Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B400U20-1

O21-B400U20-1

FRIDAY, 15 OCTOBER 2021 – MORNING

BIOLOGY – AS component 2
Biodiversity and Physiology of Body Systems

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**10**	
3.	**12**	
4.	**18**	
5.	**16**	
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. Do not used gel pen or correction fluid.

You may use pencil for graphs and diagrams only.

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 additional 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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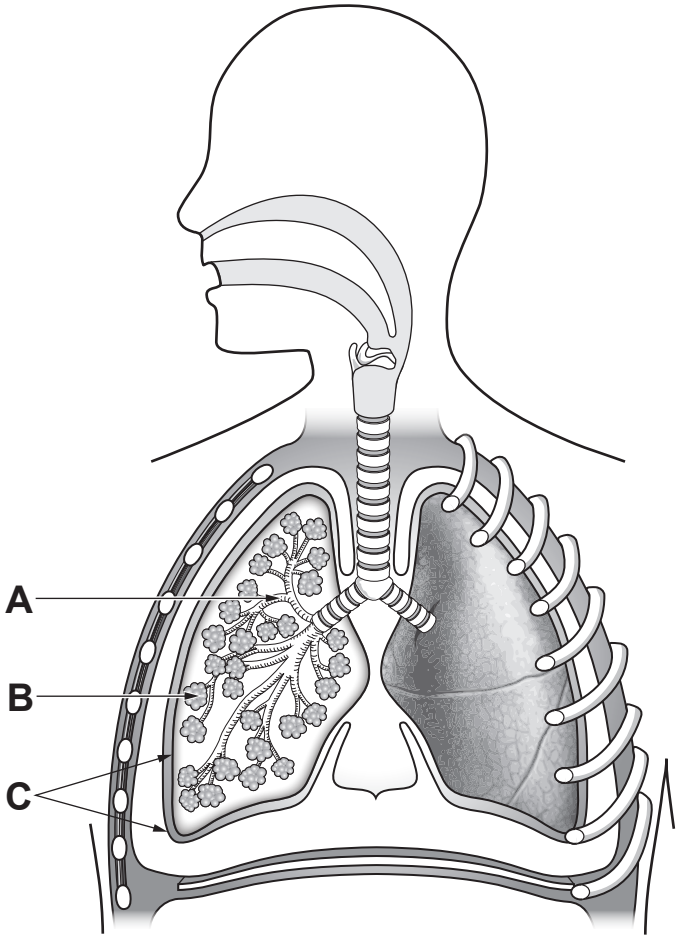
Answer **all** *questions.*

1. **Image 1.1** shows the human respiratory system.

Image 1.1



(a) (i) Name structures **A**, **B** and **C** shown in **image 1.1**. [1]

A .....

B .....

C .....

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Image 1.2 shows a transverse section of a human trachea.

Image 1.2

Magnification ×8

(ii) Use the line shown in **image 1.2** to calculate the actual diameter of the trachea lumen. [2]

Diameter = ... mm

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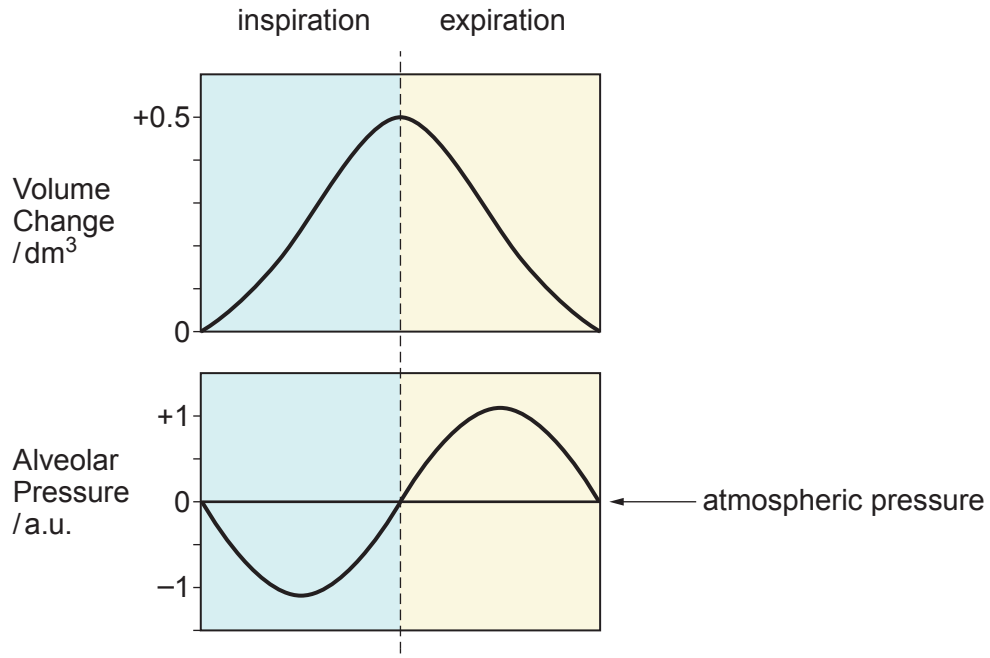
(b) **Image 1.3** shows the changes in pressure and volume changes within the human thorax during one breath.

Image 1.3



(i) I. Explain how the volume of the thorax is changed during inspiration. [3]

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II. With reference to the graphs in **image 1.3** and your own knowledge, explain the change in alveolar pressure during inspiration. [2]

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(ii) During expiration there is a risk of collapse of the alveoli due to the positive pressure. Suggest how the alveoli are adapted to deal with this. [2]

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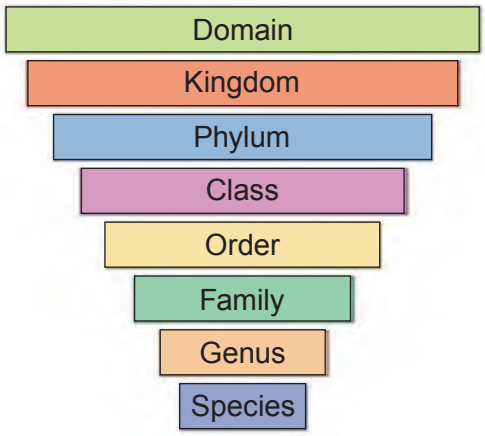
2. **Image 2.1** shows the taxonomic groups used in the classification of living organisms.

Image 2.1



(a) Organisms in the Domain Eukaryota can be divided into Kingdoms based on common features. **Complete table 2.2**. [4]

Table 2.2

Kingdom	Feature
.....	• Cellulose cell wall • Photoautotrophic
.....	• No cell wall • Nervous coordination • Heterotrophic
Fungi	• ..... • ..... • .....
.....	• Single celled • If multicellular, no tissue differentiation

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(b) **Image 2.3** shows part of a coral reef, an example of a biodiversity hotspot.

Image 2.3

(i) Define the term biodiversity. [1]

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(ii) Describe the process through which this biodiversity has been generated. [3]

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(c) Scientists compared the biodiversity levels in two different ecosystems, the tropical rainforests and the arctic tundra. The location of these ecosystems are shown in **image 2.4**. **Images 2.5 and 2.6** show examples of these ecosystems.

Image 2.4

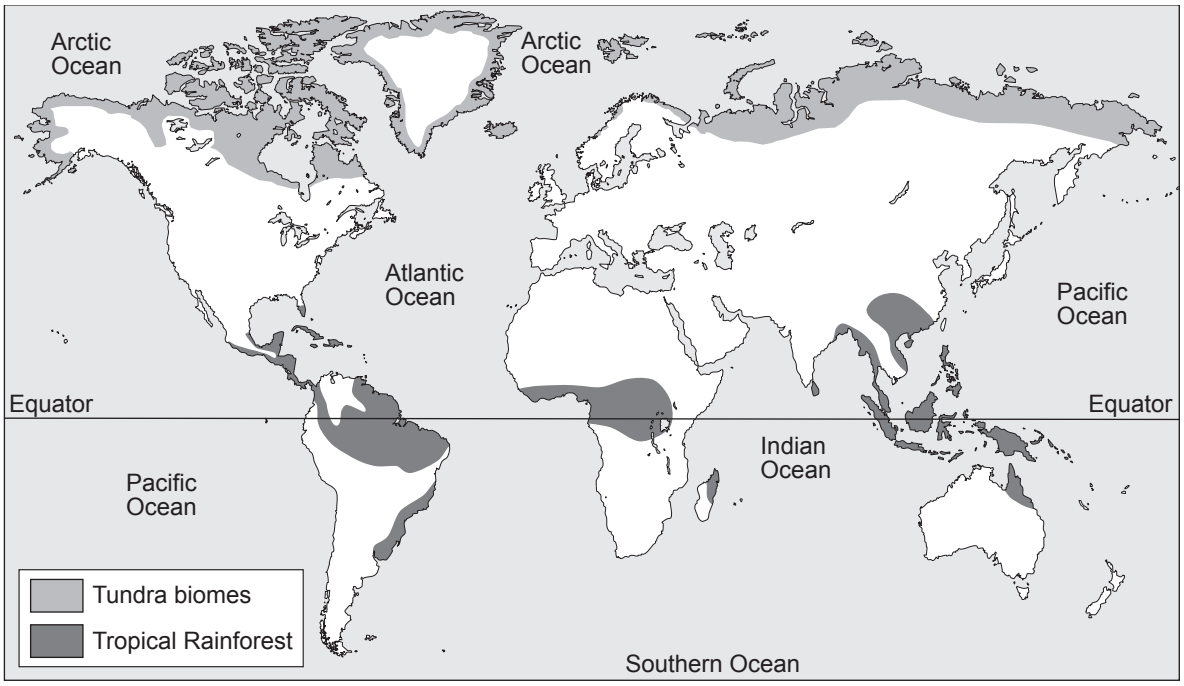

Image 2.5 – tropical rainforest

Image 2.6 – arctic tundra

Simpson's diversity index was calculated for the two ecosystems. The diversity index of the tropical rain forest was 0.96 and the tundra was 0.34. **Using the data**, conclude which ecosystem was more diverse. Suggest **one** reason for the higher biodiversity in this ecosystem. [2]

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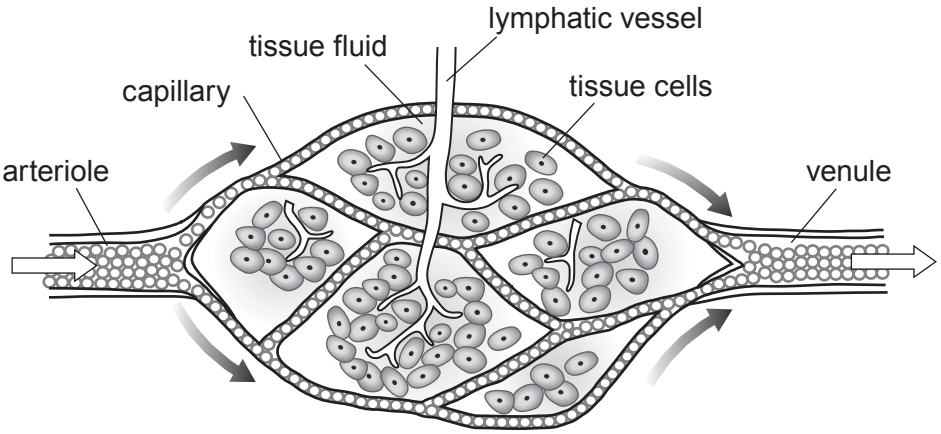
3. Tissue fluid is where gases and nutrients are exchanged between blood and tissues. **Image 3.1** shows a capillary bed and the associated lymphatic vessels.

Image 3.1



(a) (i) State **one** feature of the capillary wall which allows tissue fluid to be formed. [1]

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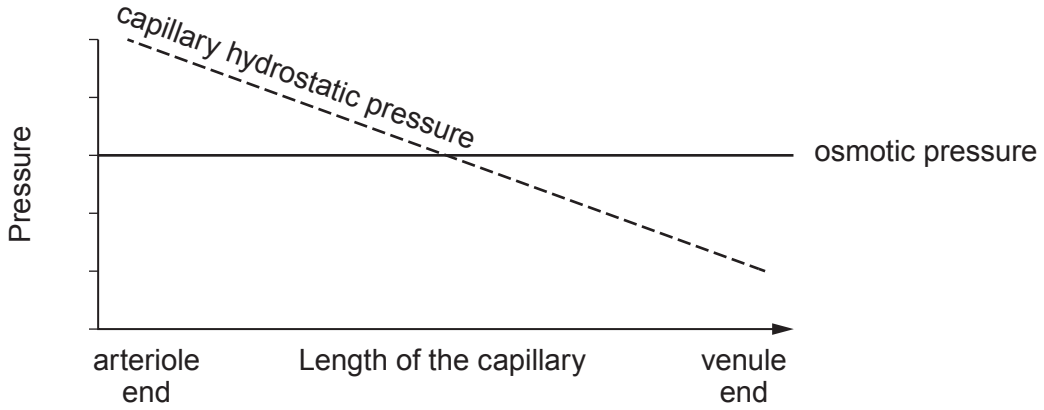
Image 3.2 shows the changes in pressure within the capillary bed as blood moves from the arteriole to venule end.

Image 3.2



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(ii) Using **image 3.2** and your own knowledge:

I. Describe and explain the change in capillary hydrostatic pressure between the arteriole end and the venule end. [4]

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II. Explain why there is a net movement of water back into the capillary at the venule end. [3]

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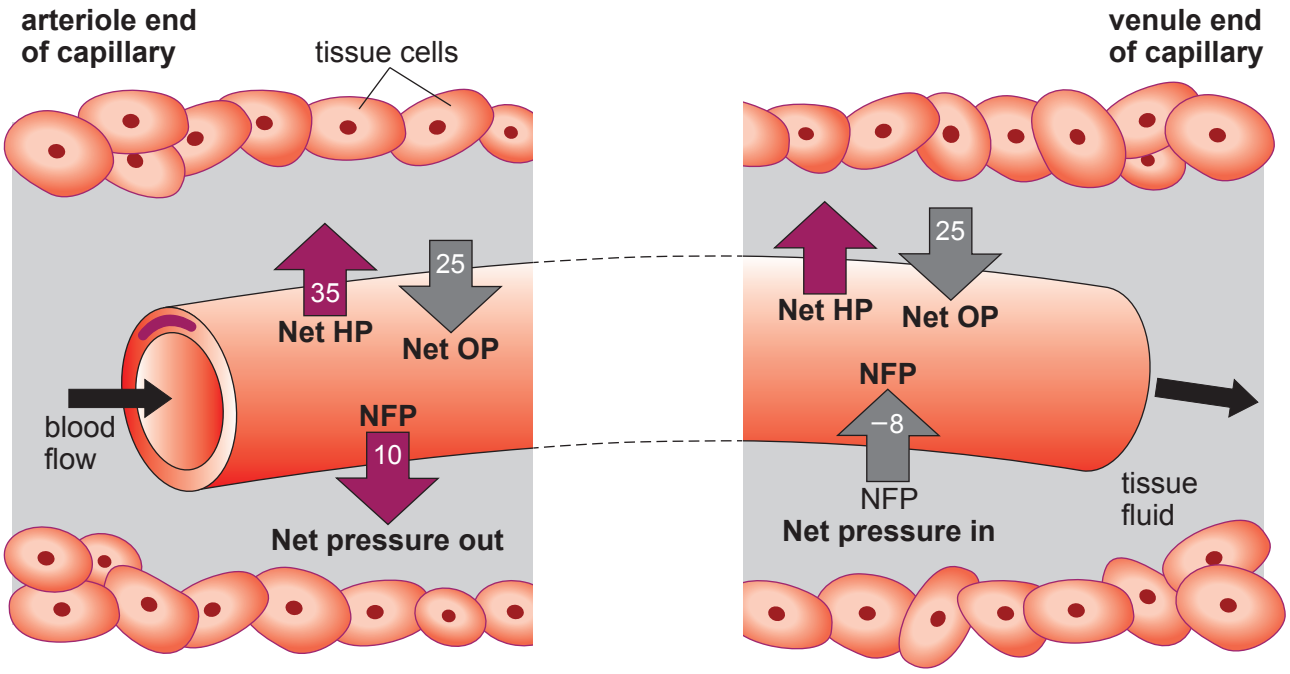
(iii) The values of osmotic pressure (OP) and hydrostatic pressure (HP) make it possible for the Net filtration pressure (NFP) to be calculated. This is shown in **image 3.3**.

Image 3.3



Arteriole NFP = Net HP – Net OP
Arteriole NFP = 35 – 25
Arteriole NFP = + 10

Use the information in **image 3.3** and the example shown to calculate:

I. the **Net HP** at the **venule** end. [1]

Net HP = ...

II. the percentage change in **Net hydrostatic pressure (Net HP)** between the arteriole and venule end of the capillary. [2]
Space for working.

Percentage change = ...

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(b) Lymphatic filariasis is a medical condition caused by parasitic worms which block the lymphatic vessels. This can result in swelling of the legs as shown in **image 3.4**.

Image 3.4

Affected leg

Unaffected leg

Explain the appearance of the affected leg. [1]

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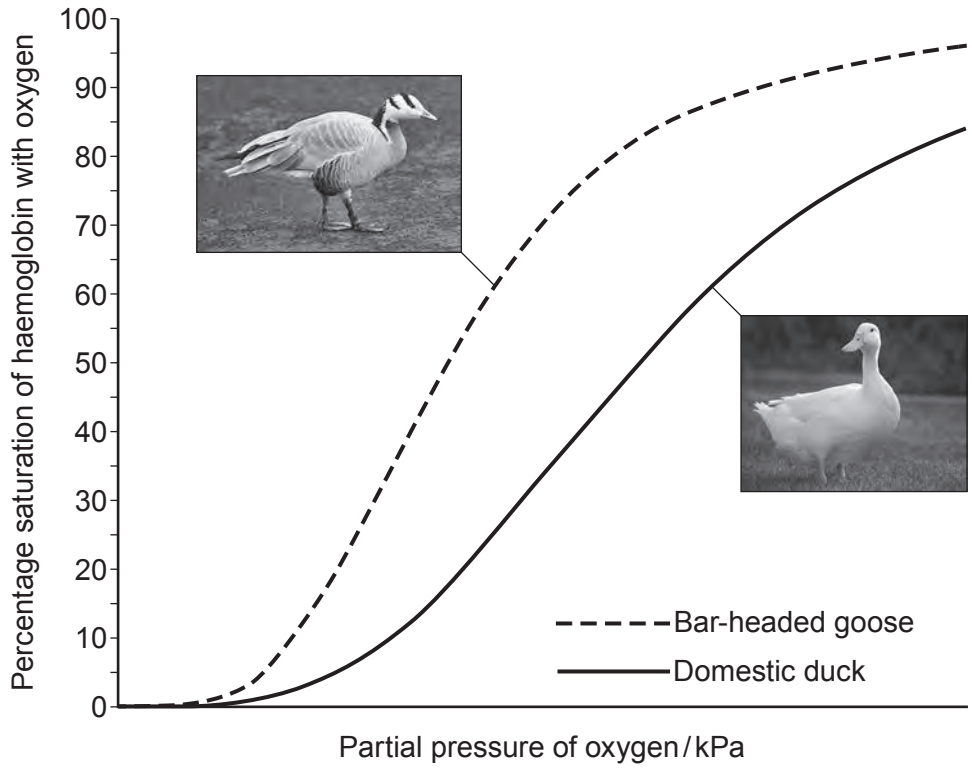
4. Bar-headed geese fly at high altitude during their migration. A sample of blood was taken from an adult Bar-headed goose and the haemoglobin was analysed. The percentage saturation of the haemoglobin was measured when exposed to varying concentrations of oxygen. This was repeated for the haemoglobin of a domestic duck. The results are shown in **image 4.1**.

Image 4.1



(a) (i) Explain the advantage of the position of the curve for Bar-headed goose haemoglobin compared to the curve for the domestic duck haemoglobin. [3]

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(ii) Suggest the benefit of this to the Bar-headed goose when flying at high altitudes. [2]

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(iii) The mean total blood volume for an adult Bar-headed goose is 5×10^5 mm^3. The mean total number of red blood cells in an adult Bar-headed goose is 1.46×10^{12}. Calculate the density (number per mm^3 blood) of red blood cells within an adult Bar-headed goose. **Express your answer to two significant figures.** [3]

Density = ... per mm^3 blood

(iv) The red blood cell density of domestic duck blood is 1.4×10^6. Compare the red blood cell density of the domestic duck and the Bar-headed goose. Suggest a reason for this. [2]

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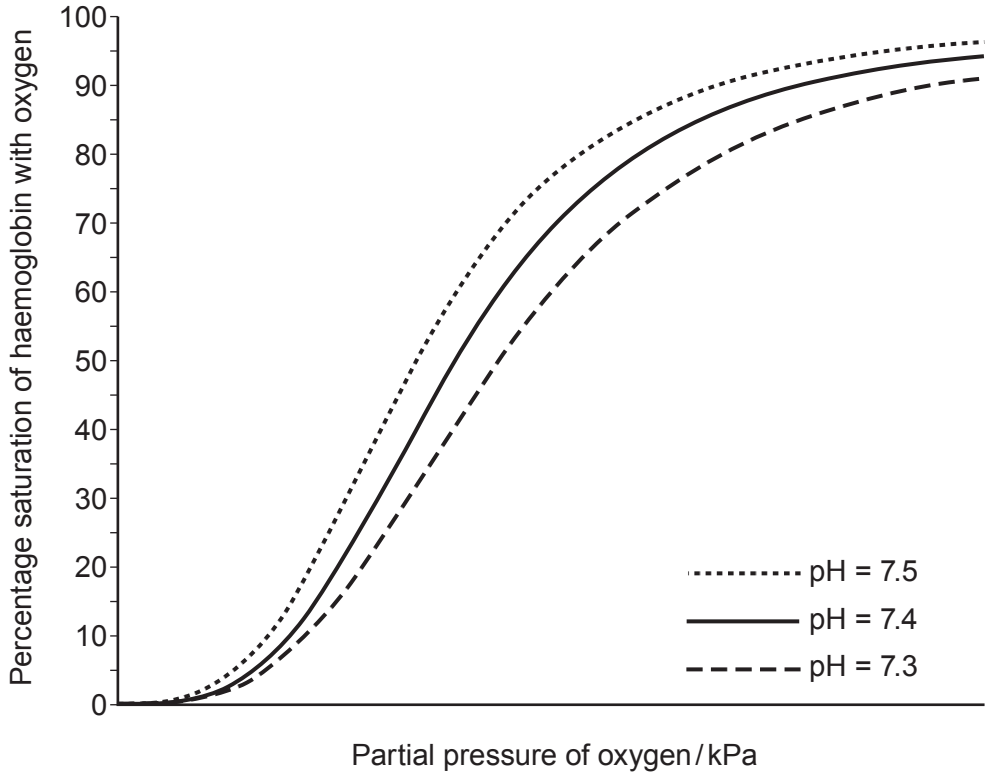
The blood sample from the goose was exposed to different pH levels. The results are shown in **image 4.2**.

Image 4.2



(b) (i) Describe the effect of changing the pH from 7.5 to 7.3 on the percentage saturation of haemoglobin with oxygen. [2]

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(ii) State the name of the effect of pH on haemoglobin saturation. Using your own knowledge, suggest how the change in pH of the goose's blood has caused this effect. [4]

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(c) For a goose to fly, it requires a lot of energy some of which is gained from the digestion of lipids. The digestive system of a goose is similar to that of a human.
State the main site of lipase secretion and name the products of lipid digestion in the goose. [2]

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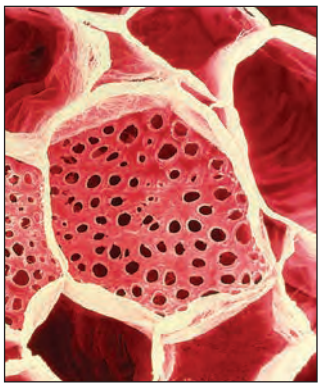
5. **Images 5.1A** and **5.1B** show sections of the vascular tissues of a plant.

Image 5.1A



A

Image 5.1B

B

(a) (i) Complete **table 5.2** by identifying the type of tissue shown in each image and name a structure visible in each image to justify your answer. [2]

Table 5.2

	Image 5.1A	**Image 5.1B**
Tissue	.....	.....
Visible structure	.....	.....

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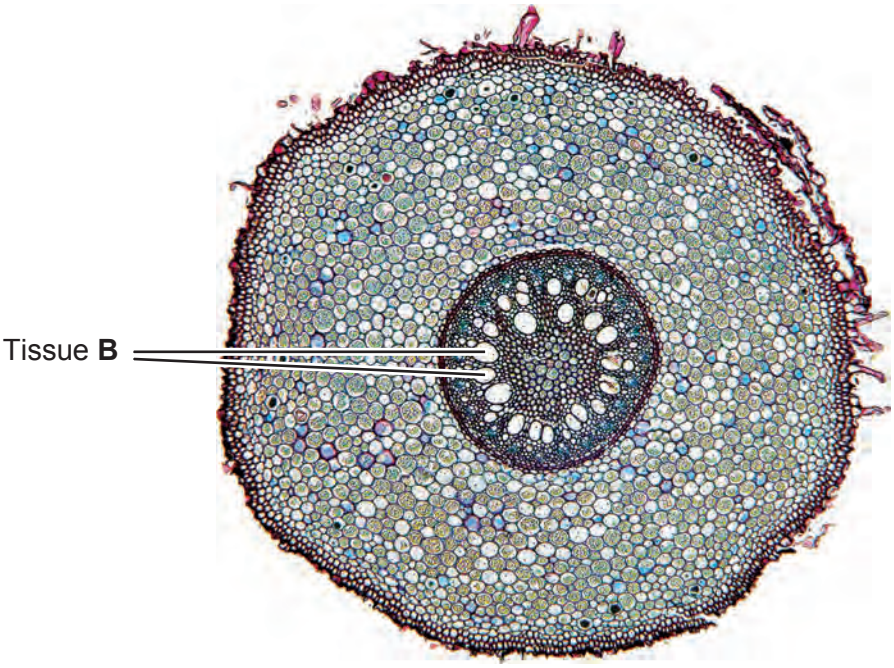
Water is absorbed by the roots and transported in the root and stem. **Image 5.3** shows detail of the vascular tissue within the root of *Ranunculus*.

Image 5.3



(ii) Mineral ions in the soil are absorbed by root hair cells and transported to the vascular tissue of the root. Explain the movement of mineral ions from the soil into tissue **B**. [4]

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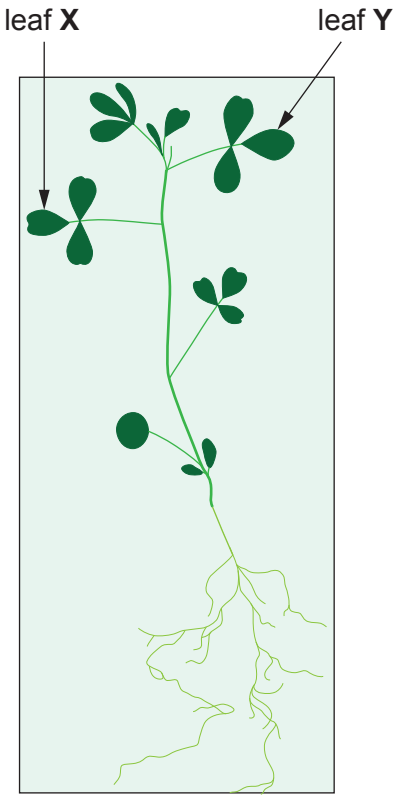
(b) Plants like alfalfa, use light energy to make carbohydrates such as sucrose, which it then transports around the plant. Ascorbic acid (AsA) is a natural carbohydrate found in plants. AsA can be taken in by leaf cells when applied to the surface.

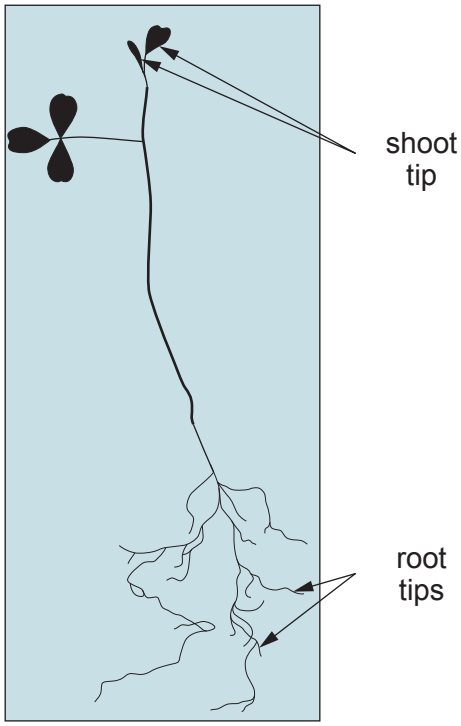
Radiolabelled ascorbic acid, ^{14}C-AsA, was applied to leaf **X** of an alfalfa plant as shown in **image 5.4A**. Autoradiography was carried out to identify where ^{14}C-AsA was located after 12 hours. The results are shown in **image 5.4B**.

Image 5.4A



Alfalfa plant

Image 5.4B



Autoradiograph of Alfalfa plant

(i) State the process by which carbohydrates are transported through a plant. [1]

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(ii) ^{14}C-AsA was found in the root tips and shoot tips of the plant, but not in mature leaf **Y**. Explain these results. [3]

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Table 5.5 shows the levels of ^{14}C-AsA at different locations in the plant over 12 hours.

Table 5.5

Time / hr	Concentration of ^{14}C-AsA / mmol dm^3		
	Leaf	Shoot tip	Root tip
6	24	26	28
12	20	27	25

(iii) Describe the change in ^{14}C-AsA concentrations between 6 and 12 hours at the root tip. Suggest a reason for the concentrations of ^{14}C-AsA at 12 hours. [2]

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(iv) State **two** factors that would need to be controlled to ensure confidence in the results. [1]

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(c) The experiment was only carried out once for 12 hours. State how this would affect the reliability of the data. Explain your answer. [1]

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(d) Suggest how the experiment could be modified to investigate the **rate** of transport of AsA through the plant. [2]

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6. Using the information in **Image 6.1** and your knowledge of gas exchange in organisms, explain how *Paramecium caudatum* is adapted for gas exchange. Explain the adaptations shown by *Pseudoceros ferrugineus* and *Eisenia fetida* which have allowed their evolution into larger multicellular organisms. [9 QER]

Image 6.1

Organism	Features
Paramecium caudatum 	• Protoctista • single celled • 0.25 mm length • aquatic environment
Pseudoceros ferrugineus 	• Flatworm • multicellular • 18–48 mm length • thin • aquatic environment
Eisenia fetida 	• Annelid • multicellular • 80 mm length • terrestrial environment • contains haemoglobin • folded body surface

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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