Surname	Centre Number	Candidate Number
Other Names		2

GCE AS

B400U20-1

S19-B400U20-1

BIOLOGY – AS component 2
Biodiversity and Physiology of Body Systems

FRIDAY, 24 MAY 2019 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**12**	
2.	**10**	
3.	**11**	
4.	**16**	
5.	**17**	
6.	**9**	
Total	**75**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet. If you run out of space, use the continuation page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
The assessment of quality of extended response (QER) will take place in question **6**.
The quality of written communication will affect the awarding of marks.

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Answer **all** *questions.*

1. The mammalian circulatory system is comprised of the pulmonary and systemic circulations. The table below shows the maximum and minimum blood pressure in different parts of the circulatory system of a mammal.

Part of the circulatory system	Blood pressure / kPa	
	Maximum	Minimum
Left ventricle	16.00	0.00
Right ventricle	3.33	0.00
Aorta	16.00	10.67
Pulmonary artery	3.33	1.07
Muscle capillary	2.00	1.60
Lung capillary	1.08	0.67
Pulmonary vein	0.67	0.27
Vein in forelimb	0.67	0.67
Artery in forelimb	12.57	8.62

(a) (i) Calculate the mean pressure in the lung capillary. [1]

Mean pressure = ... kPa

(ii) The mean pressure in the muscle capillary is 1.80 kPa. Explain the cause of the difference between this and the mean pressure in the lung capillary. [1]

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(iii) Suggest and explain **one** advantage for the lower mean pressure in the lung capillary. [2]

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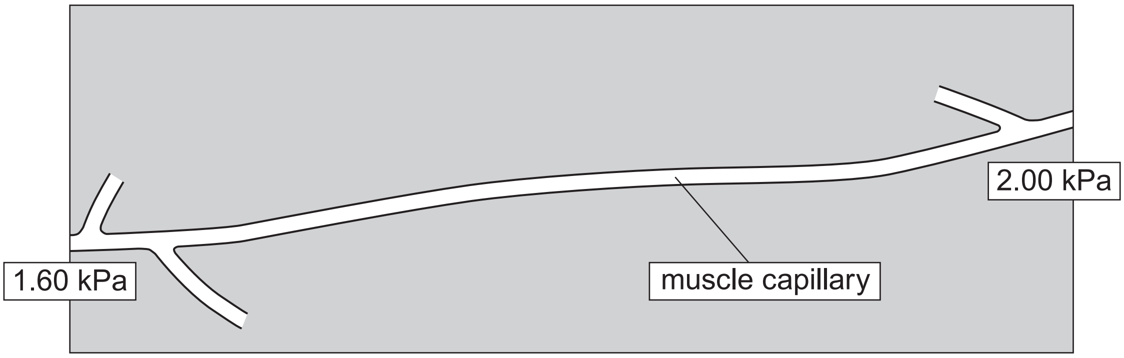
(b) The diagram below shows a muscle capillary transporting blood through a tissue. It also shows where the maximum and minimum pressures occur.



(i) **Draw an arrow** on the diagram to indicate the direction of blood flow. [1]

(ii) Account for the difference between the maximum and minimum pressures in the muscle capillary. [3]

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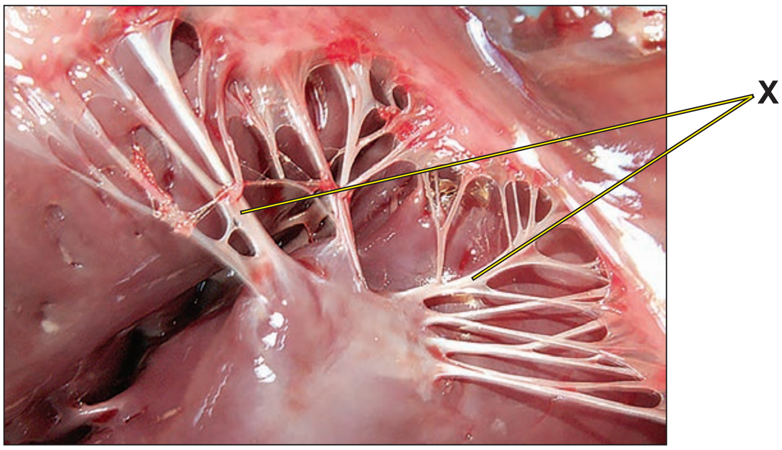
(c) The photograph below shows the detail of the interior of the ventricle of a dissected mammalian heart.



(i) Name the structures labelled **X** in the diagram which are attached to the bicuspid valve. [1]

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(ii) Explain the function of the structures labelled **X**. [2]

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(d) State **one** ethical issue which should be considered when using animals for dissection. [1]

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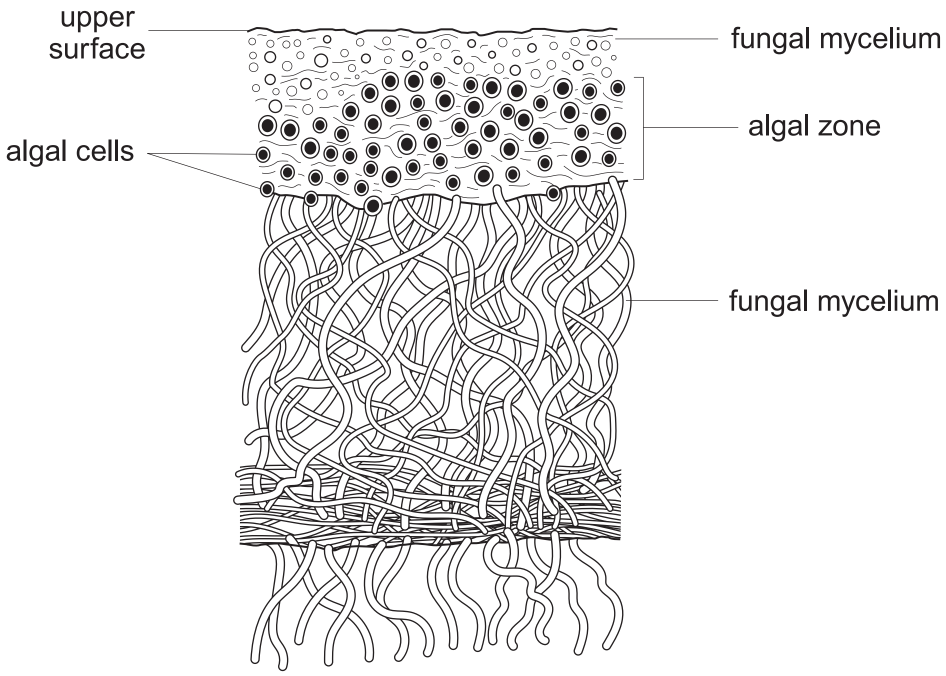
2. Lichens are found growing on many surfaces such as buildings, rocks and tree trunks. They are composed of two organisms, a fungus and a single-celled, photosynthetic alga. The two organisms co-exist in a relationship where both benefit. The main part of the lichen is known as a thallus. The diagram below shows a cross section through a lichen thallus.



(a) Fungi are classed as saprotrophs. Define the term *saprotroph*. [2]

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(b) Name **one** inorganic ion the algae would require for growth and explain why it cannot grow without this inorganic ion. [2]

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(c) Explain the position and distribution of the algae within the lichen thallus. [2]

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(d) Evidence shows that the fungus is able to absorb and transport inorganic ions dissolved in rainwater which the algae then use for growth.

With reference to the modes of nutrition of the two organisms within the lichen suggest the benefit of the association with the algae to the fungus. [2]

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(e) A scientist extracted samples of DNA from the algae in lichen from two different locations with similar environmental conditions. Describe how the DNA samples could be used to determine whether the algae within the two lichens were the same species or not. [2]

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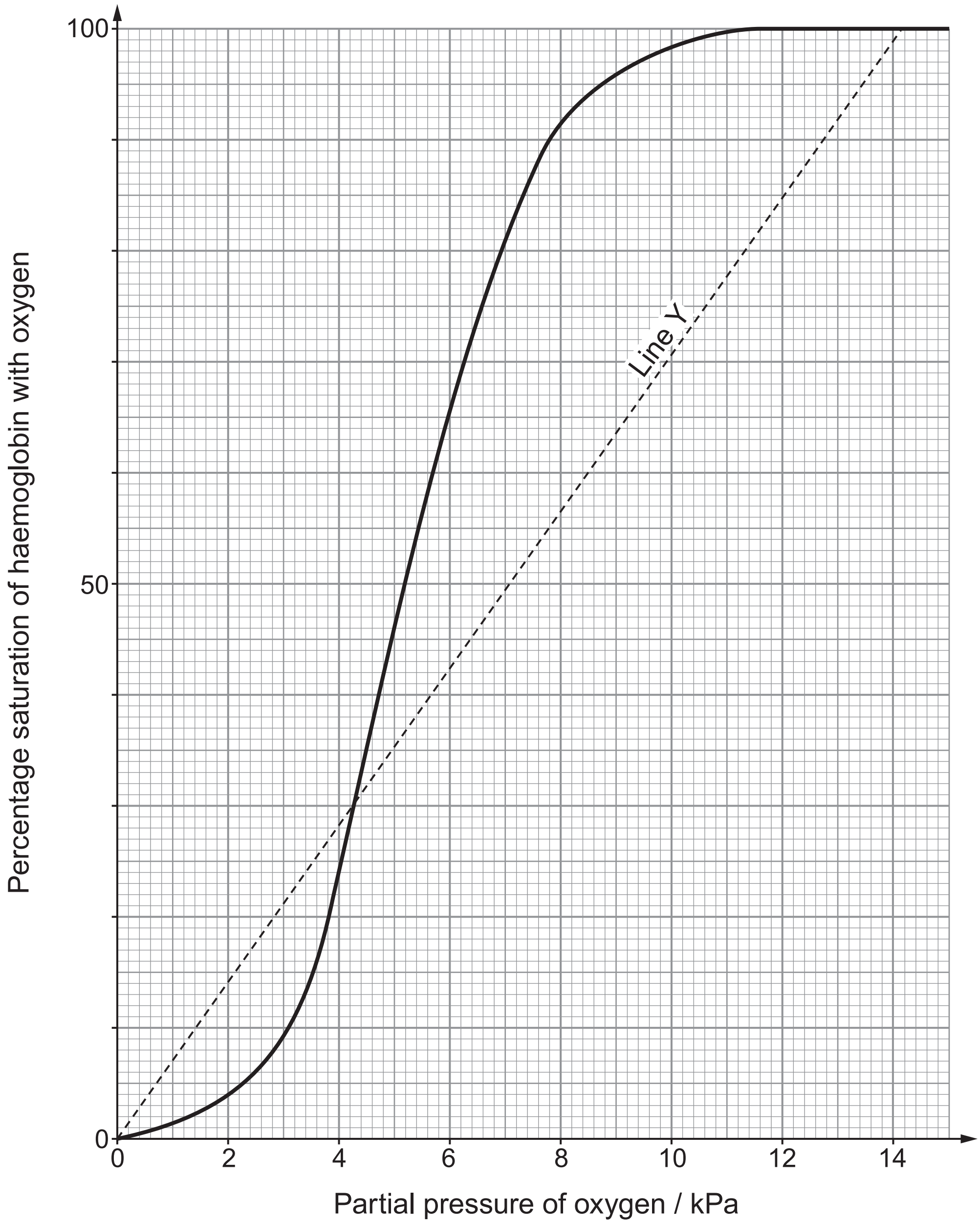
3. The diagram below shows the oxygen dissociation curve for adult human haemoglobin.



(a) The curve shows a sigmoid (S-shaped) relationship between partial pressure of oxygen and saturation of haemoglobin with oxygen. Line Y shows the theoretical linear relationship.

(i) Using the sigmoid curve the percentage decrease in the haemoglobin saturation between 6 kPa and 2 kPa is 15.5 % per kPa.

Calculate the equivalent **percentage decrease per kPa** for the linear relationship shown in the graph. [2]

Decrease = ... % per kPa

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(ii) Explain why the sigmoid curve is more efficient for a respiratory pigment than the linear relationship. [2]

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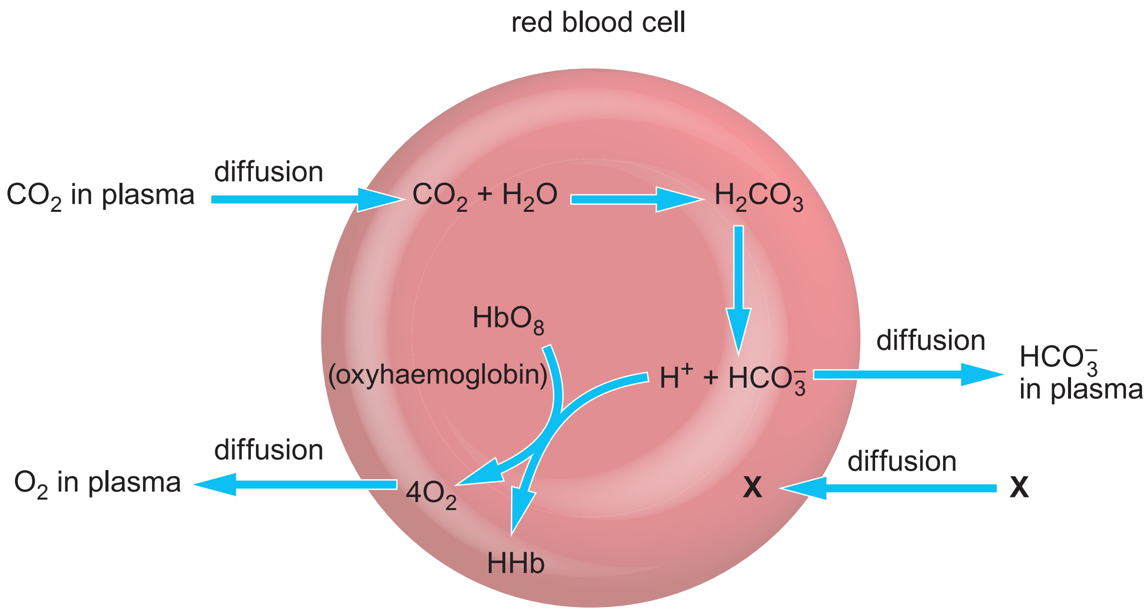
(b) The diagram below shows the process by which a red blood cell located in a capillary of actively respiring tissue is involved in the transport of carbon dioxide.



(i) Carbon dioxide normally dissolves slowly in water.

Explain why carbon dioxide dissolves much more quickly within red blood cells. [1]

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(ii) Name ion **X** and explain why it enters red blood cells. [2]

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(iii) Use the diagram to explain why an increase in the rate of respiration would lead to more oxygen being released from oxyhaemoglobin. [4]

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4. An investigation was carried out to determine the effect of sheep grazing on the plant biodiversity of an upland heath. An area of previously grazed land was fenced off to exclude the sheep and the plant biodiversity was immediately calculated and then recalculated after 5 years. Each calculation of plant biodiversity involved taking a large number of random samples at the site.

(a) (i) Define the term *biodiversity*. [1]

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(ii) Describe a suitable method which could be used to collect the data needed to estimate plant biodiversity in this investigation. [4]

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(iii) Explain the importance of taking a **large number** of **random** samples. [2]

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(iv) Suggest a suitable control for this investigation. [2]

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The table below shows the results of the investigation.

Species	Number of individuals	
	Immediately after fencing	Five years after fencing
Erica cinerea (height: 20 cm – 60cm)	34	18
Calluna vulgaris (height: 20 cm – 60 cm)	26	10
Carex binervis (height: 15 cm – 120 cm)	24	53
Galium saxatile (height: 5 cm – 20 cm)	43	0
Potentilla erecta (height: 10 cm – 30 cm)	53	12
Sorbus aucuparia (height: up to 10 m)	0	2
Diversity (Simpson's index)	0.79	

(b) (i) Use the formula given below to calculate the Diversity index for the experimental site after grazing was excluded for 5 years. **Give your answer to 2 decimal places.** [3]

$$\text{Diversity} = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

N = total number of individual plants
n = number of individuals per species
$\sum$ = sum of

Species	n	$(n-1)$	$n(n-1)$
Erica cinerea			
Calluna vulgaris			
Carex binervis			
Galium saxatile			
Potentilla erecta			
Sorbus aucuparia			
	N =		$\sum n(n-1)$ =
	$(N-1)$ =		

$N(N-1)$ = ...

Diversity index = ...

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(ii) State the conclusion you can make about the effect of excluding grazing on the biodiversity of the site. [1]

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(c) After grazing had been excluded for 5 years the percentage ground cover by *Erica cinerea* had increased from 33% to 67%.

Use this information and the information given in the table on page 12 to suggest how this change could have affected the overall biodiversity at the site. [3]

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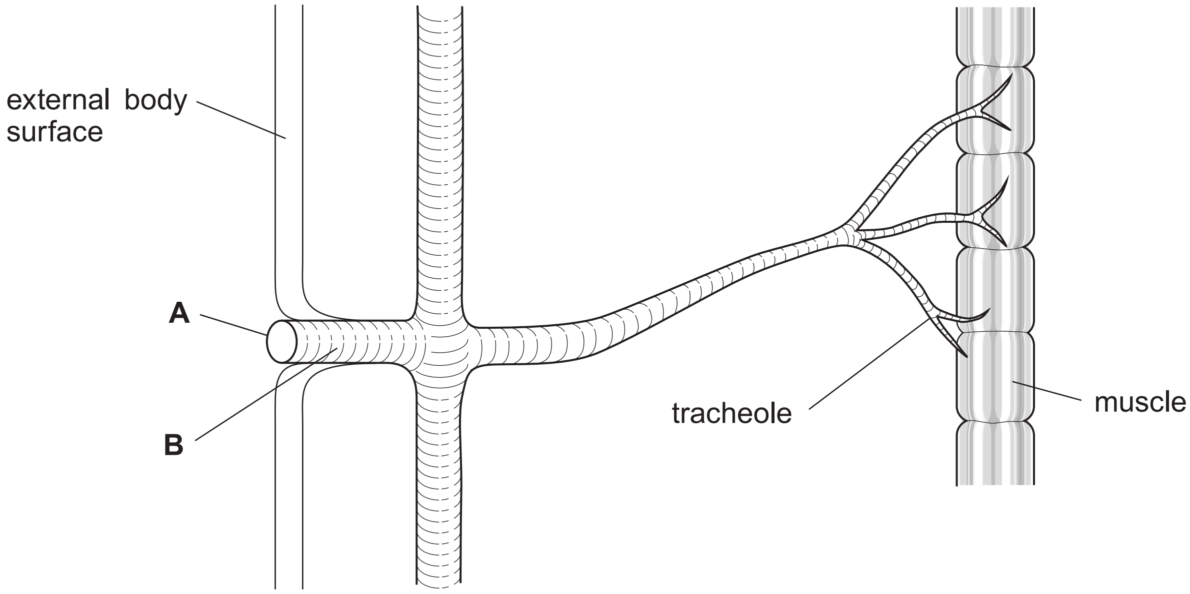
5. Insects have evolved an internal gas exchange system as an adaptation to a terrestrial environment. The diagram below shows part of an insect's gas exchange system.



(a) Name the structures labelled **A** and **B**. [1]

A: ....

B: ....

(b) Many small animals such as earthworms have a circulatory system with a respiratory pigment such as haemoglobin.

(i) Explain why earthworms need a respiratory pigment, but insects do not. [2]

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(ii) Suggest why having the type of gas exchange system shown in the diagram means that insects are not able to grow as large as animals which have a circulatory system and haemoglobin. [1]

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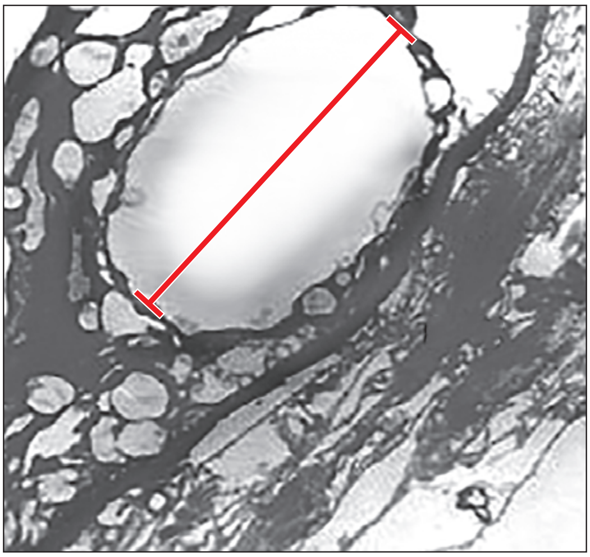
The electron micrograph below shows a transverse section of an insect tracheole.



(c) Using the line provided on the electron micrograph, calculate the diameter of the insect tracheole in the electron micrograph, given that the magnification of the image is × 10 000.

Give your answer in μm to 2 significant figures. [2]

Diameter = ... μm

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Albacore tuna (*Thunnus alalonga*) is a fast-swimming predatory fish which can swim at speeds of up to 80 km hr^{-1} and often performs very deep dives into colder water in pursuit of prey. The tuna has a very high rate of respiration and has several adaptations which help it maximise its rate of gas exchange:

- gills have a surface area up to 30 times greater than other fish of comparable size
- gas exchange surface is much thinner than that of other fish
- higher blood pressure than other fish
- counter-current flow in its gills

However, it has lost the ability to pump water over its gill surface, relying instead on a process known as ram ventilation. In this process, the fish keeps its mouth open as it swims and water is forced over the gill surface as it moves through the water.

(d) (i) Explain how a thin gas exchange surface and high blood pressure help a tuna to maximise its rate of gas exchange. [3]

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(ii) Tuna must swim continuously. Explain why this is essential. [3]

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Another adaptation found in tuna is that they are able to maintain a core body temperature several degrees above that of the surrounding water. They achieve this by means of a counter-current heat exchanger located deep within their muscle. Cool blood in arteries from the gills passes very close to warm blood in the veins flowing in the opposite direction. This allows heat from the warm blood to raise the temperature of the cooler blood before it reaches the muscle capillaries.

(e) The tuna's heat exchanger employs a counter-current flow mechanism. Explain how such an arrangement helps to maximise the rate of heat exchange. [2]

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(f) Suggest why it is particularly important to the tuna to raise the temperature of blood before it reaches the muscle capillaries. [3]

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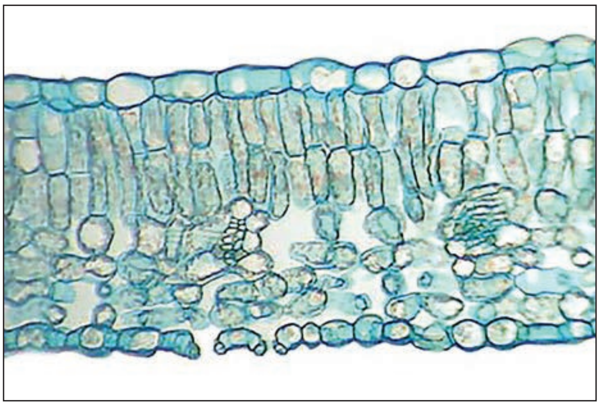
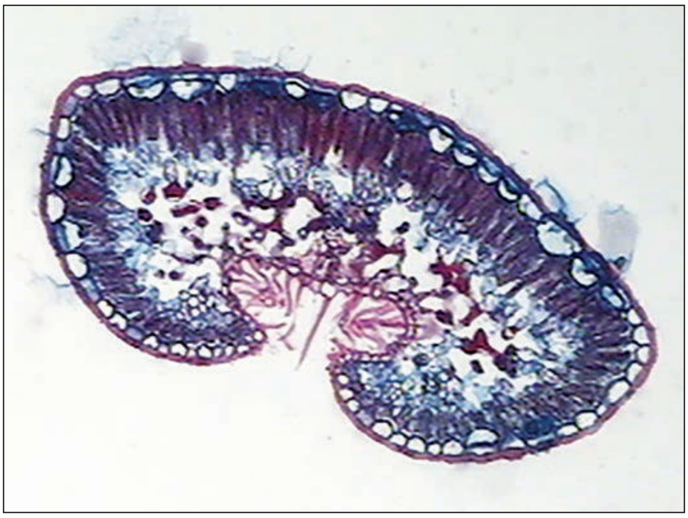
6. The three photomicrographs below show three types of angiosperm leaf adapted to different environmental conditions.

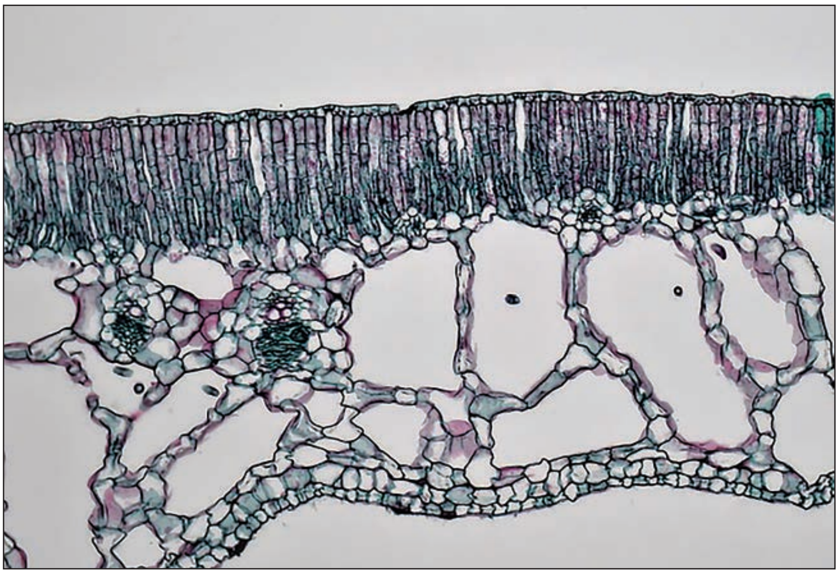
Photomicrograph **A**



Photomicrograph **B**



Photomicrograph **C**



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Describe how the structures present in the leaf in photomicrograph **A** allow the plant to carry out photosynthesis and explain how the adaptations in the leaves in photomicrographs **B** and **C** enable the plants to survive in different environmental conditions. [9 QER]

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