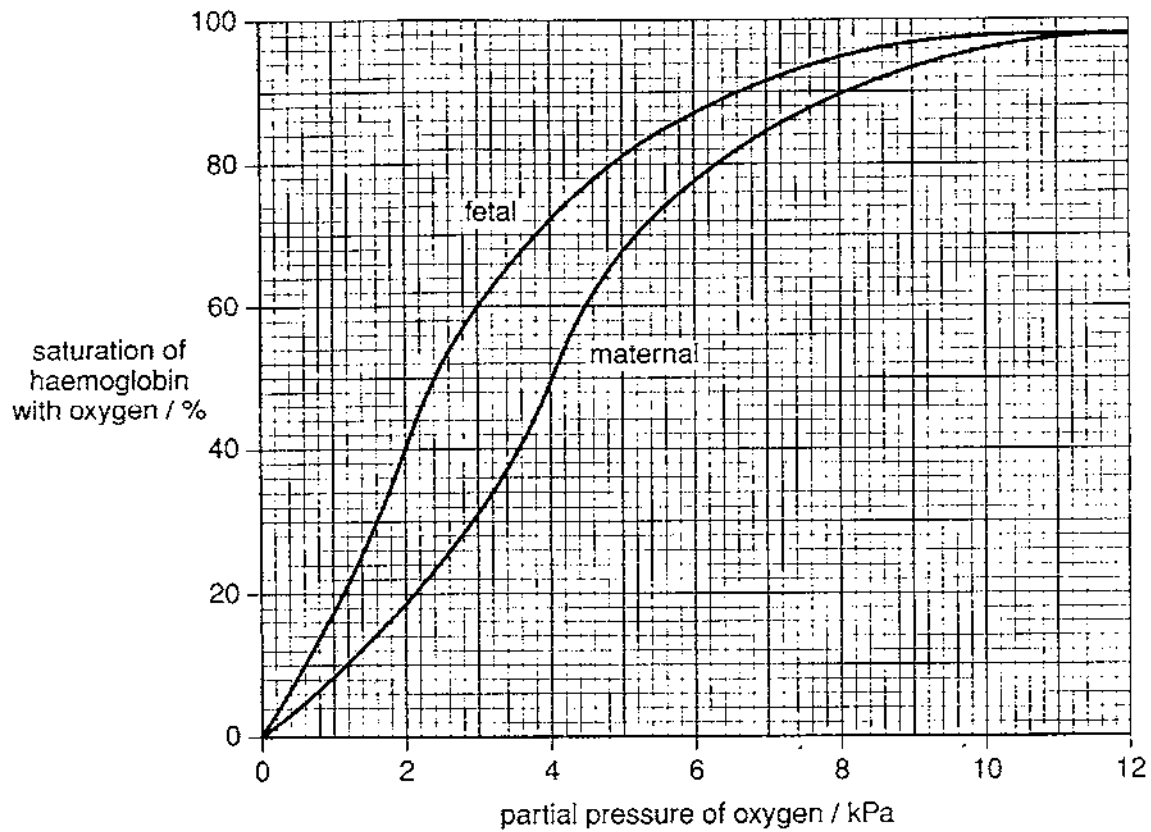


Fig. 2.1

- (i) State the difference in the percentage saturation of haemoglobin with oxygen between the fetal and the maternal blood at an oxygen partial pressure of 3 kPa.

\_\_\_\_\_ [1]

(ii) Explain why the difference between the two curves is essential for the survival of the fetus.

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[4]

(b) After birth, the adult form of haemoglobin gradually replaces the fetal form of haemoglobin.

Suggest why this is necessary.

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[2]

[Total: 7]

- 3 (a) Fig. 3.1 shows the internal structure of the mammalian heart and associated blood vessels.

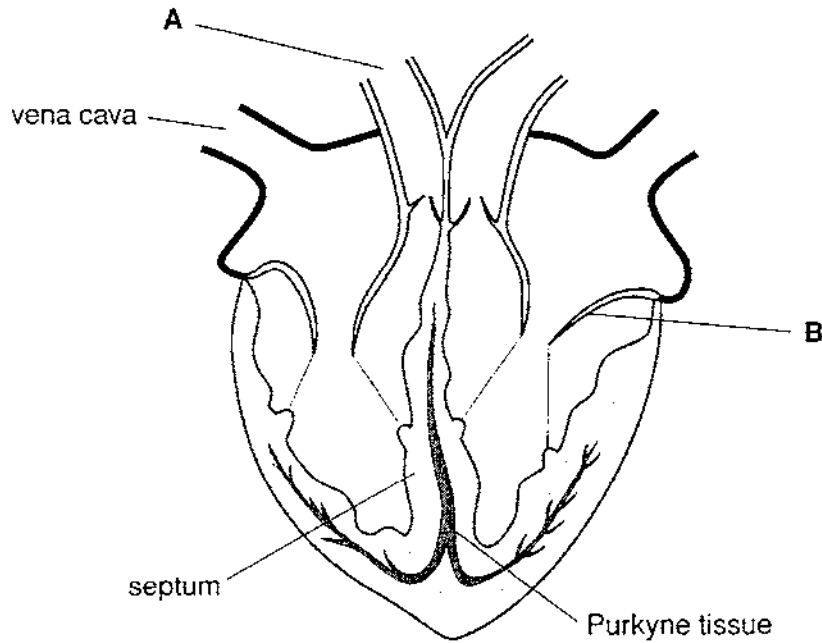


Fig. 3.1

- (i) State the name of structures A and B.

A \_\_\_\_\_

B \_\_\_\_\_ [2]

- (ii) Use arrows on Fig. 3.1 to show the direction of blood flow through the **left** side of the heart. [1]
- (iii) Suggest how the heart would be affected if the Purkyne tissue ceased to function.

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\_\_\_\_\_

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\_\_\_\_\_ [2]

(iv) The septum shown on Fig. 3.1 completely separates the left and right sides of the heart.

Explain why it is important that the two sides of the heart are completely separated.

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[2]

Question 3 continues on the next page.





4 Xerophytes are plants that are adapted for survival in areas where there is not much water available in the soil.

(a) Xerophytes are usually found in habitats where the soil water potential is about  $-50$  kPa. Explain why the cell contents of the roots of xerophytes must have a water potential lower (more negative) than  $-50$  kPa if the plants are to survive in these habitats.

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[2]

(b) Xerophytes have various modifications that reduce water loss from their leaves.

State **two** such adaptations that reduce water loss **and** explain how the reduction in loss is achieved.

adaptation 1 \_\_\_\_\_

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adaptation 2 \_\_\_\_\_

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[4]

[Total: 6]

- (a) Mammals exchange respiratory gases via their lungs, whose surface area is greatly enlarged by the presence of many alveoli.

Fig. 5.1 is a diagram showing part of the wall of an alveolus and an associated capillary.

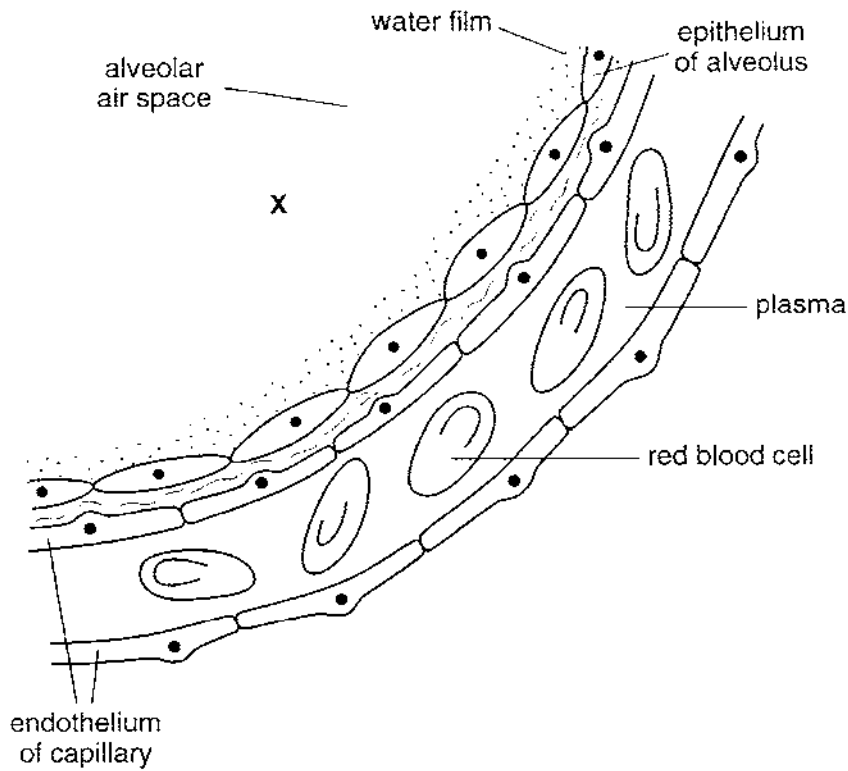


Fig. 5.1

Describe the mechanism by which oxygen gets from point X on Fig. 5.1 to the red blood cells.

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[2]

- (b) Once in the red blood cells, the oxygen is picked up by haemoglobin. Explain how **two** features of red blood cells, **other than the presence of haemoglobin**, make them efficient in the collection of oxygen and its transport to the tissues.

feature 1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

feature 2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [4]

- (c) In addition to the red blood cells shown in Fig. 5.1, various types of white blood cell can be found in the blood system. Some of these white blood cells are lymphocytes.

Describe **one** feature that would allow you to identify a white blood cell as a lymphocyte when viewed with a light microscope.

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\_\_\_\_\_ [1]

[Total: 7]

END OF QUESTION PAPER

**2803/01 Transport**

**June 2005**

**Mark Scheme**

|   |   |
|---|---|
| <b>Abbreviations, annotations and conventions used in the Mark Scheme</b> | / = alternative and acceptable answers for the same marking point<br>; = separates marking points<br>NOT = answers which are not worthy of credit<br>R = reject<br>( ) = words which are not essential to gain credit<br><u>      </u> = (underlining) key words which <b>must</b> be used to gain credit<br>ecf = error carried forward<br>AW = alternative wording<br>A = accept<br>ora = or reverse argument |
|---|---|

| Question       | Expected Answers  | Marks        |
|----------------|---|--------------|
| 1 (a) (i)      | cut shoot under water ;<br>insert into apparatus under water / AW ;<br>full of water / no extra bubbles / no airlocks ; <i>applies to plant / apparatus</i><br>cut shoot at a slant ;<br>dry off leaves / AW ;<br>ensure , air / water , tight joints / AW ;<br>use a , healthy / AW , shoot :<br>allow time to acclimatise / AW ;<br>keep , condition(s) / named condition(s) , constant ;<br>measure per unit time / AW ;<br>shut screw clip ;<br>ref to scale ; e.g. note where bubble is at start / keep ruler fixed ;<br><b>R 'move bubble to end' ideas</b> | <b>4 max</b> |
|                | (ii) water uptake / AW ; R water used   | <b>1</b>     |
| (b) (i)        | 103 ; R decimals  | <b>1</b>     |
|                | (ii) <i>R refs to water or water particles</i>  |              |
|                | 1 boundary layer / saturated air / water vapour / AW, around leaf in still air / A ;<br>2 (which) fan / wind , removes / reduces , <i>ecf wrong ref to water</i><br>3 ref steeper water potential gradient ; R concentration gradient<br>4 (therefore) faster / greater / more / AW, evaporation / diffusion ;<br><i>must be linked to above</i>  | <b>3 max</b> |
| (c)            | set up in same (environmental) condition(s) / named condition ;<br>calculate the rate per unit area of leaf / idea of getting same area of leaf in both ;<br>detail of how this could be done ; e.g. draw round all leaves on graph paper<br>replicates ;<br>both picked at same time / same degree of turgidity / AW ;<br>run for the same time / AW ;   | <b>2 max</b> |
| <b>[Total:</b> |   | <b>11]</b>   |

| Question  | Expected Answers   | Marks |
|-----------|--|-------|
| 2 (a) (i) | 29 ;   | 1     |
| (ii)      | fetus gains oxygen from, maternal blood / mother / AW ;<br>across <u>placenta</u> ;<br>partial pressure / AW, of oxygen in placenta is low ;<br>2-4 kPa ;<br>both in the fetal and maternal parts / AW ;<br>maternal haemoglobin releases oxygen ;<br>fetal haemoglobin has a high(er) affinity for oxygen ;<br>ref to maintaining diffusion gradient ;<br>oxygen needed for , respiration / energy release / AW ; R energy production | 4 max |
| (b)       | <i>accept answer written in terms of adult haemoglobin</i><br><br>affinity (of fetal haemoglobin) would be too high ;<br>would not release oxygen readily enough / AW ;<br>ref to idea that adult females will need difference with their fetuses in due course ;<br>ref to high partial pressure of oxygen in lungs allowing loading with Hb with lower<br>affinity ;   | 2 max |
| [Total:   |  | 7]    |

| Question  | Expected Answers   | Marks |
|-----------|--|-------|
| 3 (a) (i) | A = pulmonary artery ;<br>B = bicuspid <u>valve</u> ; A atrioventricular / AV, <u>valve</u> <i>mark first on list</i> R 'arterio...'   | 2     |
| (ii)      | arrows correctly positioned on left side only ;  | 1     |
| (iii)     | 1 wave of excitation / impulse / AW, stops ;<br>2 at the AVN / no transmission to heart apex / AW ;<br>3 no ventricular, contraction / systole ;<br>4 fibrillation / described e.g. heartbeat, unco-ordinated / irregular / no rhythm ;<br>5 blood not squeezed , upwards / out of ventricles / AW ; A ref to pressure change<br>6 atrial contraction continues ;  | 2 max |
| (iv)      | <i>credit answers written in context of what would happen if there was a hole</i><br><br>stops oxygenated and deoxygenated blood <u>mixing</u> ;<br>ensures, (fully) oxygenated blood gets to the body / deoxygenated blood to lungs ;<br>ref to possible drop in blood pressure if hole present ;<br>ref to allowing different pressures being maintained on each side / AW ;<br>AVP ; e.g. prevention of rise in heart rate if two sides not separated | 2 max |
| (b) S1    | three named layers ;   |       |
| S2        | (tunica intima / inner layer / AW) <u>endothelium</u> ;  |       |
| S3        | (tunica intima / inner layer / AW) <u>squamous</u> (epithelial) cells ;  |       |
| S4        | (tunica media / middle layer / AW), thin / narrow / AW ;   |       |
| S5        | (tunica media / AW), muscle <u>and</u> elastic tissue ; R large amounts<br><i>refs to collagen neutral</i>   |       |
| S6        | (tunica externa) <u>collagen</u> ; R if muscle mentioned here  |       |
| S7        | valves ;   |       |
| S8        | large / wide, <u>lumen</u> ;<br><b>max 4 S marks</b> <i>credit S marks from labelled diagrams</i>  |       |
| F9        | smooth , endothelium / epithelium / lining / AW, reduces friction ;<br>R if smoothness related to muscle   |       |
| F10       | credit one reference to, thinness / strength , of wall withstanding low pressure ;   |       |
| F11       | ref to thinness of wall to allow skeletal muscle to squeeze vein ;   |       |
| F12       | valves to prevent backflow / AW ;  |       |
| F13       | ref to, wide lumen / walls distending , to accommodate large volume of blood ;   |       |
| F14       | detail of this e.g. relationship between large volume and slow flow rate ;<br><b>max 3 F marks</b>   | 6 max |
|           | <b>QWC – legible text with accurate spelling, punctuation and grammar ;</b>  | 1     |
|           | <b>[Total: 14]</b>   |       |

| Question | Expected Answers   | Marks |
|----------|--|-------|
| 4 (a)    | <p>water moves down a water potential gradient / AW ;<br/>           by osmosis ;<br/>           (ref to roots being below <math>-50</math> kPa means) water will enter (the root) ;</p>   | 2 max |
| (b)      | <p><i>function must match adaptation, adaptation can stand alone<br/>           assume answer is about water vapour unless clearly wrong e.g. water droplets</i></p> <p>covered in hairs ;<br/>           reflect heat or water vapour, trapped / not blown away ;</p> <p>thick, waxy layer / cuticle / AW ;<br/>           reduces loss (via the epidermis) / reflects heat ; <b>R</b> no loss<br/> <i>if cuticle related to reflective nature, 'thick' not needed</i></p> <p>small / AW , leaves ; <b>A</b> no leaves (e.g. cacti) / needles / spines / spikes <b>R</b> thorns<br/>           reduced surface area for loss / reduces number of stomata ;<br/> <b>R</b> ref to spines etc related to preventing consumption by herbivores</p> <p>sunken stomata / AW ; <b>A</b> substomatal chamber hairs as an alternative here<br/>           water vapour, trapped / not blown away ;</p> <p>rolling up of leaves / curled leaves ;<br/>           less surface area / stomata on inside or water vapour, trapped / not blown away ;</p> <p>small air spaces in the mesophyll ;<br/>           quickly become fully saturated / reduced area for loss ;</p> <p>stomata, shut in day / open at night / AW ;<br/>           day hotter / night cooler ;</p> <p>AVP ; e.g. reduced stomatal number plus reason<br/>           AVP ; timed leaf fall<br/>           rosette of leaves close to ground</p> | 4 max |

[Total: 6]



| Question          | Expected Answers   | Marks |
|-------------------|--|-------|
| 5 (a)             | diffusion / down a (concentration) gradient ;<br>dissolves in the water film / goes into solution / AW ;<br>crosses , cell(s) / named cell / cytoplasm / plasma / membrane(s) / wall of alveolus or capillary ;  | 2 max |
| (b)               | <i>two from</i><br><br>biconcave / AW ;<br>large surface area to volume (ratio) ;<br>optimum oxygen uptake / fast diffusion ; ora for oxygen release at tissues<br><b>max 2 for this feature</b><br><br>small / about 7µm (diameter) / about same size as capillary / AW ;<br>all haemoglobin close to surface / fast diffusion / short diffusion path / capillaries can be small to get close to all tissues / (RBC) close to capillary wall for exchange / AW ;<br><br>no nucleus / no or few organelles ;<br>maximum space, for oxygen carriage / haemoglobin ;<br><br>elastic / flexible / pliable , membrane ;<br>allows them to go along capillaries ; | 4 max |
| (c)               | large nucleus / very little cytoplasm / non-granular cytoplasm / about the same size as red blood cells but with a nucleus ;<br><b>A</b> from a diagram<br><b>R</b> nucleus unqualified / bean-shaped nucleus / lobed nucleus<br><br><i>only accept first answer if more than one feature listed, BUT 'large' alone is not a feature, so R e.g. large bean-shaped nucleus</i>  | 1     |
| <b>[Total: 7]</b> |  |       |