1 **(a)** The reactions of chemical digestion are catalysed by enzymes.

Fig. 1.1 shows the stages of an enzyme-catalysed reaction.

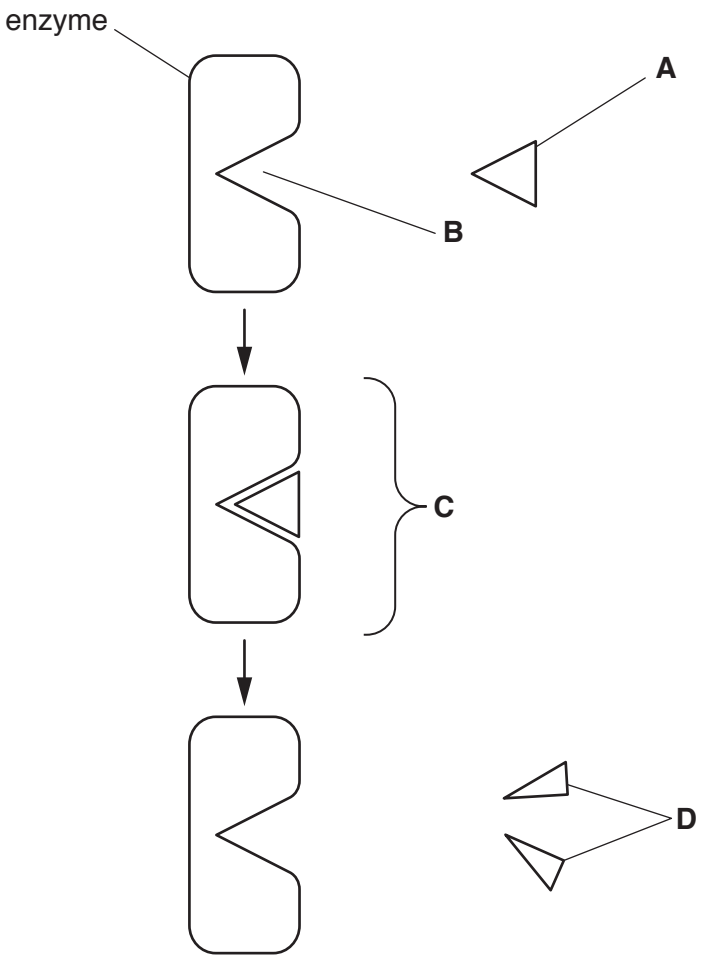

Fig. 1.1

State the names of **A** to **D** in Fig. 1.1.

A .....

B .....

C .....

D .....

[4]

(b) Explain the importance of chemical digestion.

.....

.....

.....

.....

.....

.....[2]

(c) Fig. 1.2 shows the human alimentary canal and associated organs.

The functions of some of these parts of the body are given in Table 1.1.

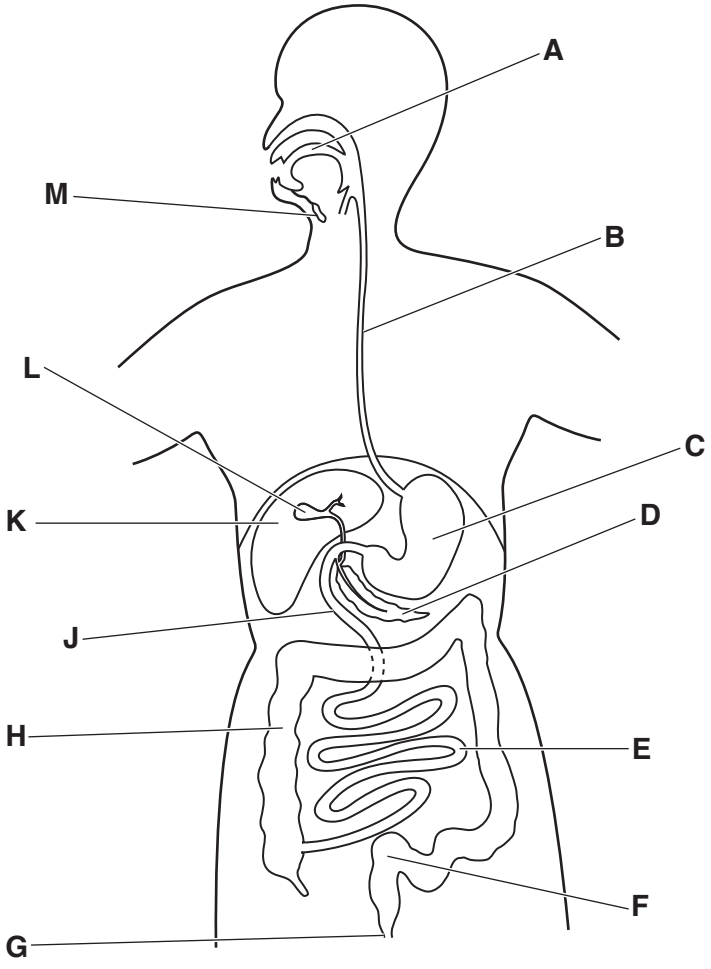

Fig. 1.2

Complete Table 1.1. One row has been done for you.

Table 1.1

function	letter from Fig. 1.2	name of structure
site of starch digestion		
reabsorption of water		
secretion of pepsin		
site of maltose digestion		
secretion of bile		
storage of faeces	**F**	rectum
secretion of lipase and trypsin		

[6]

[Total: 12]

3 A student cut a section of a root and made an outline drawing of the distribution of tissues as shown in Fig. 3.1.

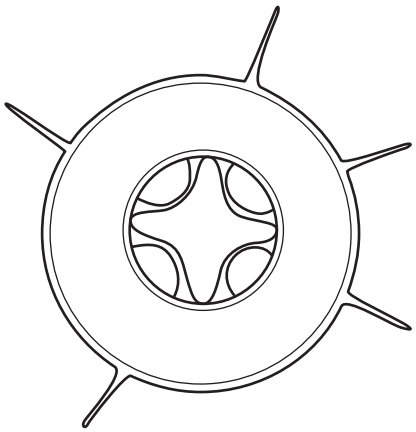

Fig. 3.1

(a) (i) Identify the position of the xylem tissue by drawing a label line and the letter **X** on Fig. 3.1. [1]

(ii) State why xylem is a tissue.

.....

.....

.....

.....[2]

(b) Water absorbed by the roots moves through the stem and enters the leaves. Most of this water is lost in transpiration.

Explain how the internal structure of leaves results in the loss of large quantities of water in transpiration.

.....

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.....

.....

.....

.....

.....[3]

[Total: 6]

5 **(a)** State the balanced chemical equation for aerobic respiration.

.....[2]

(b) Researchers in the Czech Republic investigated oxygen consumption in horses. They measured the oxygen consumption of the horses while they were exercising at four different paces: walking, trotting, cantering and galloping.

The results are shown in Fig. 5.1.

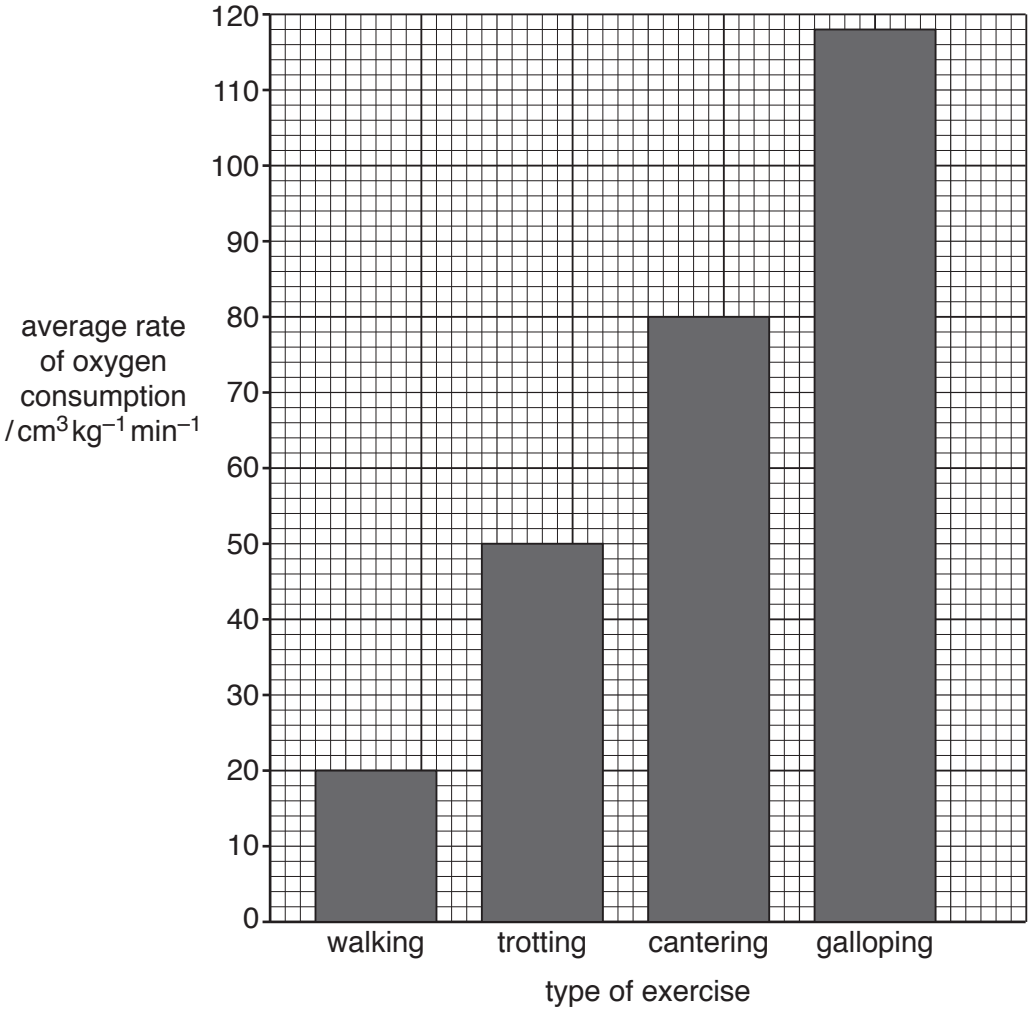

Fig. 5.1

Calculate the percentage increase in the average rate of oxygen consumption as the horses change from walking to trotting.

Show your working.

..... %
[2]

(c) The researchers also calculated the oxygen debt for each type of exercise.

They found that the horses developed a larger oxygen debt when they exercised by galloping and cantering rather than when they walked.

Explain why the horses developed an oxygen debt when they exercised.

.....

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.....[3]

(d) Describe how the horses would recover from an oxygen debt when they stop exercising.

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.....[4]

[Total:11]

1 **(a)** Red pandas, *Ailurus fulgens*, and humans have a similar arrangement of teeth.

Fig. 1.1 shows a section through one tooth of a red panda. Fig. 1.2 shows the side view of the lower jaw of a red panda.

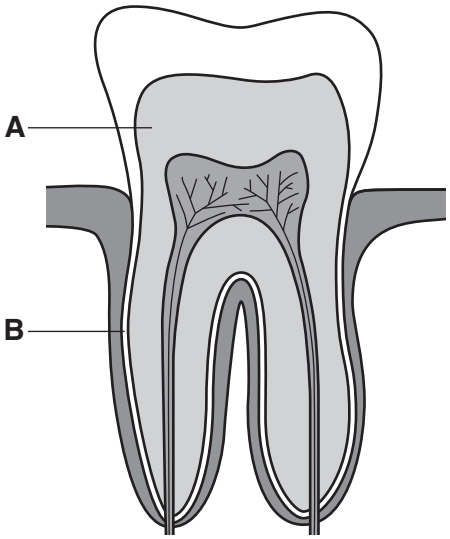

Fig. 1.1

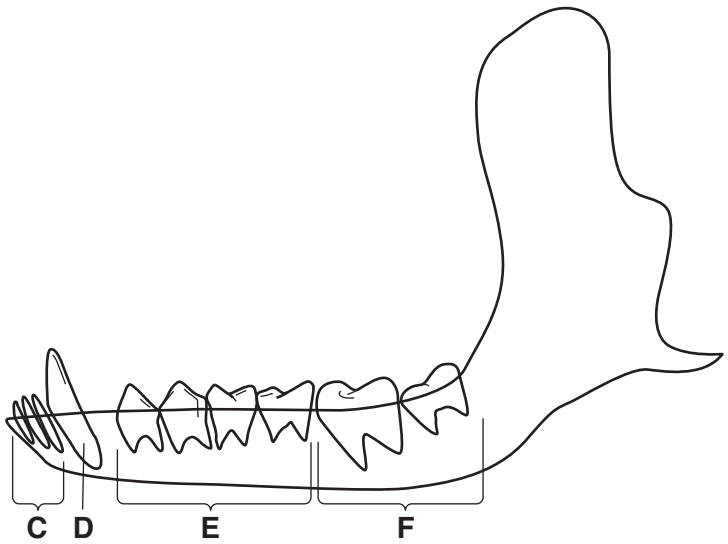

Fig. 1.2

(i) State the names of the structures labelled **A** to **F** in Fig. 1.1 and Fig. 1.2.

A .....

B .....

C .....

D .....

E .....

F .....

[3]

(ii) State the type of digestion that breaks down large pieces of food.

..... [1]

(b) Food that sticks to the teeth can be used by bacteria for anaerobic respiration.

This type of respiration releases a substance that can cause tooth decay.

(i) State the type of substance released by the bacteria, during respiration, that causes tooth decay.

..... [1]

(ii) State the names of the **two** parts of a tooth that are dissolved by the substance released by bacterial respiration.

1 .....

2 .....
[2]

(c) The teeth of red pandas do not decay as much as human teeth.

Suggest the component of a human diet that causes teeth to decay as a result of bacterial respiration.

..... [1]

[Total: 8]

3 Aphids are insects that feed on the phloem sap in plants.

Fig. 3.1 shows a diagram of an aphid with its mouth parts inserted into the stem of a plant.

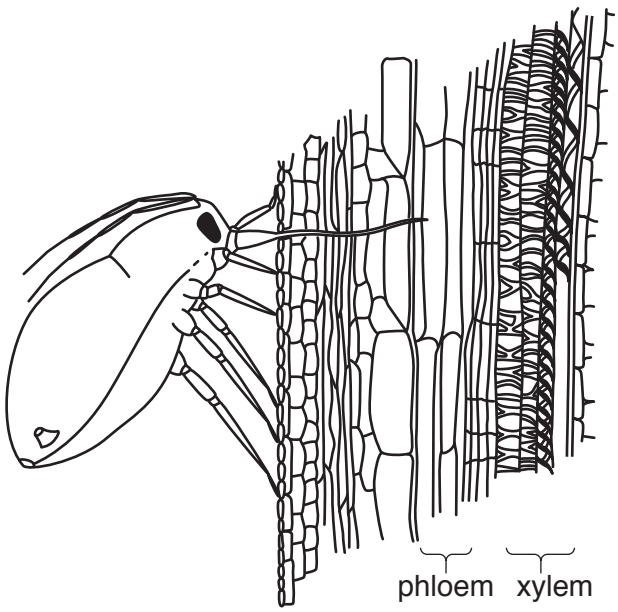

Fig. 3.1

(a) The mouth parts of the aphid reach the phloem tissue of the stem.

(i) State the name of the foods the aphid could suck out of the phloem tissue.

1 .....

2 .....
[2]

(ii) Explain the role of phloem in plant transport. Use the words **source** and **sink** in your answer.

.....

.....

.....

.....

.....

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..... [4]

(b) Fig. 3.1 shows some of the features of xylem.

Describe how xylem is adapted for its functions.

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..... [6]

(c) Some farmers spray their crops with insecticides to kill pests such as aphids.

Explain the benefits of killing pests.

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..... [2]

[Total: 14]

5 Fig. 5.1 shows an adult fly, *Chrysomya megacephala*.

Fig. 5.1

(a) State **three** visible features from Fig. 5.1 that could be used to distinguish adult insects from other arthropods.

1 .....

2 .....

3 .....

[3]

(b) Fly larvae are immature insects that are often used in experiments on respiration.

Give the balanced chemical equation for aerobic respiration.

..... [2]

(c) A respirometer is shown in Fig. 5.2. It can be used to estimate an organism's rate of respiration.

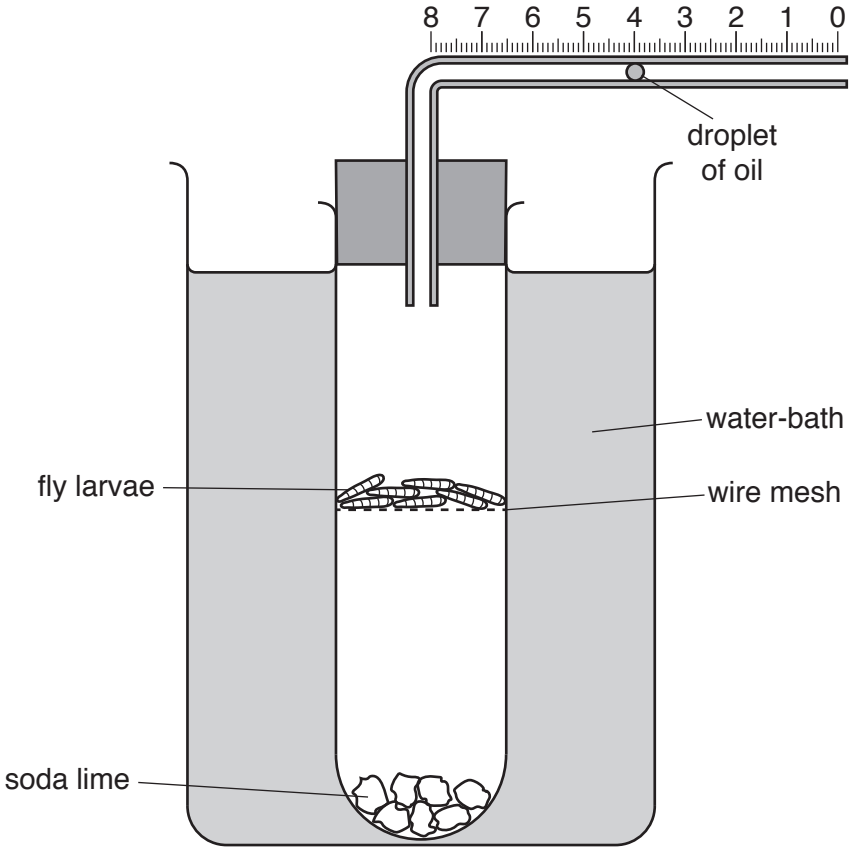

Fig. 5.2

(i) Complete the sentences:

A respirometer can be used to calculate the ..... of oxygen used by the fly larvae by measuring the ..... the droplet of oil moves in one minute. A water-bath is used to ..... the temperature of the apparatus.

[3]

(ii) The soda lime in the respirometer absorbs carbon dioxide.

Explain why this is important in this investigation.

.....

.....

..... [1]

(iii) Fly larvae respire to release energy.

State **two** uses of energy in a fly larva.

1 .....

2 .....

[2]

(d) A student used a respirometer to investigate the effect of temperature on the rate of respiration of germinating seeds.

Predict the results of this investigation and explain your prediction.

prediction .....

.....

.....

explanation .....

.....

.....

.....

.....

.....

[4]

[Total: 15]

1 Two functions of the alimentary canal are mechanical digestion and chemical digestion.

(a) Outline where **and** how mechanical digestion occurs in the alimentary canal.

.....

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.....

.....

.....

.....

.....

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.....[4]

(b) Enzymes catalyse the reactions of chemical digestion. Table 1.1 gives information about chemical digestion in three parts of the alimentary canal.

Complete Table 1.1.

Table 1.1

part of the alimentary canal	enzyme	substrate	product(s)
mouth		starch	
stomach			peptides
		fat	fatty acids and glycerol

[3]

(c) Substances that are absorbed from the alimentary canal may enter cells and become part of the cells.

(i) State the storage carbohydrate made from glucose in liver cells.

.....[1]

(ii) State the type of protein used in the immune system that is produced from amino acids by lymphocytes.

.....[1]

(iii) Fat is produced from fatty acids and glycerol by cells in the fatty tissue beneath the skin.

State **one** function of this layer of fat.

.....[1]

[Total: 10]

3 Fig. 3.1 is a scanning electron micrograph of a vertical section through part of the leaf of a broad bean plant, *Vicia faba*.

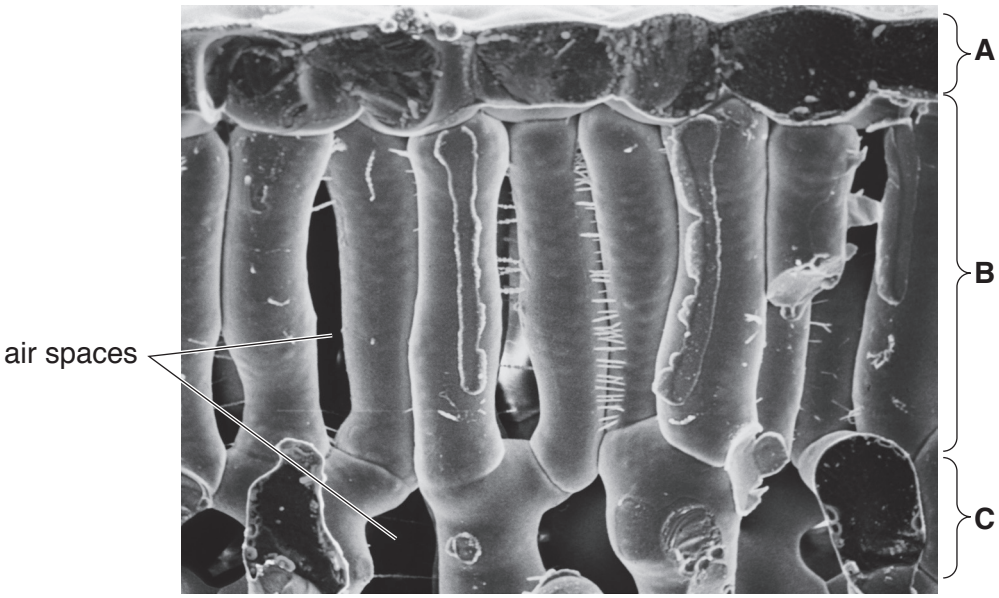

Fig. 3.1

(a) (i) State the names of the tissues labelled **A** and **B**.

A .....

B .....
[2]

(ii) The cells in regions **B** and **C** in Fig. 3.1 have a large surface area.

Explain why this is necessary for the functioning of the leaf cells.

.....

.....

.....

.....

.....

.....[3]

(iii) Explain why there are many interconnecting air spaces within the leaf.

.....

.....

.....

.....[2]

(b) When water is in short supply, plants can wilt as shown in Fig. 3.2.

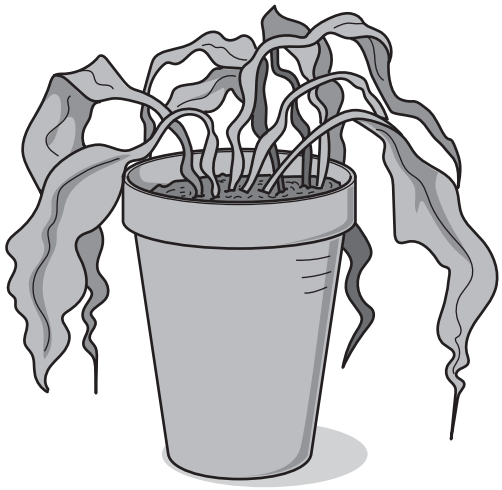

Fig. 3.2

(i) State **two** conditions that are likely to increase the chances of wilting.

1 .....

2 .....
[2]

(ii) Explain what happens to the cells of a leaf to cause wilting.

.....

.....

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.....

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.....[4]

(iii) Wilting may look harmful, but it is often a strategy for survival.

Suggest the advantages to a plant of wilting.

.....

.....

.....

.....

.....

.....[2]

[Total: 15]

5 **(a)** State the balanced chemical equation for aerobic respiration.

.....[2]

(b) Students investigated the rate of respiration of crickets (a type of insect) using a carbon dioxide sensor and laptop as shown in Fig. 5.1. The sensor was fitted inside an airtight glass jar. The apparatus was set up in a room with a constant temperature of 17 °C.

Fig. 5.1

The students found that the concentration of carbon dioxide inside the jar increased by 50 ppm in 120 seconds.

Calculate the rate of carbon dioxide production as ppm per second.

Show your working and express your answer to two significant figures.

..... ppm s^{-1} [1]

(c) After 10 minutes, the students opened the jar by removing the sensor. They left the jar open for 5 minutes but made sure that the crickets remained in the jar. They then replaced the sensor and took more readings for another 10 minutes.

State **and** explain one reason for opening the jar after 10 minutes.

.....

.....

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.....

.....[2]

(d) During the investigation the temperature inside the jar increased. The temperature outside the jar remained constant.

Explain why the temperature inside the jar increased.

.....

.....

.....

.....

.....[2]

(e) Researchers in Chile also investigated the rate of respiration in crickets.

They investigated the effect of temperature and body mass on the rate of respiration. They measured the rate of oxygen consumption in crickets with different body masses, at different temperatures.

The researchers' results are shown in Fig. 5.2.

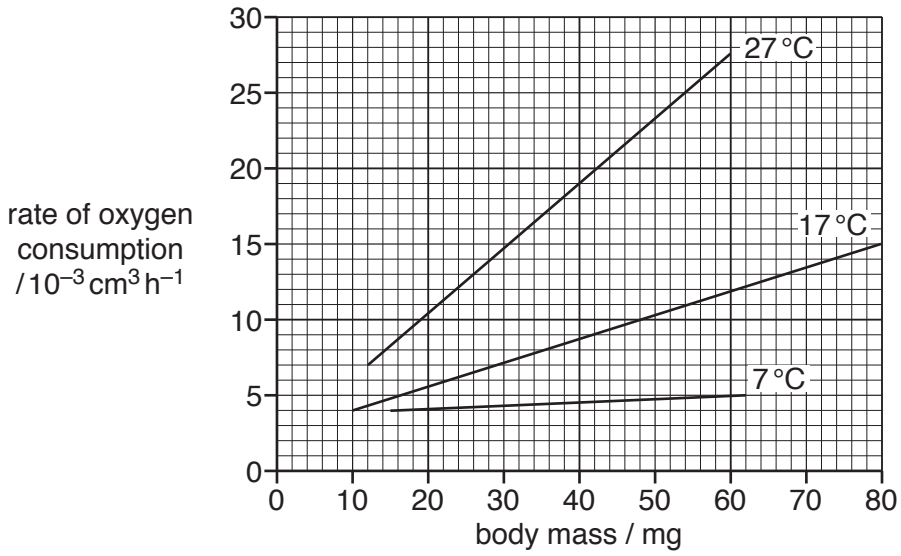

Fig. 5.2

State **two** conclusions that can be made from the data in Fig. 5.2 **and** support each conclusion with evidence from the graph.

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.....[4]

[Total:11]

3 Fig. 3.1 shows a photomicrograph of a section of a root.

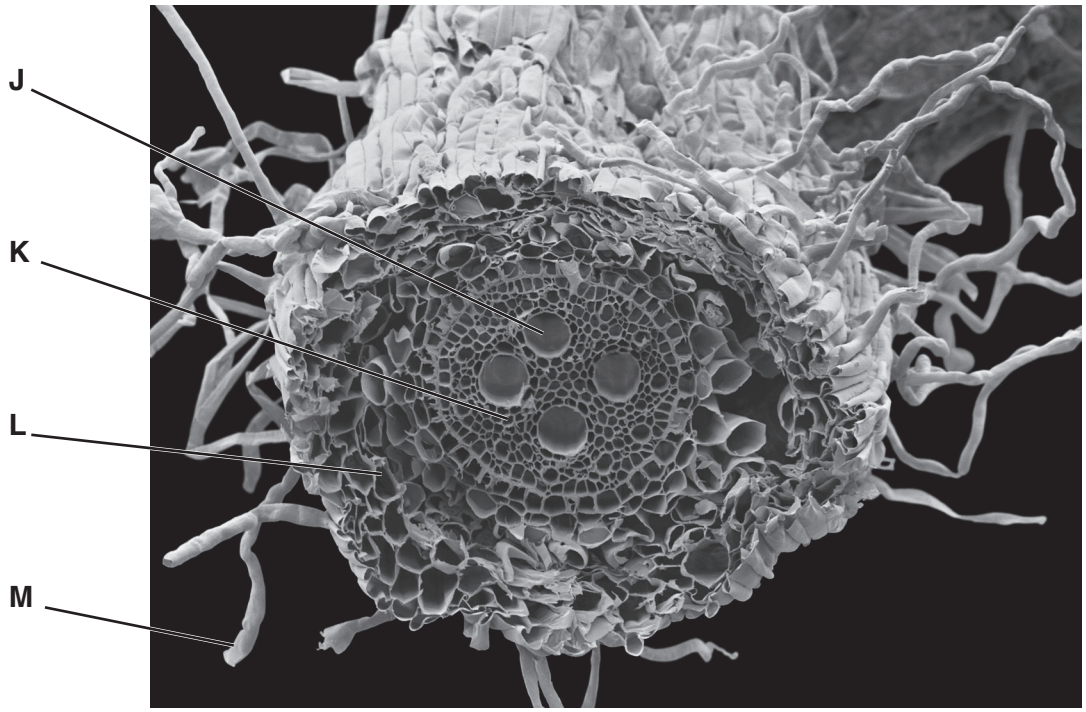

Fig. 3.1

(a) Structure **J** is a xylem vessel.

The xylem vessels conduct water from the roots to the stems.

State the features of xylem vessels that enable them to conduct water.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Describe the pathway of water from outside the root to the xylem vessels (**J**) at the centre of the root. Use the letters in Fig. 3.1 in your answer.

.....

.....

.....

.....

.....

.....

.....

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.....[5]

(c) Scientists wanted to determine the flow-rate of water in roots.

They measured the flow-rate in three zones of onion roots as shown in Fig. 3.2.

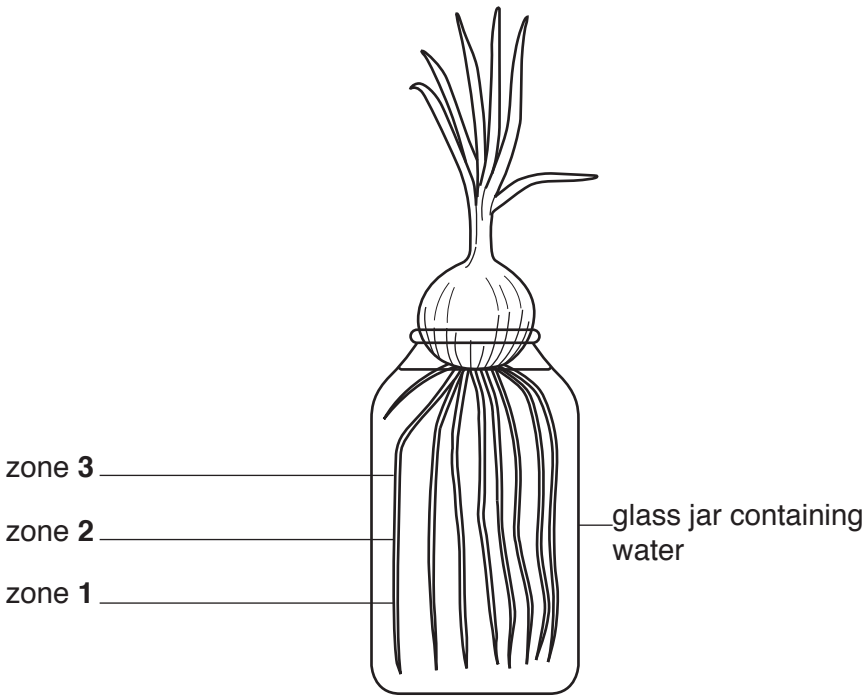

Fig. 3.2

They measured the flow-rate in healthy roots and roots that had been treated with a toxic solution.

Their results are shown in Table 3.1.

Table 3.1

zone in Fig. 3.2	average flow-rate of water / arbitrary units	
	healthy roots	treated roots
1	150	160
2	230	200
3	280	270

(i) Calculate the percentage increase in the average flow-rate between zone **1** and **3** for healthy roots.

Give your answer to **two** significant figures.

Show your working.

..... %
[2]

(ii) The scientists observed that the xylem vessels nearer the root tip were narrower than the xylem vessels higher up the root.

Describe how the width of xylem vessels in different zones of a root affects the average flow-rate of water. Use the information in Table 3.1 in your answer.

.....

.....

.....

.....

.....

.....

.....[3]

(iii) Suggest why there was little difference in the flow-rate in healthy roots and in roots treated with the toxic solution.

.....

.....

.....

.....

.....[2]

[Total: 15]

(b) The digestive systems of young mammals are not fully developed.

Enzymes such as amylase, maltase and protease are often added to baby food to aid chemical digestion.

(i) Complete Table 6.1 by stating the substrate and product(s) for each enzyme reaction.

Table 6.1

enzyme	substrate	product(s)
amylase		
maltase		
protease		

[3]

(ii) Suggest why the temperature of baby food must be controlled when the enzymes are added.

.....

.....

.....[2]

(iii) State **one** other condition that must also be controlled to optimise enzyme activity.

.....[1]

[Total: 11]

3 **(a)** Fig. 3.1 is a photomicrograph of some xylem vessels.

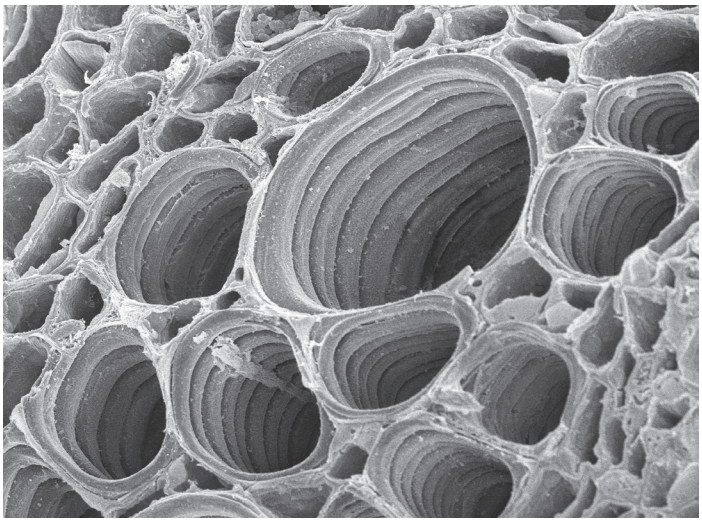

Fig. 3.1

(i) State **one** structural feature of xylem vessels and explain how this is related to the function of water transport.

feature .....

.....

explanation .....

.....

.....

.....

[2]

(ii) Explain the mechanism that is responsible for the movement of water in xylem vessels.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(iii) State **one** role of xylem vessels **other than** transport.

..... [1]

(b) The rate of transpiration is affected by several factors including the temperature and the humidity of the air.

State **and** explain the effect of an increase in temperature on the rate of transpiration.

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..... [3]

[Total: 10]

5 Fig. 5.1 shows a photomicrograph of human blood.

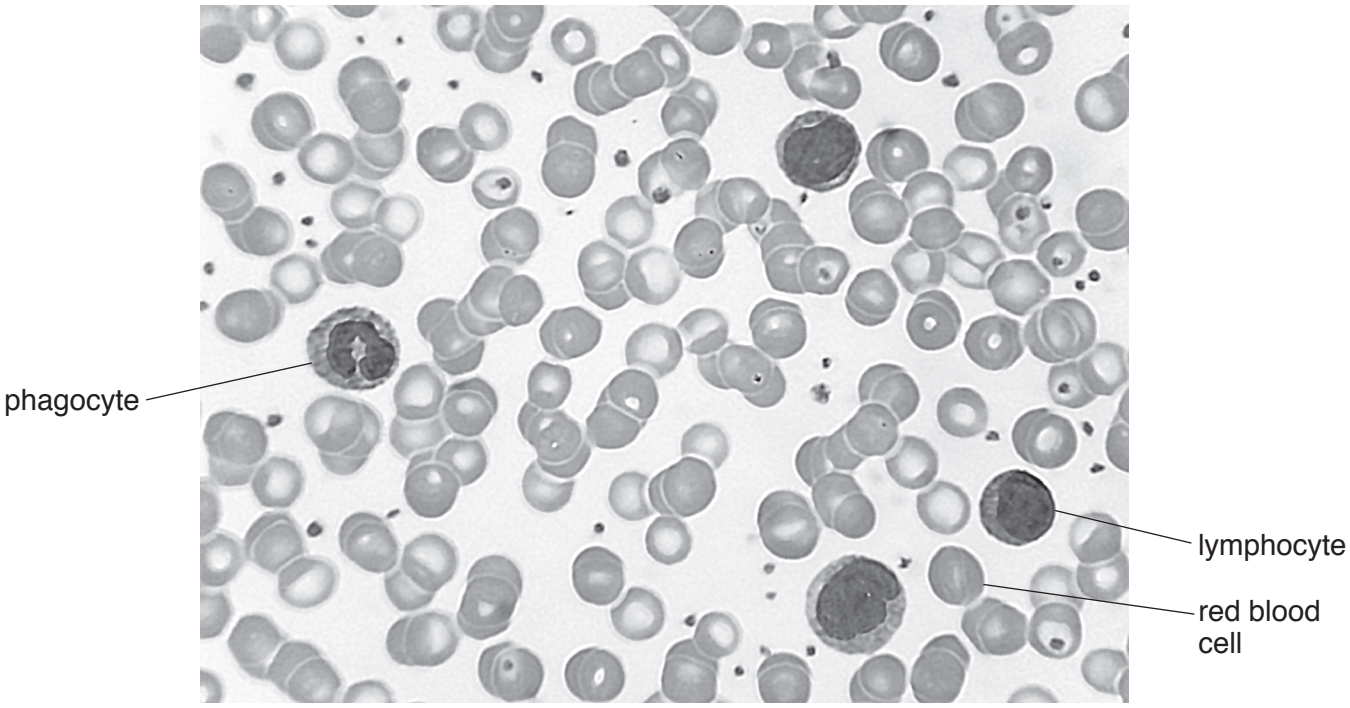

Fig. 5.1

(a) Describe the differences in appearance and the roles of the **three** cells labelled in Fig. 5.1.

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.....

.....

..... [6]

(b) Fig. 5.2 shows some of the stages of blood clotting.

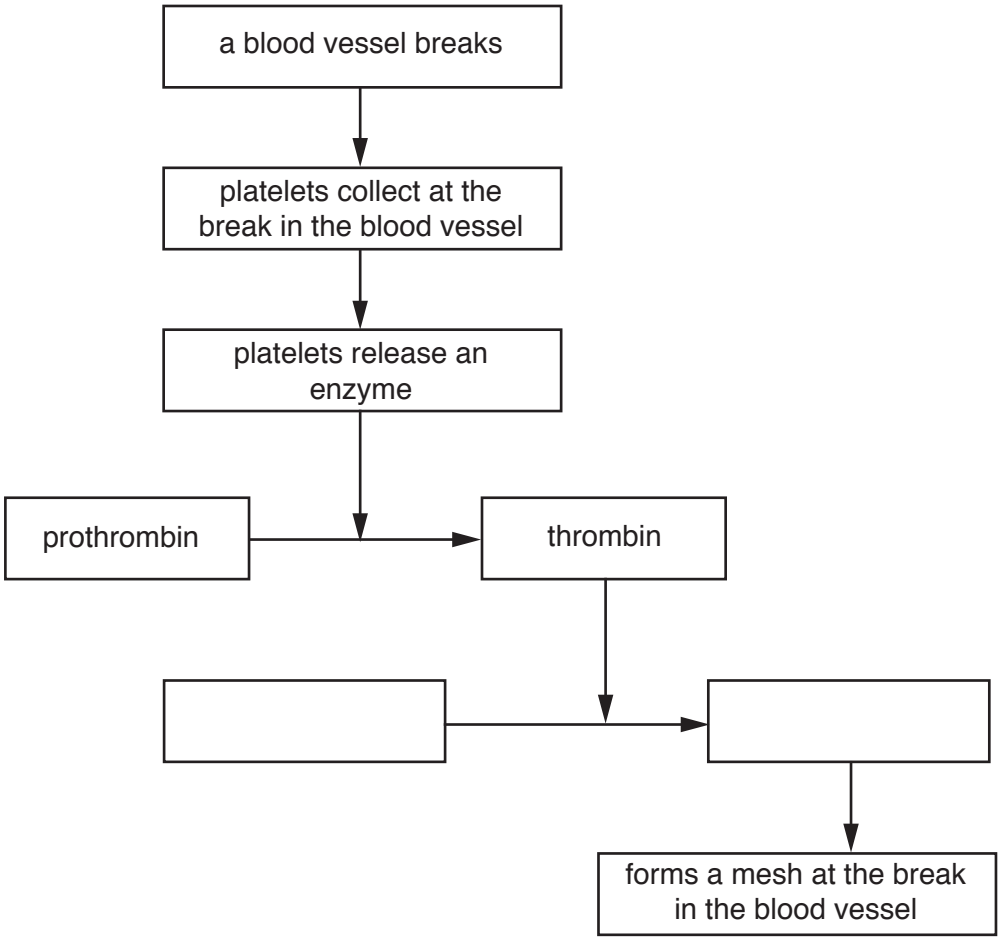

Fig. 5.2

(i) Complete Fig. 5.2 by filling in the **two** empty boxes. [1]

(ii) State **two** roles of blood clotting.

.....

.....

.....

.....

..... [2]

6 Fig. 6.1 shows the Galapagos iguana, *Amblyrhynchus cristatus*.

Fig. 6.1

(a) (i) State **two** features that are used to classify animals, such as the Galapagos iguana, as reptiles.

1 .....

2 .....
[2]

(ii) State **two** features that are present in plant cells that are **not** present in the cells of reptiles.

1 .....

2 .....
[2]

(b) Galapagos iguanas feed on seaweed which contains starch and other carbohydrates.

(i) State the name of the enzyme that digests starch.

..... [1]

(ii) State the names of **two** parts of the alimentary canal where starch is digested.

1 .....

2 .....
[2]

3 **(a)** Fig. 3.1 is a photomicrograph of part of the upper surface of a broad bean leaf, *Vicia faba*.

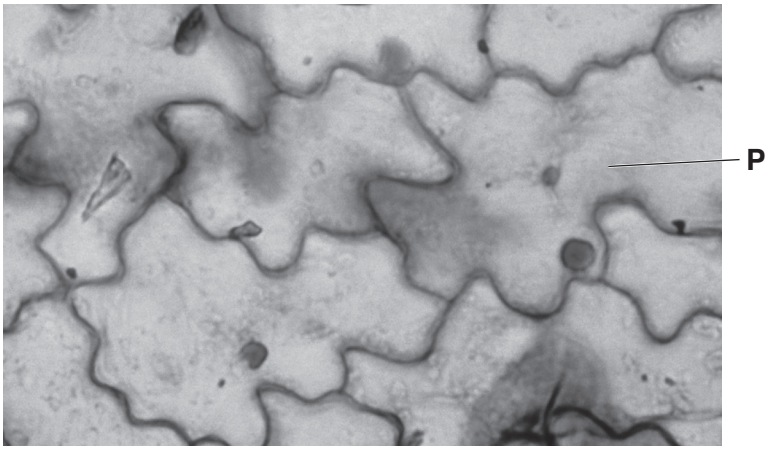

Fig. 3.1

(i) On Fig. 3.1, identify and label **two** structures that are visible in cell **P**. [2]

(ii) State the name of the tissue shown in Fig. 3.1.

.....[1]

(iii) The tissue shown in Fig. 3.1 is transparent.

Explain why it is important to the plant that the tissue shown in Fig. 3.1 is transparent.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Stomata are found on the lower surface of broad bean leaves.

Describe the function of stomata.

.....

.....

.....

.....

.....

.....

.....[3]

(c) More than 40 years ago, botanists studied the leaves of broad bean plants and discovered that guard cells control the opening and closing of stomata. They found that stomata were open when the guard cells were turgid.

Table 3.1 shows some of their measurements.

Table 3.1

	closed stomata	open stomata
ion concentration in guard cells / pmol	0.3	2.5
guard cell volume / μm^3	4000.0	6500.0
turgor pressure in the guard cells / MPa	2.0	4.8
width of stomatal opening / μm	0.0	8.0

(i) Ions move into guard cells by active transport.

Describe how the ions move into the guard cells.

.....

.....

.....[2]

(ii) Describe **and** explain how the change in ion concentration causes the guard cell volume to change. Use the information in Table 3.1 in your answer.

.....

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.....[5]

(iii) The botanists left the broad bean plants unattended for three days. During this time the broad bean plants wilted.

Suggest **two** environmental factors that can cause plants to wilt.

1 .....

2 .....
[2]

[Total: 18]

6 Fig. 6.1 is a diagram showing some body cells and parts of the human lymphatic and circulatory systems.

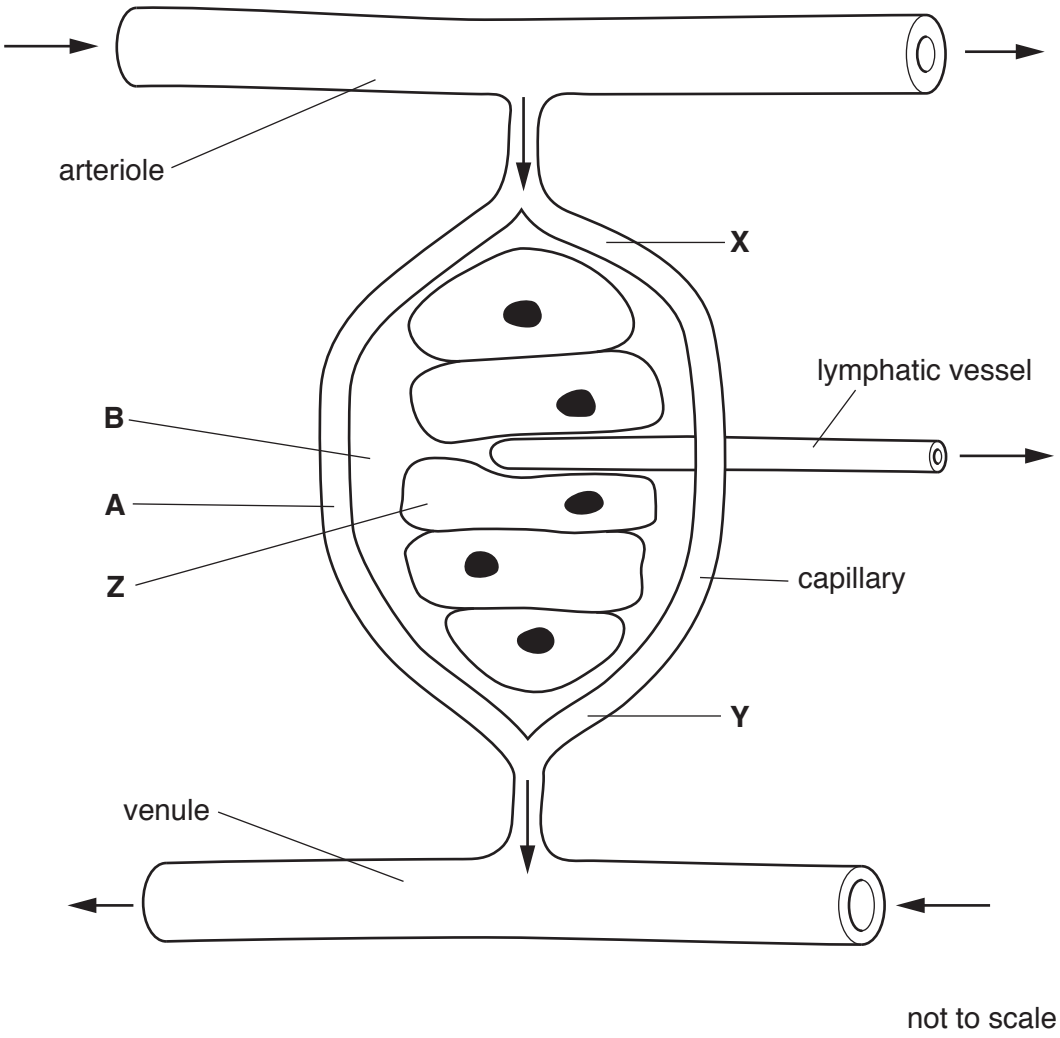

Fig. 6.1

(a) Capillaries allow blood to reach most cells in the body.

(i) State the name of the process by which oxygen moves from **A** to **Z** as shown in Fig. 6.1.

.....[1]

(ii) Describe how some of the liquid in **A** moves to **B** in Fig. 6.1.

.....

.....

.....[2]

(iii) State **one** component of blood that remains inside the capillaries as the blood flows from **X** to **Y** in Fig. 6.1.

.....[1]

(b) Lymphatic vessels are similar in structure to veins.

(i) Describe the structure of veins.

.....

.....

.....

.....

.....[2]

(ii) Describe the role of the lymphatic vessel shown in Fig. 6.1.

.....

.....

.....

.....

.....[2]

(c) Lacteals are another part of the lymphatic system.

State where in the body lacteals are found and state their function.

location in the body .....

function .....

.....

[2]

(d) In the lymphatic system, there are structures that contain large numbers of lymphocytes.

(i) State the name of these structures.

.....[1]

(ii) State the role of lymphocytes.

.....

.....

.....[2]

[Total: 13]

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2 The rate of photosynthesis of terrestrial plants can be determined by measuring the uptake of carbon dioxide.

(a) Explain why plants take up carbon dioxide during photosynthesis.

.....

.....

.....

.....

..... [2]

(b) The rate of photosynthesis of parts of individual leaves can be measured using a hand-held device as shown in Fig. 2.1.

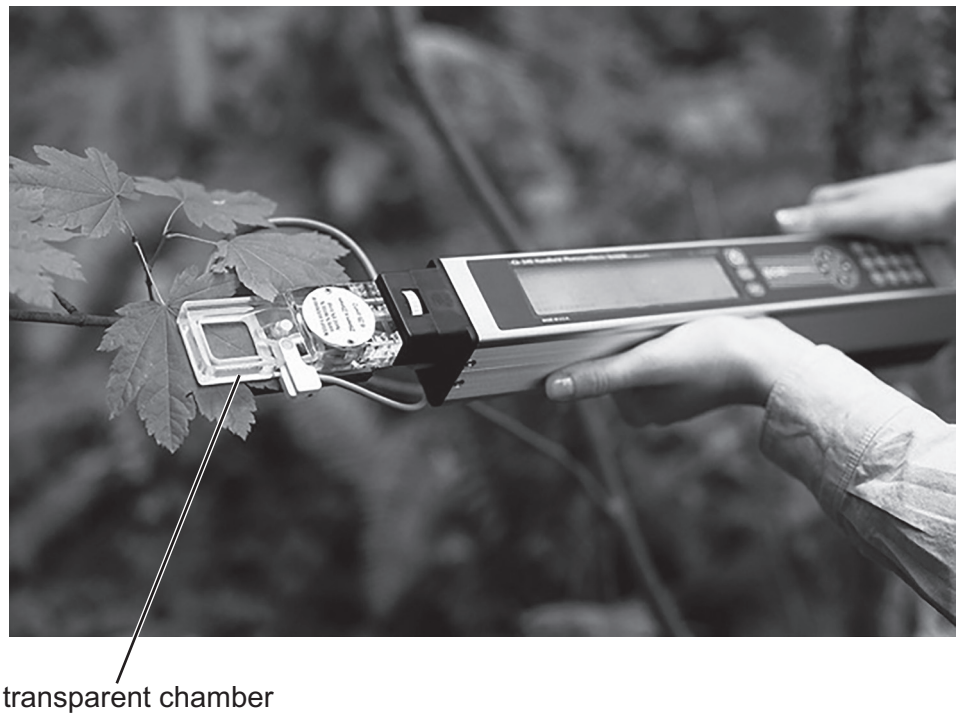

Fig. 2.1

This apparatus allows air to flow through the transparent chamber that encloses part of the leaf. The apparatus measures the carbon dioxide concentration of the air entering and leaving the chamber.

Explain how the results from the apparatus can be used to calculate the rate of photosynthesis.

.....

.....

.....

..... [2]

(c) A student used the apparatus shown in Fig. 2.1 to investigate the effect of temperature on the rate of photosynthesis of the leaves of Chinese plantain, *Plantago asiatica*, at two different concentrations of carbon dioxide, **A** and **B**.

Fig. 2.2 shows the results of the investigation.

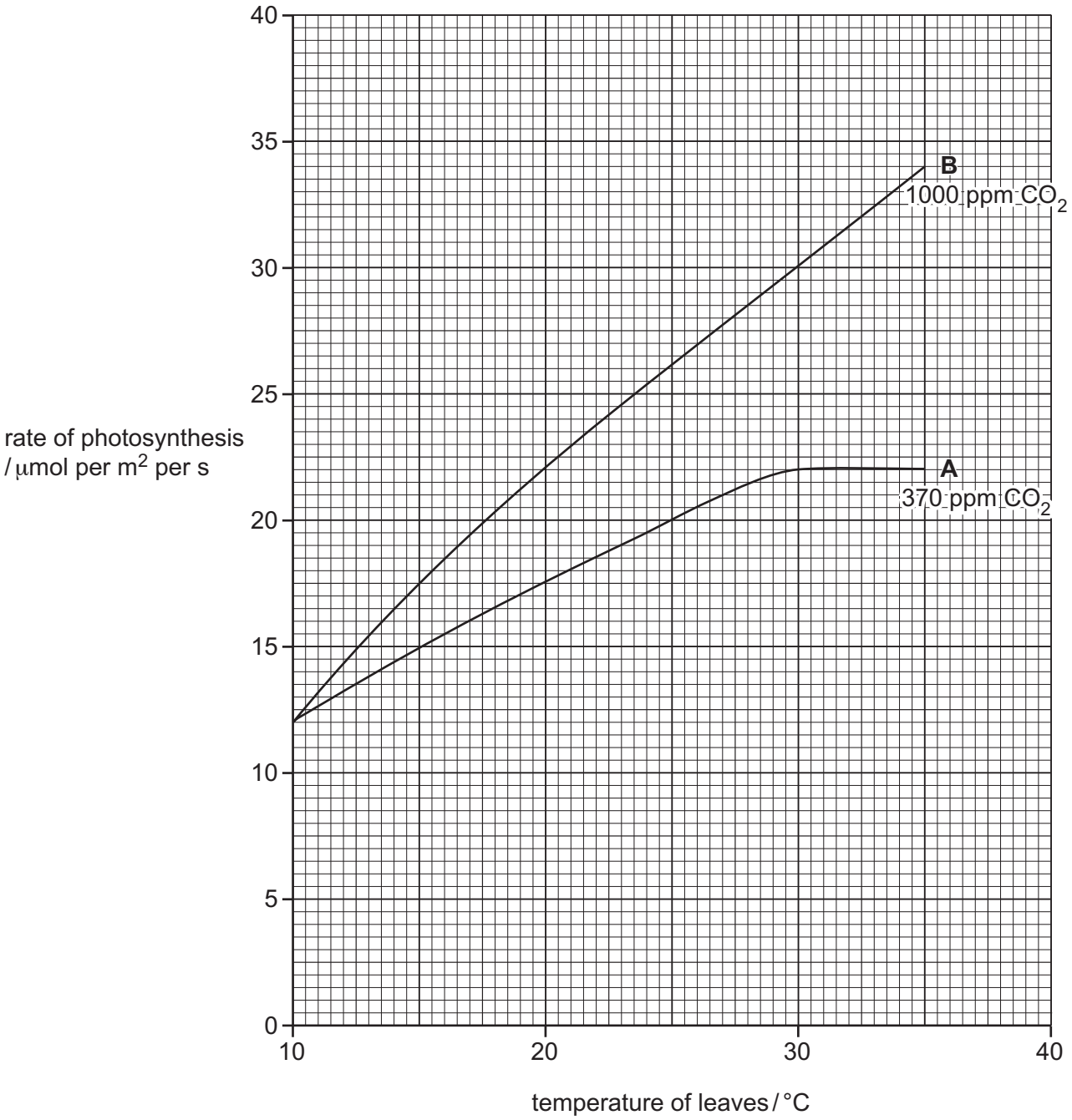

Fig. 2.2

(i) State **one** environmental factor that should have been kept constant in this investigation.

..... [1]

(ii) Describe the effect of temperature on the rate of photosynthesis when carbon dioxide concentration **A** was supplied.

Use the data from Fig. 2.2 in your answer.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Calculate the percentage increase in the rate of photosynthesis at 30 °C when the carbon dioxide concentration was increased from **A** to **B** as shown in Fig. 2.2.

Show your working and give your answer to the nearest whole number.

..... %
[2]

(iv) Explain the effect of increasing temperature on the rate of photosynthesis for carbon dioxide concentration **B**.

Use the term *limiting factor* in your answer.

.....

.....

.....

.....

.....

.....

..... [3]

(v) The student concluded that carbon dioxide concentration is the factor limiting the rate of photosynthesis between 30 °C and 35 °C for the results shown for **A** in Fig. 2.2.

State the evidence for this conclusion.

.....

.....

..... [1]

(d) A similar investigation was carried out on Arizona honeysweet, *Tidestromia oblongifolia*, that grows in Death Valley in California where the highest temperatures may be greater than 45 °C.

The results are shown in Fig. 2.3.

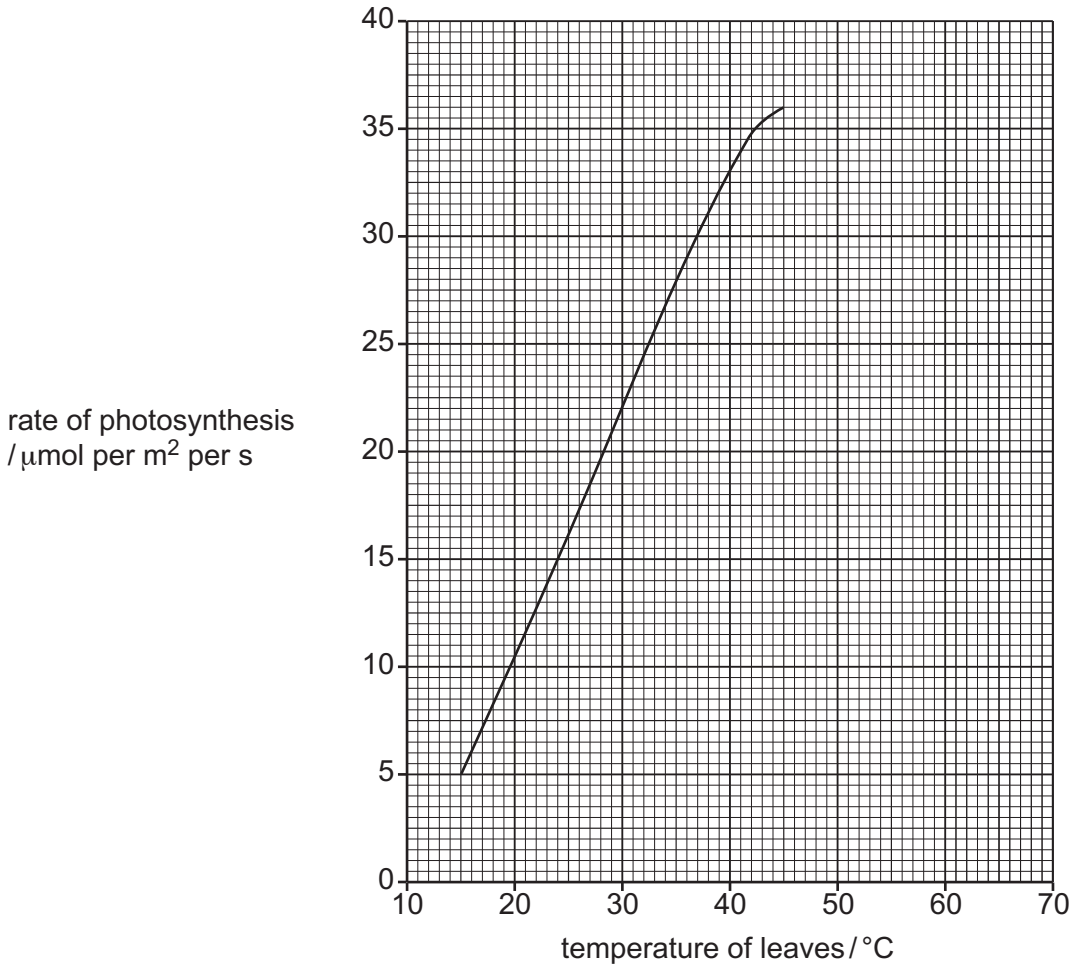

Fig. 2.3

Predict **and** explain what would happen to the rate of photosynthesis if the investigation is continued at temperatures higher than 45 °C.

.....

.....

.....

.....

..... [2]

[Total: 16]

3

(b) Transmission of impulses relies on the flow of ions through the cell membranes of neurones down their concentration gradients. Active transport is responsible for maintaining the concentration gradients of ions across the membranes of neurones.

Explain how ions are moved across membranes by active transport.

.....

.....

.....

.....

.....

.....

..... [3]

4 **(a)** Table 4.1 shows four structures associated with the human male reproductive system.

Complete Table 4.1 by identifying the level of organisation of each structure.

Choose your answers from the list.

cell **cell structure** **organ**

organ system **organism** **tissue**

Table 4.1

structure	level of organisation
epithelium	
nucleus	
sperm	
testis	

[4]

Fig. 4.1

2

(b) Soybean plants, *Glycine max*, were grown in two separate plots.

Each plot used a carbon dioxide enrichment system to control the atmospheric carbon dioxide concentration.

The atmospheric carbon dioxide concentrations in the two plots were kept at:

- 370 ppm, which is similar to the current atmospheric carbon dioxide concentration
- 550 ppm, which is a possible future atmospheric carbon dioxide concentration.

When the soybean plants were fully grown, scientists calculated the average rates of photosynthesis at regular intervals from 04:00 to 22:00 for both plots.

The results are shown in Fig. 2.1.

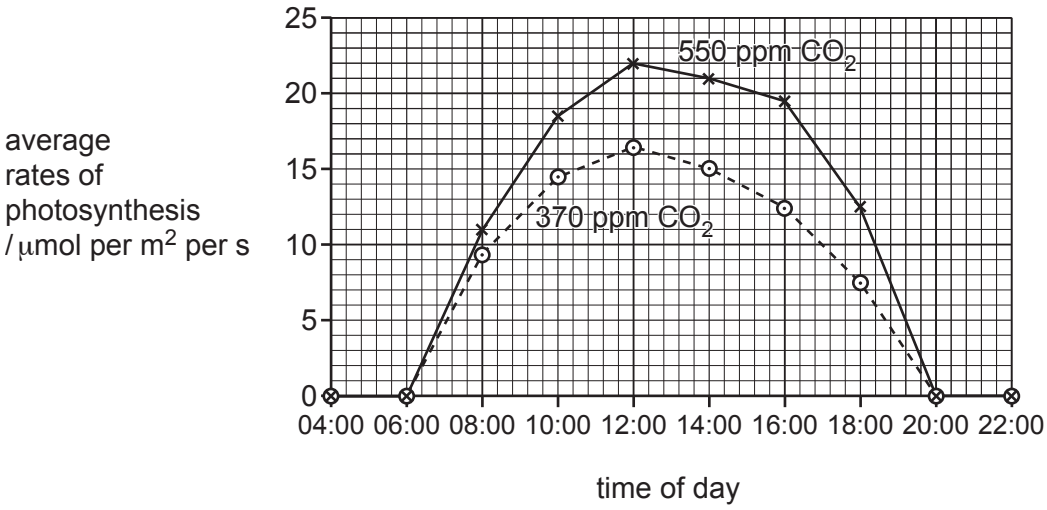

Fig. 2.1

Describe **and** explain the effect of carbon dioxide concentration on the average rates of photosynthesis of the soybean plants from 04:00 to 22:00.

Use the data from Fig. 2.1 in your answer.

.....

.....

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.....

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.....

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.....

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.....

.....

..... [6]

(c) The scientists also made observations of the leaf structure of the soybean plants.

Epidermis and mesophyll tissues are adapted for photosynthesis.

Complete Table 2.1 by stating **two** structural features of each of these tissues **and** explain how each feature is an adaptation for photosynthesis.

Table 2.1

tissue	feature	how the feature is an adaptation for photosynthesis
epidermis	1	....
	2	....
mesophyll	1	....
	2	....

[4]

(d) When the scientists were working in the plot with a carbon dioxide concentration of 550 ppm, their breathing rates were higher than when they worked in the other plot.

Suggest why their breathing rates were higher.

.....

.....

.....

.....

..... [2]

[Total: 15]

1 Bacteria are classified in the Prokaryote kingdom.

(a) State **two** features of animal cells that are **not** found in bacteria.

1 .....

2 .....

[2]

(b) The bacterium *Bacillus megaterium* was grown in the laboratory fermenter shown in Fig. 1.1.

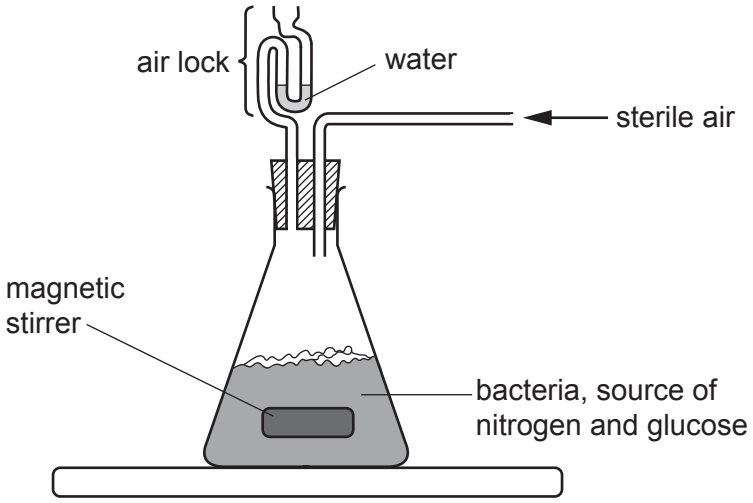


Fig. 1.1

(i) Explain why a source of nitrogen and glucose were added to the fermenter.

nitrogen .....

.....

glucose .....

.....

[2]

(ii) Suggest why it is important to stir the contents of the fermenter continuously.

.....

.....

.....

.....

.....

.....

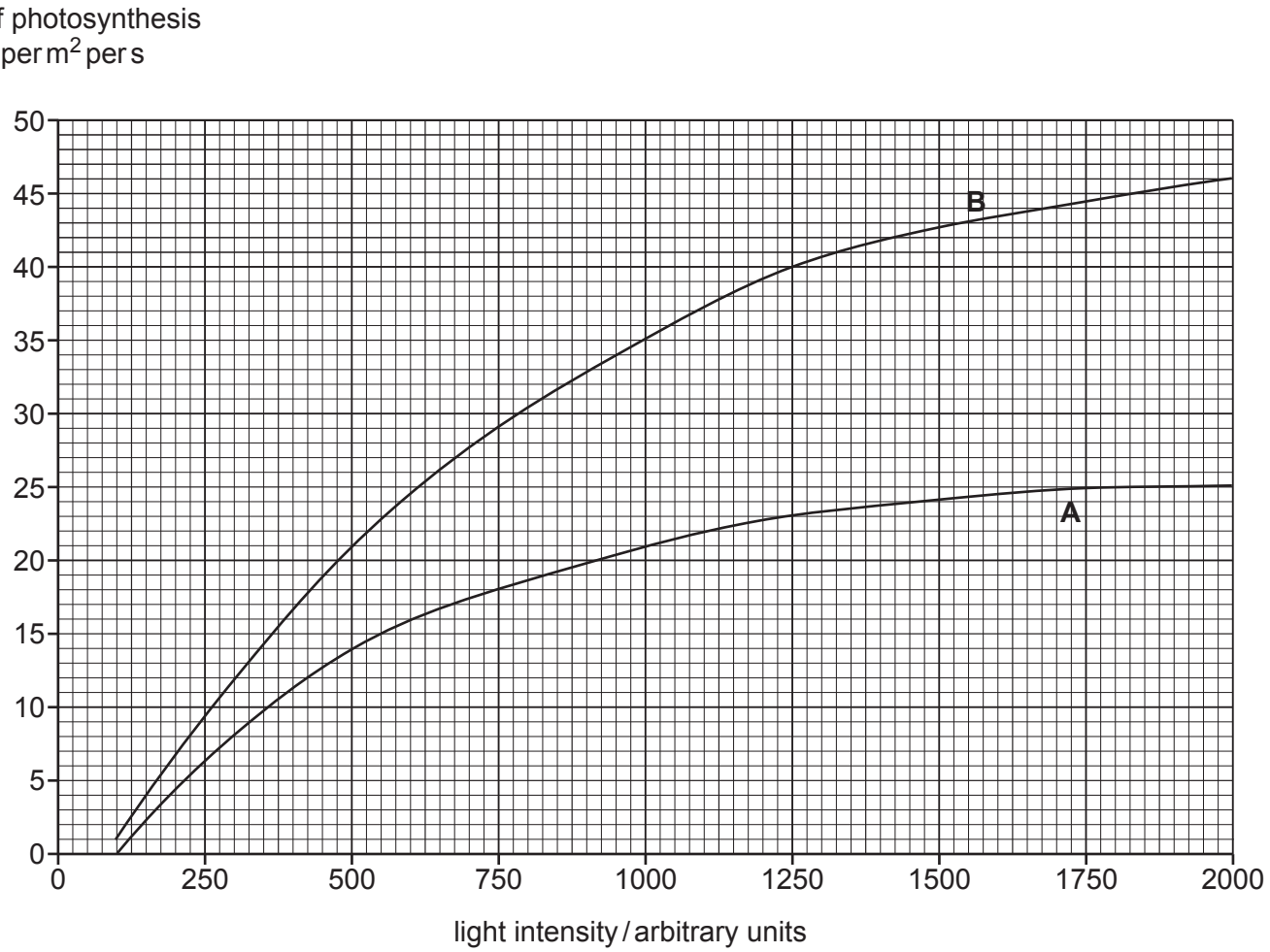
..... [3]

2 **(a)** State the **word** equation for photosynthesis.

..... [2]

(b) Scientists investigated the effect of light intensity on the rate of photosynthesis in the leaves of eucalyptus trees at two different concentrations of carbon dioxide, **A** and **B**.

The results are shown in Fig. 2.1.



Key:

A carbon dioxide concentration 140 ppm

B carbon dioxide concentration 1000 ppm

Fig. 2.1

(i) Suggest **and** explain why the scientists kept the temperature of the leaves at 20 °C while they recorded results.

.....

.....

.....

.....

..... [2]

(ii) Calculate the percentage increase in the rate of photosynthesis at a light intensity of 1250 arbitrary units when the carbon dioxide concentration was increased from 140 ppm to 1000 ppm.

Show your working and give your answer to the nearest whole number.

..... %
[3]

(iii) Describe the effect of increasing light intensity on the rate of photosynthesis when the concentration of carbon dioxide was 140 ppm.

.....

.....

.....

.....

.....

.....

..... [3]

(iv) Explain the effect of increasing light intensity on the rate of photosynthesis when the concentration of carbon dioxide was 1000 ppm.

Use the term *limiting factor* in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 14]

4 Mammals have a double circulation.

(a) State what is meant by the term *double circulation*.

.....

.....

..... [1]

(b) Table 4.1 shows some information about the functions of the components of blood.

Complete Table 4.1.

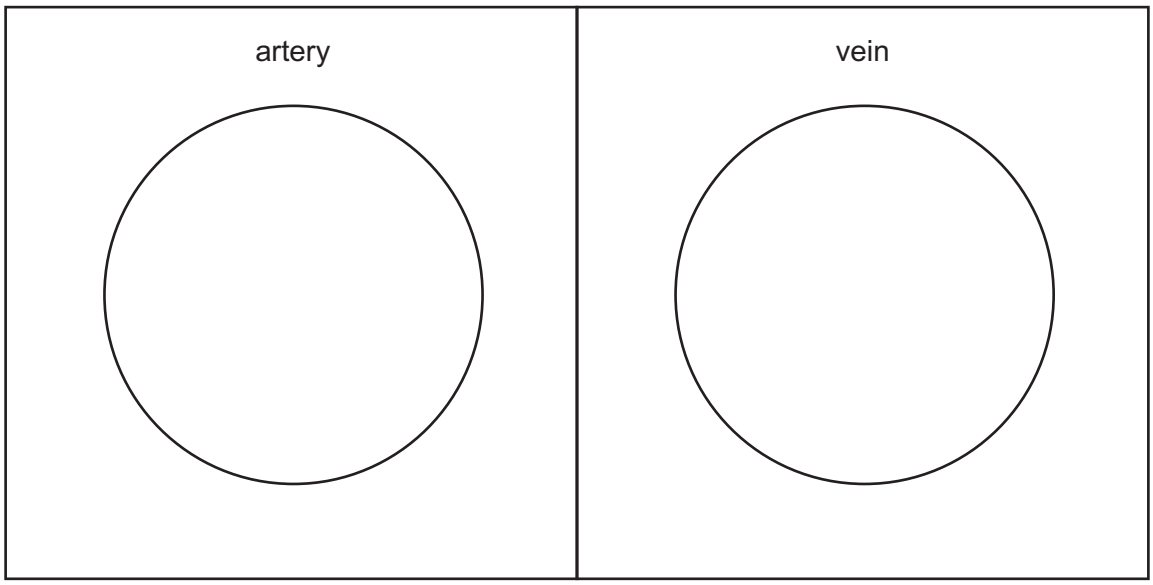
Table 4.1

function	type of cell
production of antibodies	
	phagocyte
promotes blood clotting	
transports oxygen	

[4]

(c) Blood is transported in arteries and veins.

Complete the drawings of the cross-sections of an artery and a vein to show the differences between these two types of blood vessel. Label the lumen in each drawing.



[2]

(d) A diagram of a mammalian heart and associated blood vessels is shown in Fig. 4.1.

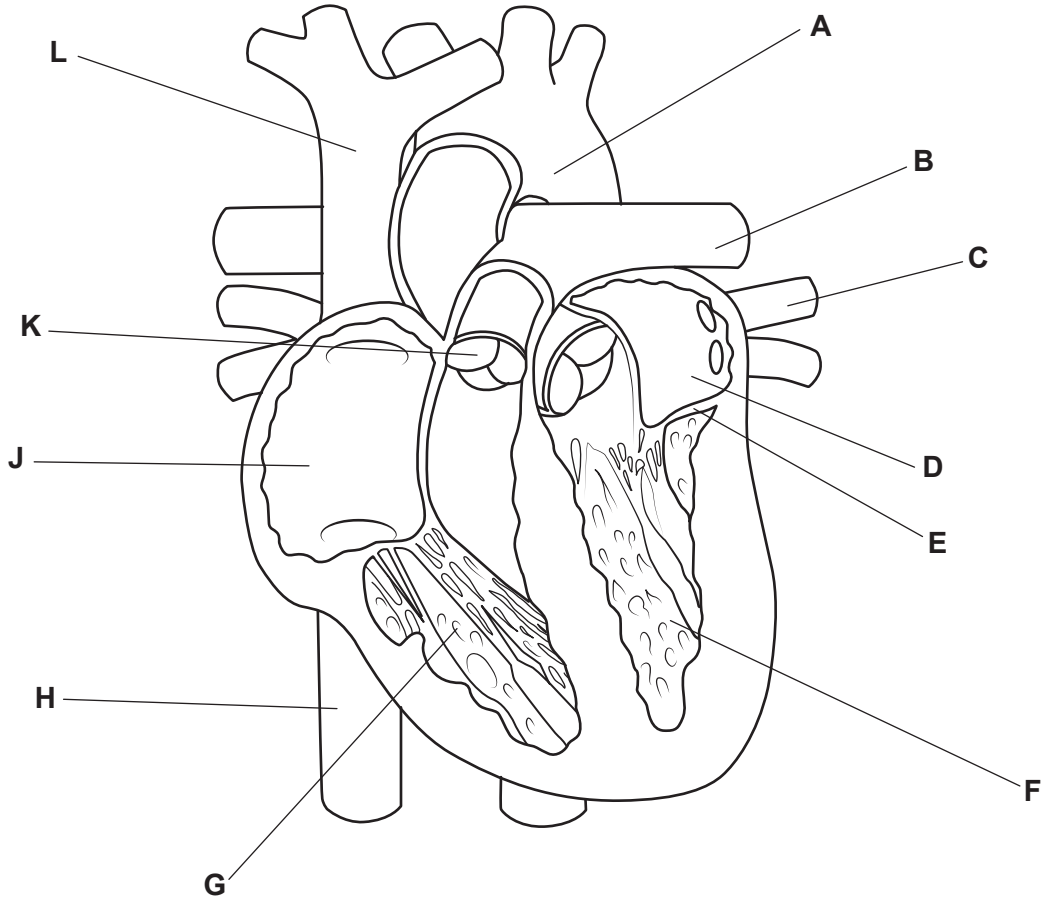


Fig. 4.1

(i) Sketch arrows on Fig. 4.1 to show the pathway taken by deoxygenated blood from the heart towards the lungs. [2]

(ii) Table 4.2 contains statements about the structures visible in Fig. 4.1.

Complete Table 4.2 by:

- stating the name of each structure
- identifying the structure with the corresponding letter from Fig. 4.1.

Table 4.2

statement	name of structure	letter from Fig. 4.1
chamber that creates the highest blood pressure		
blood vessel containing blood with the highest concentration of oxygen		
structure that prevents blood going from ventricle to atrium		
structure that prevents backflow of blood from artery to ventricle		
chamber that receives blood from vena cava		

[5]

(e) Mammals also have a lymphatic system.

Outline the functions of the lymphatic system.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 17]

6 Fig. 6.1 is a photomicrograph of part of a cell from the pancreas that produces enzymes that are released into the small intestine.

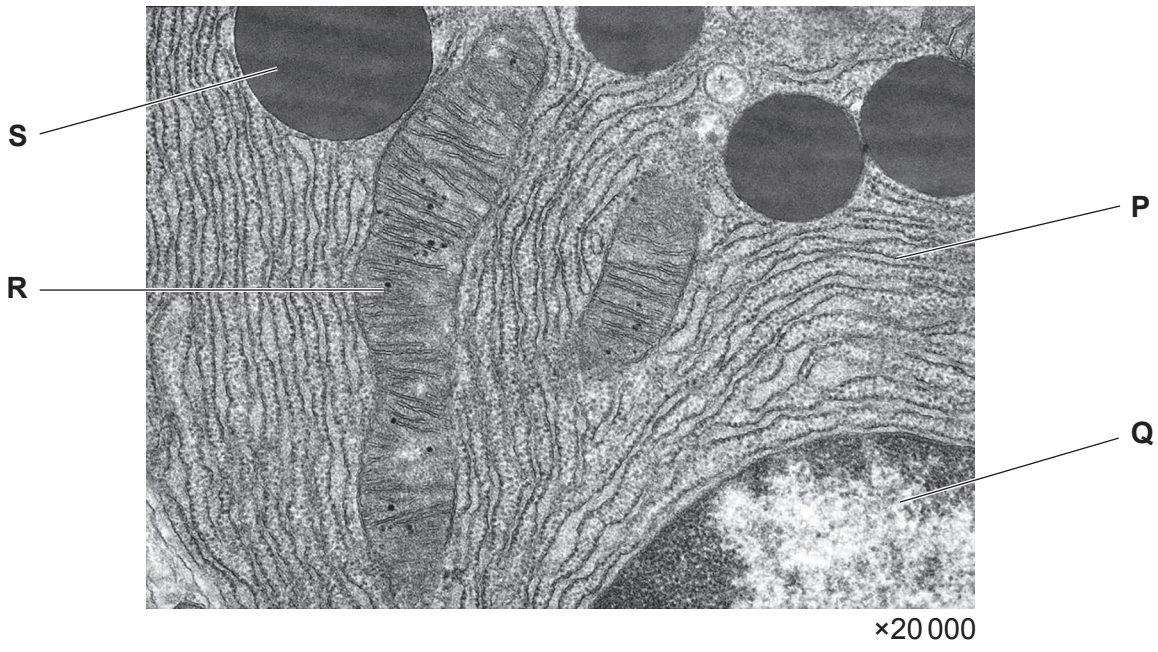


Fig. 6.1

(a) (i) Structure **Q** is part of the nucleus of the cell.

State **one** function of a nucleus.

.....

.....

..... [1]

(ii) State the names of the structures labelled **P** and **R** in Fig. 6.1.

P .....

R .....
[2]

(b) The structure labelled **S** transports enzymes to the cell membrane for release into the pancreatic duct. These structures contain molecules of amylase, trypsin and lipase.

Complete the sentences with the most appropriate words.

Enzymes are made of protein and act as ..... because they increase the rate of chemical reactions, but are not changed in those reactions. Amylase speeds up the digestion of ..... to ..... Trypsin continues the chemical digestion of protein begun by the enzyme ..... in the stomach.

The optimum pH for pancreatic enzymes is greater than pH 7. Bile is produced by the ..... and enters the small intestine, where it ..... stomach acid to provide the appropriate pH. Bile also breaks down fat by ..... to increase the surface area for the action of lipase.

[7]

[Total: 10]

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1 All living organisms are placed into groups according to their features.
Myriapods are one of the main groups of arthropods.

(a) State **two** features of myriapods that can be used to distinguish them from other arthropods.

1 .....

2 .....
[2]

Fig. 1.1 shows that there are four main groups of arthropods.

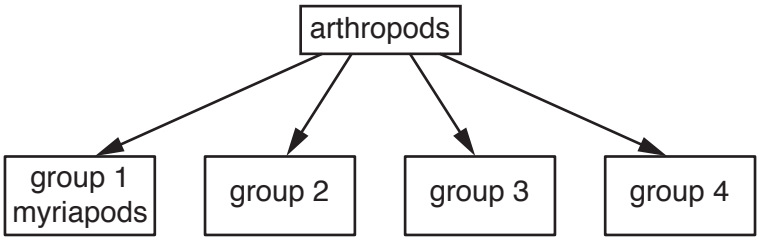


Fig. 1.1

(b) State the names of **two** of the other groups of arthropods in Fig. 1.1.

1 .....

2 .....
[2]

(c) Myriapods can be classified into four classes, **1**, **2**, **3** and **4**.

Fig. 1.2 is a dichotomous key that can be used to distinguish the four classes of myriapods.

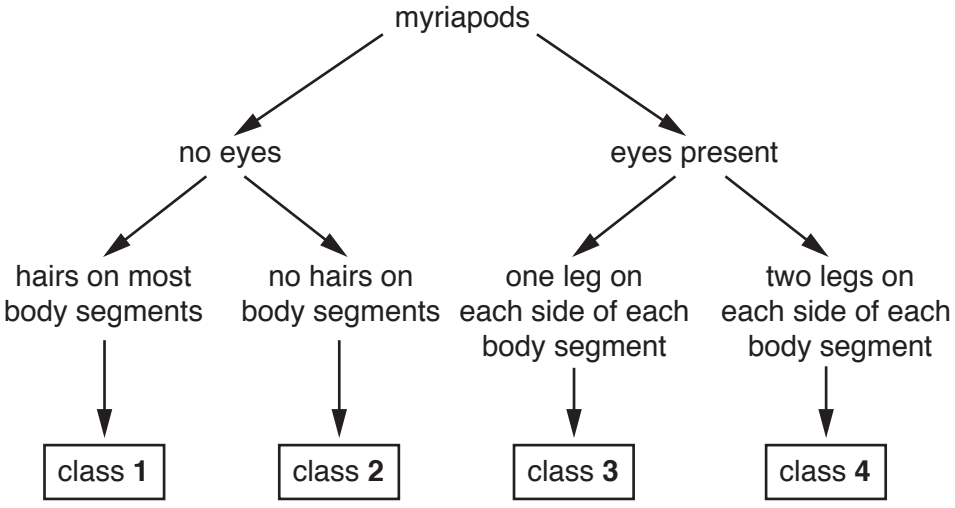


Fig. 1.2

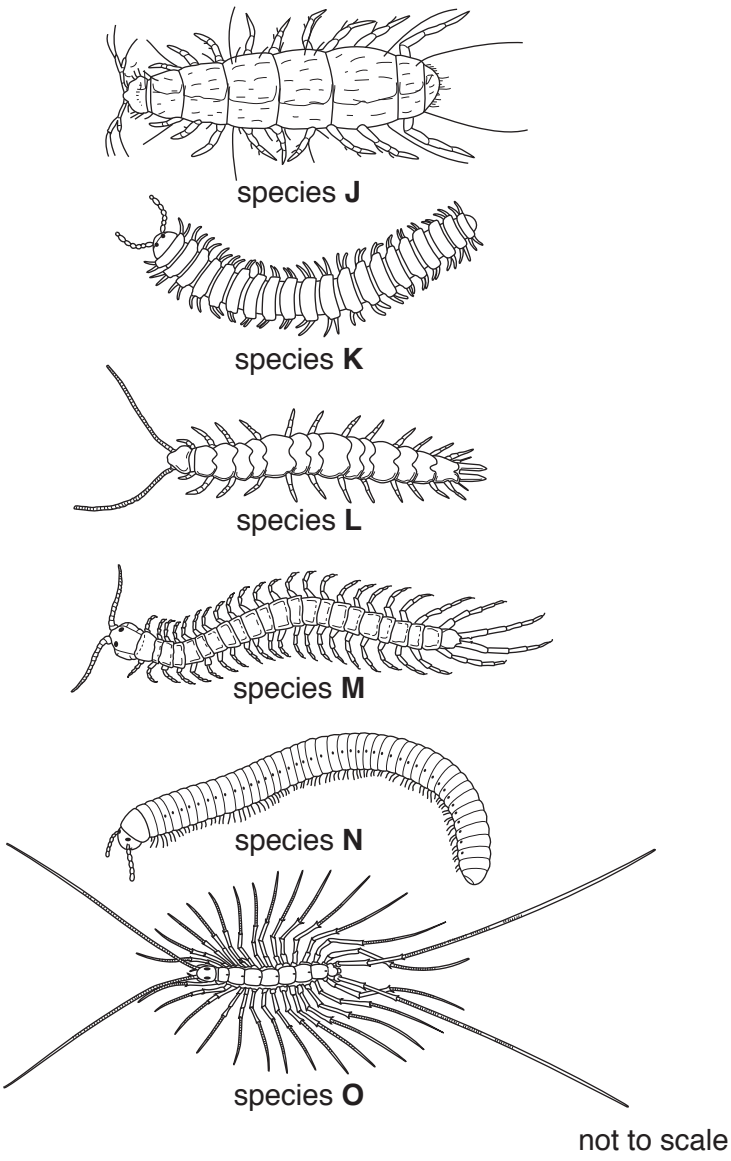


Fig. 1.3

Complete Table 1.1 by using the key in Fig. 1.2 to classify the six myriapods in Fig. 1.3 into the four classes.

Table 1.1

class	letter(s) of species from Fig. 1.3 in each class
1	
2	
3	
4	

[3]

(d) Fig. 1.4 is a photograph of the myriapod, *Apheloria virginiensis*.

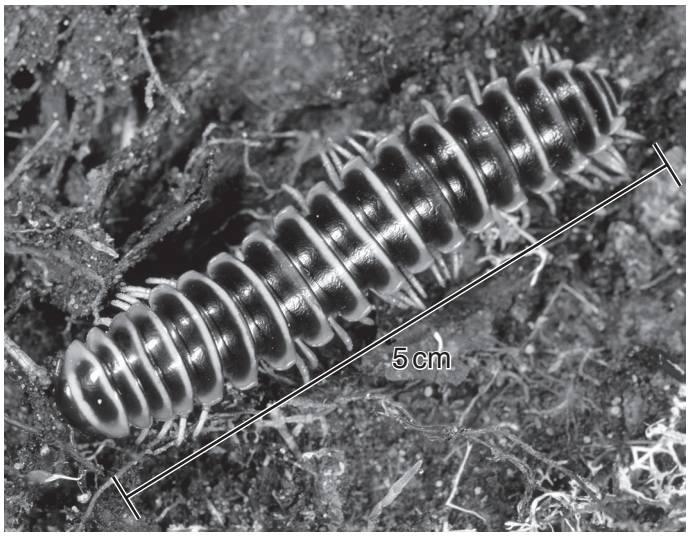


Fig. 1.4

(i) State the genus name and kingdom name for the myriapod shown in Fig. 1.4.

genus .....

kingdom .....
[2]

(ii) *A. virginiensis* releases the poison cyanide when it is attacked by predators. Cyanide stops enzymes in the mitochondria from functioning.

Suggest why cells die if the mitochondria do not function.

.....

.....

..... [1]

[Total: 10]

2 Phloem is used to transport sucrose and amino acids in plants. Sucrose is a carbohydrate.

(a) Describe the uses of carbohydrates **and** amino acids in plants.

.....

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 2.1 shows a diagram of a plant. The arrows point to circles containing magnified cross-sections of those parts of the plant.

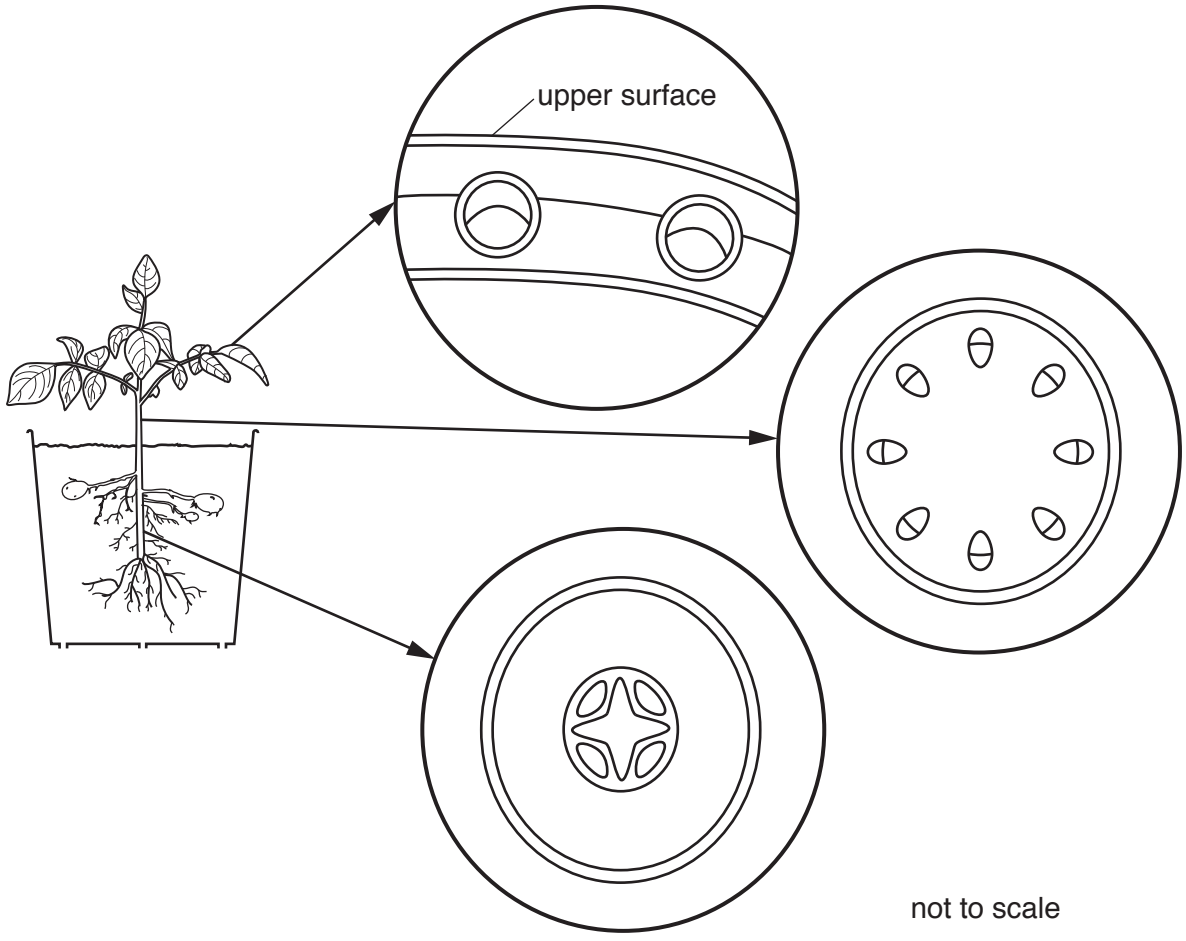


Fig. 2.1

Label the position of the phloem in each of the three magnified sections in Fig. 2.1.

Use a label line and the letter **P** for each section. [3]

(c) Aphids are used by investigators to discover how plants transport sucrose.

Fig. 2.2 shows an aphid with its mouthparts inserted into a plant stem to feed on the liquid in the phloem.

Fig. 2.2

A plant was put in a dark cupboard for several days.
Four aphids, **A**, **B**, **C** and **D**, were then placed on the plant in the dark cupboard as shown in Fig. 2.3.

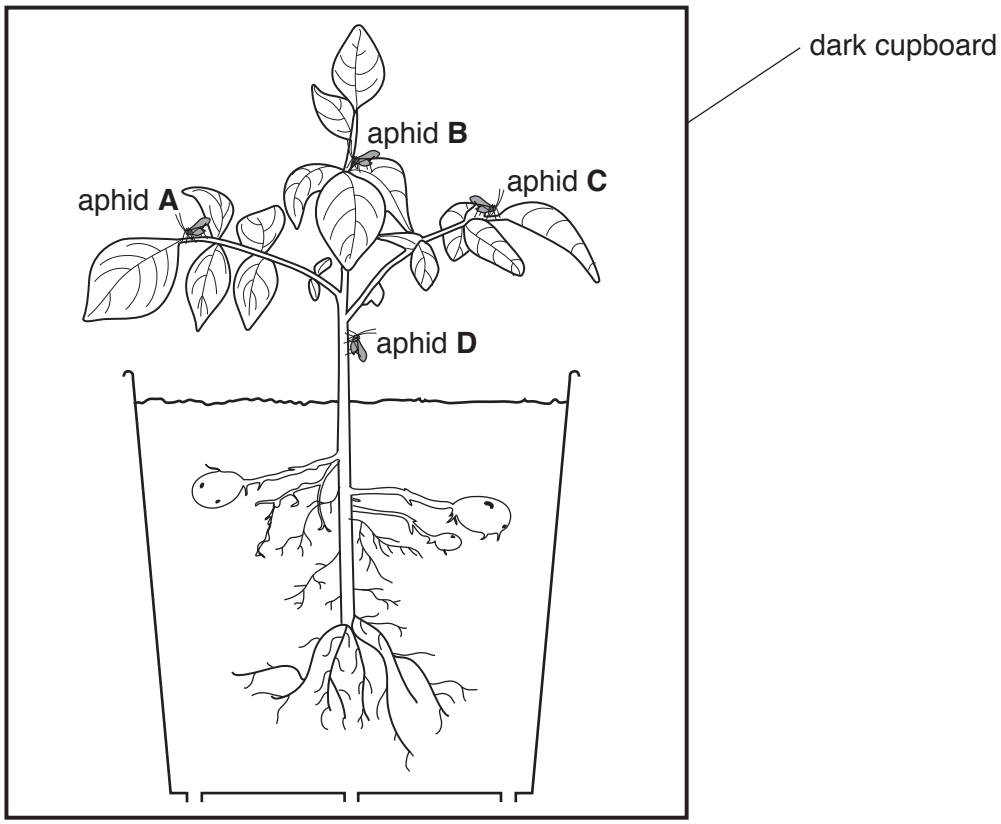


Fig. 2.3

(i) Immediately after the aphids were placed on the plant it was observed that:

- all the aphids ingested the same volume of liquid from the phloem
- aphid **D** ingested the highest concentration of sucrose.

Explain why aphid **D** ingested the highest concentration of sucrose.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Many crop farmers try to prevent insects such as aphids from damaging their plants.

Describe how modern technology is used to reduce damage to crop plants by insects.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Other insects are useful to crop farmers.

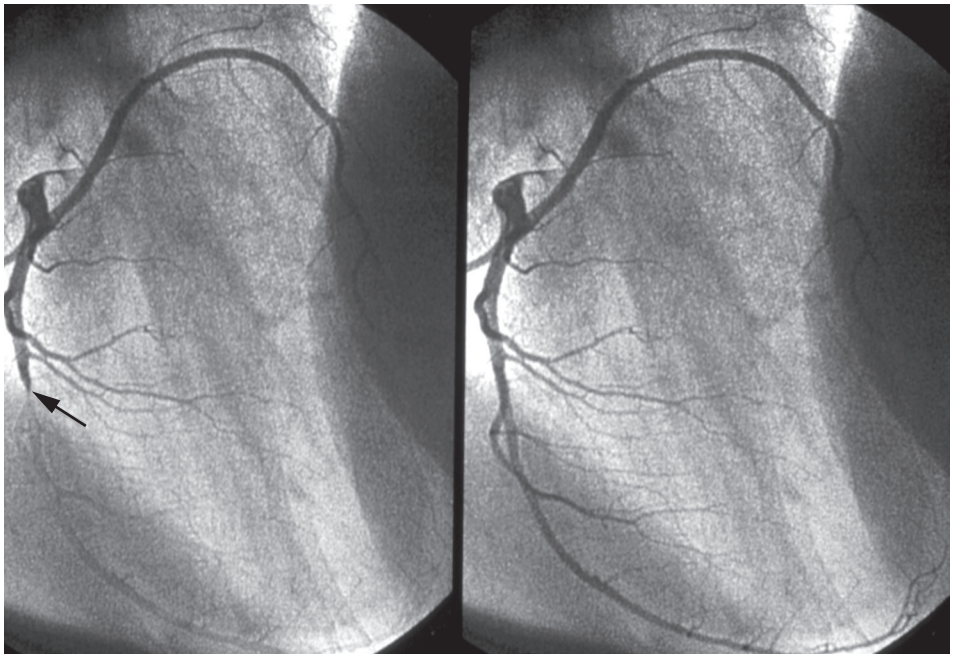
Give **one** example of how insects are useful to farmers.

.....

..... [1]

[Total: 14]

5 Fig. 5.1 shows an angiogram of a heart before and after treatment for coronary heart disease (CHD). An angiogram is an image of the blood flow through the blood vessels of the heart.



before treatment after treatment

Fig. 5.1

(a) The arrow on Fig. 5.1 shows the position of a blockage in a blood vessel.

(i) State the name of the blocked blood vessel.

..... [1]

(ii) The blockage is caused by a blood clot.

Describe how a blood clot forms.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) State the name of a drug that can be used to treat coronary heart disease.

..... [1]

(b) Many health specialists think that the risk of coronary heart disease can be reduced by doing regular exercise.

A long-term study of a large group of women was used to test this hypothesis.
The women were between 35 and 45 years old at the start of the study.
Every two years the same group of women were asked how much they were exercising.

After 28 years the researchers analysed their data:

- They calculated the average time spent exercising per week by each woman.
- They put the women into categories determined by how much exercise they had done.
- For each category, they calculated the number of women who died from coronary heart disease (CHD).

The results are shown in Fig. 5.2.

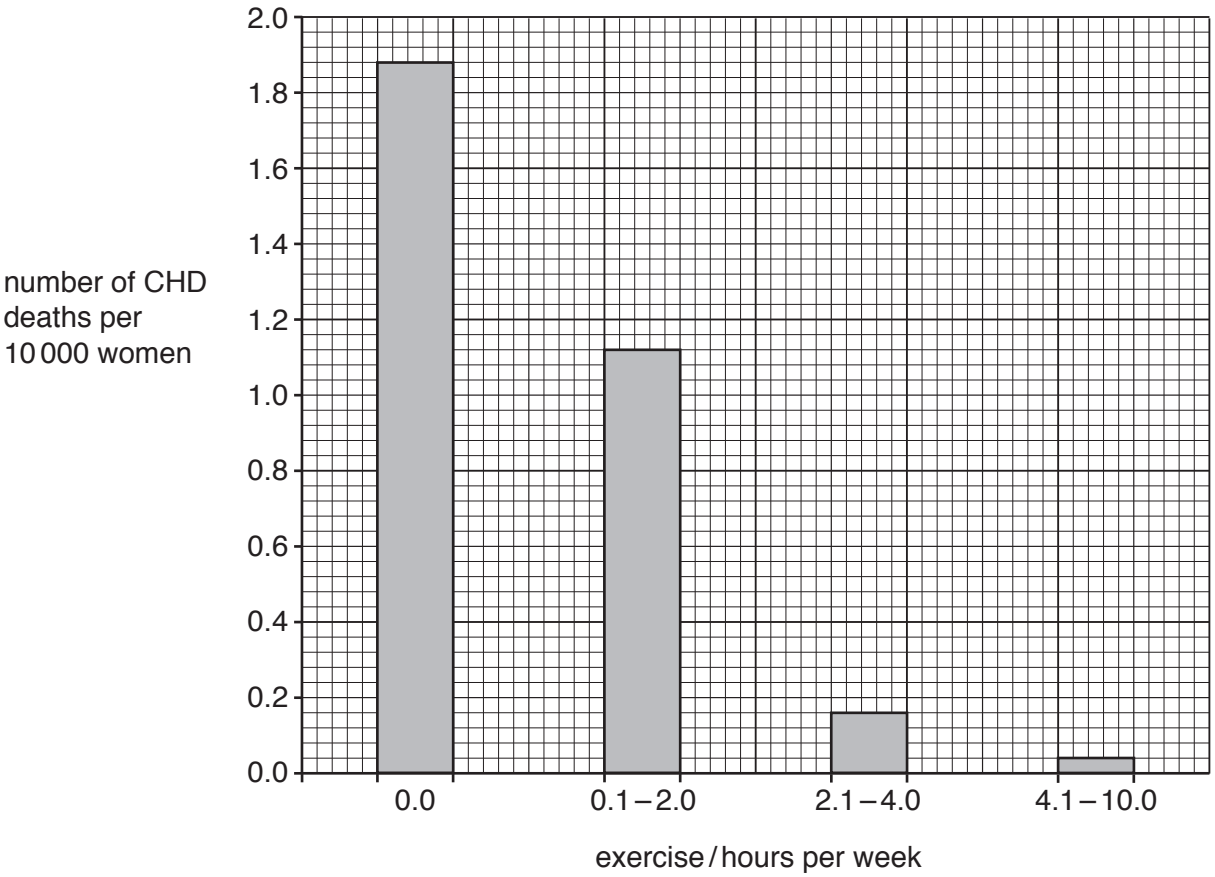


Fig. 5.2

(i) Calculate the percentage **decrease** in the number of CHD deaths per 10 000 women between those who did no exercise and those who exercised for 4.1 to 10.0 hours a week, using the data in Fig. 5.2.

number of CHD deaths per 10 000 women who did no exercise .....

number of CHD deaths per 10 000 women who did 4.1 to 10.0 hours per week of exercise

.....

Give your answer to the nearest whole number.

Space for working.

..... %
[3]

(ii) Health professionals wanted to use the results of this study to encourage the whole population to take more exercise.

Discuss the arguments for and against health professionals using this study in this way.

Use the information about how the study was designed and the results in Fig. 5.2 in your arguments.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) Exercise causes heart rate to increase.

Explain why exercise causes an increase in heart rate.

.....

.....

.....

.....

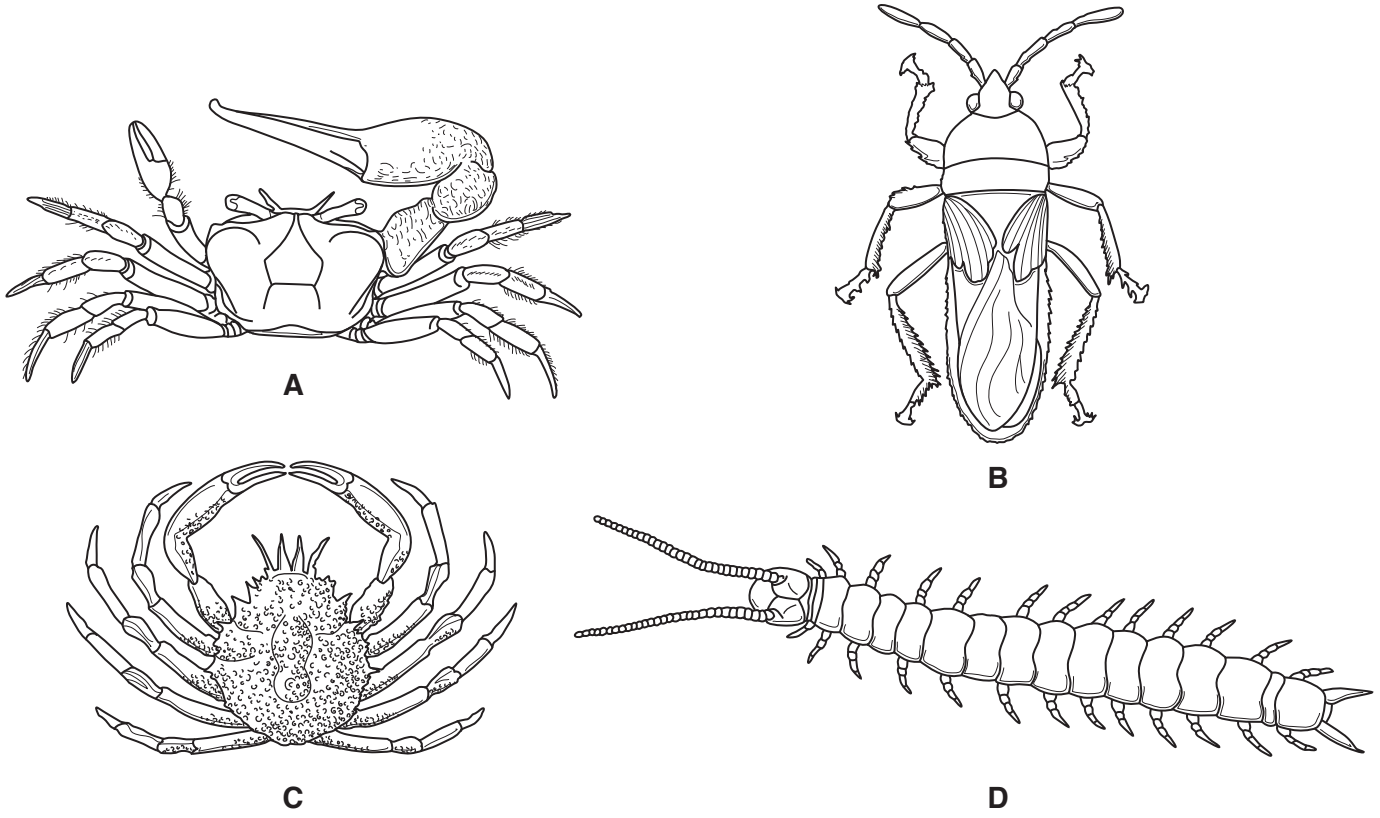
.....

.....

..... [3]

[Total: 16]

1 **(a)** Fig. 1.1 shows four arthropods.



not to scale

Fig. 1.1

(i) State **two** features, visible in Fig. 1.1, that are common to all arthropods.

1 .....

2 .....

[2]

(ii) Fig. 1.2 is a dichotomous key for the arthropods shown in Fig. 1.1.

Complete Fig. 1.2 by writing suitable statements in:

- box **2** to identify species **B**
- box **3** to separate species **C** and **A**.

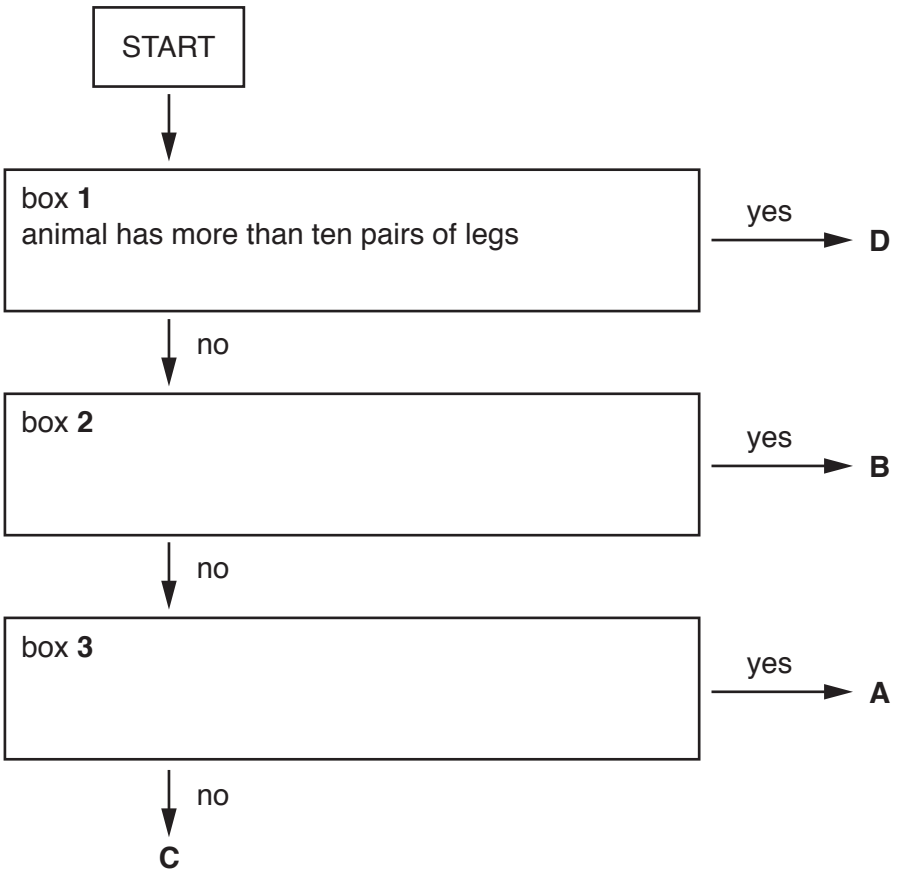


Fig. 1.2

[2]

2 Fig. 2.1 shows part of a cross-section of the stem of a young sunflower plant.

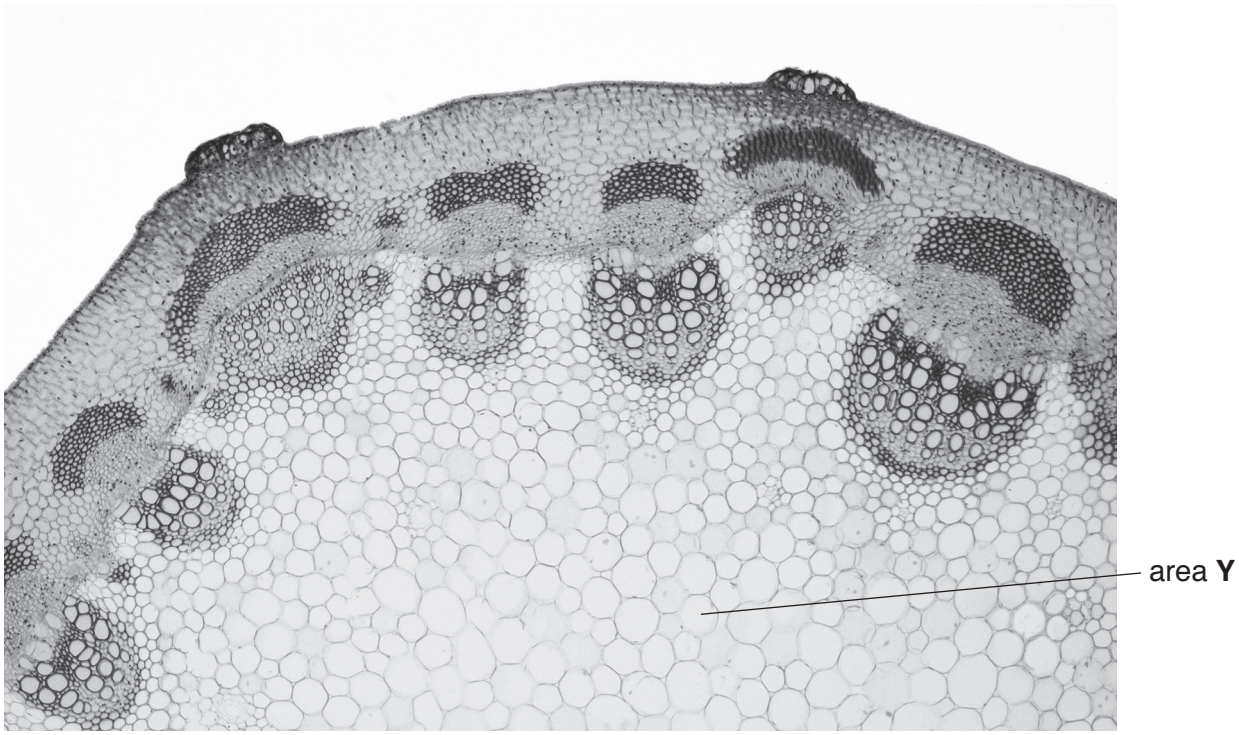


Fig. 2.1

(a) Draw a circle around **one** vascular bundle on Fig. 2.1.

Label the **xylem** in the vascular bundle with the letter **X**. [2]

(b) Explain how the cells in **area Y** are able to support the stem so that it stays upright.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Researchers used carbon dioxide that contained a traceable source of carbon (^{13}C) to investigate translocation of sucrose from the leaves of bean plants, *Phaseolus vulgaris*.

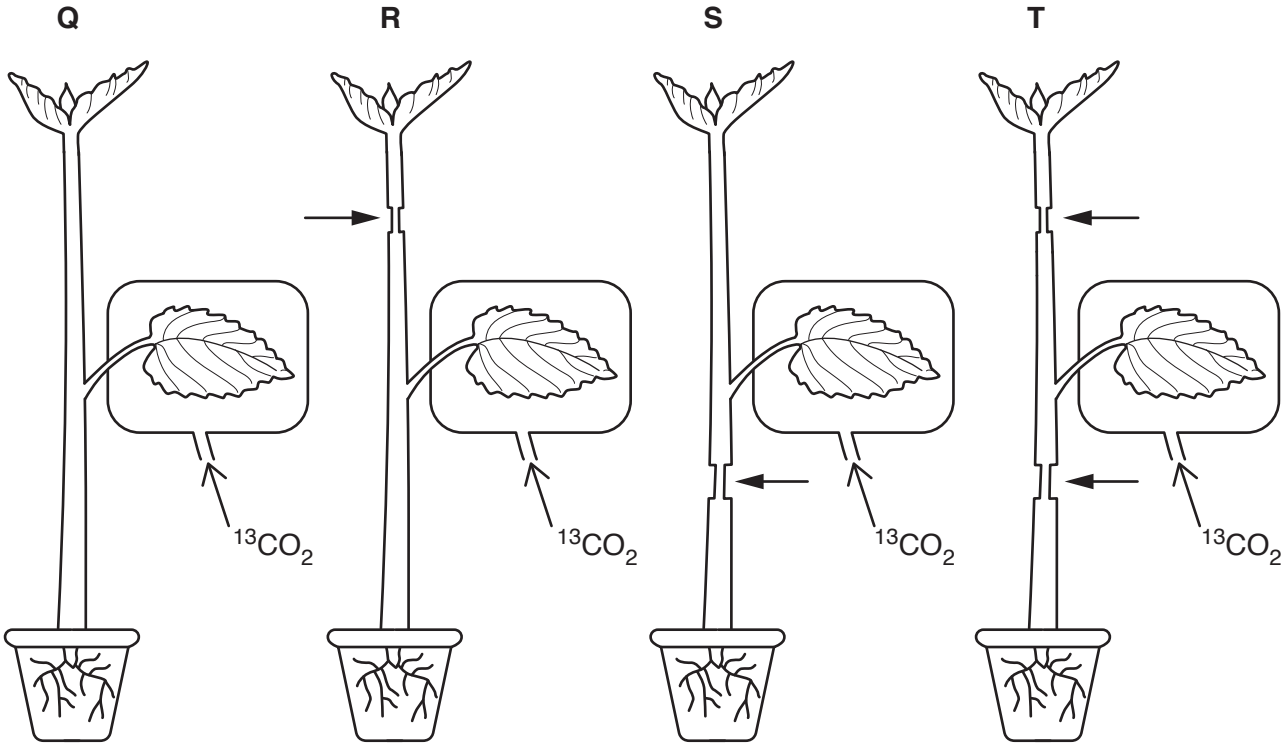
Fig. 2.2 shows that glucose produced in photosynthesis is converted to sucrose for translocation.

carbon dioxide ⟶ glucose ⟶ sucrose

Fig. 2.2

Researchers selected four plants, **Q**, **R**, **S** and **T**, which had leaves that were of similar sizes. The leaves on the four plants were supplied with $^{13}CO_2$.

After the leaves had started to make sucrose, the researchers cut away a ring of tissue in different places as shown in Fig. 2.3. The rings of tissue that were removed from plants **R**, **S** and **T** contained the phloem.



Key: ⟶ the positions on the stems where rings of tissue containing phloem were removed.

Fig. 2.3

The quantities of sucrose containing ^{13}C in the shoot tips and in the roots were determined.

The results are shown in Table 2.1.

Table 2.1

plant	quantity of sucrose containing ^{13}C / arbitrary units	
	shoot tip	root
Q	3.24	0.94
R	0.00	0.44
S	4.14	0.00
T	0.00	0.00

Describe **and** explain the effect of removing the phloem on the translocation of sucrose in plants **Q**, **R**, **S** and **T**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

3 Cells in the lining of the stomach secrete gastric juice, which contains hydrochloric acid and pepsin.

(a) (i) State **two** roles of hydrochloric acid in the stomach.

1 .....

2 .....
[2]

(ii) Describe the function of pepsin.

.....

.....

.....

..... [2]

(b) Define the term *assimilation*.

.....

.....

.....

..... [2]

(c) There are stem cells in the epithelial tissue that forms the lining of the stomach.

Explain why these stem cells are necessary.

.....

.....

.....

.....

..... [2]

(d) The epithelial cells of the small intestine have many microvilli.

State the role of the microvilli.

.....

.....

.....

..... [2]

(e) *Lactobacillus* is a type of bacterium. A study was carried out to investigate the ability of *Lactobacillus* to attach to the epithelial cells that form the lining of the small intestine.

Researchers added *Lactobacillus* bacteria to epithelial cells that had been grown in Petri dishes.

Every 15 minutes, the researchers estimated the average number of bacteria that were attached to the epithelial cells in the Petri dishes.

The results are shown in Fig. 3.1.

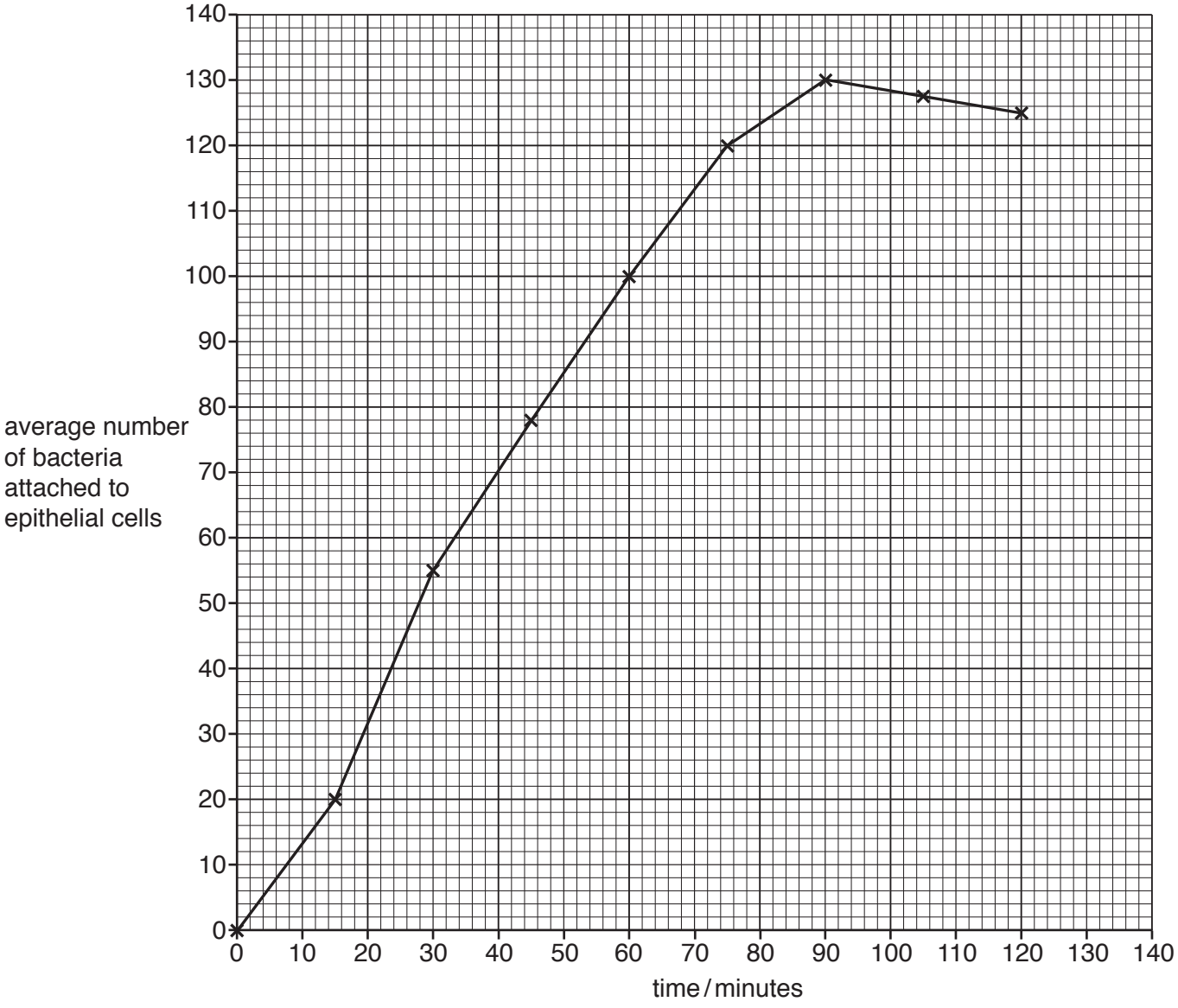


Fig. 3.1

Calculate the percentage increase in the average number of bacteria attached to epithelial cells from 45 minutes to 75 minutes.

average number of bacteria at 45 minutes ..... .

average number of bacteria at 75 minutes ..... .

Give your answer to the nearest whole number.

Space for working.

..... %
[3]

[Total: 13]

1 **(a)** The ant-mimic jumping spider, *Myrmarachne formicaria*, is shown in Fig. 1.1.

The common name of this species describes its behaviour. It is an arachnid that tricks its prey because it looks like the insects that it eats.

Fig. 1.1

(i) Suggest which trophic level in a food chain *M. formicaria* could belong to.

..... [1]

(ii) State the genus of the spider shown in Fig. 1.1.

..... [1]

(iii) Some keys use paired choices of features to identify species such as the ant-mimic jumping spider.

State the name of this type of key.

..... [1]

(b) Spiders are classified as arachnids. Arachnids are one of the main groups of arthropods.

Fig. 1.2 shows diagrams of six arthropods, four of which are arachnids.

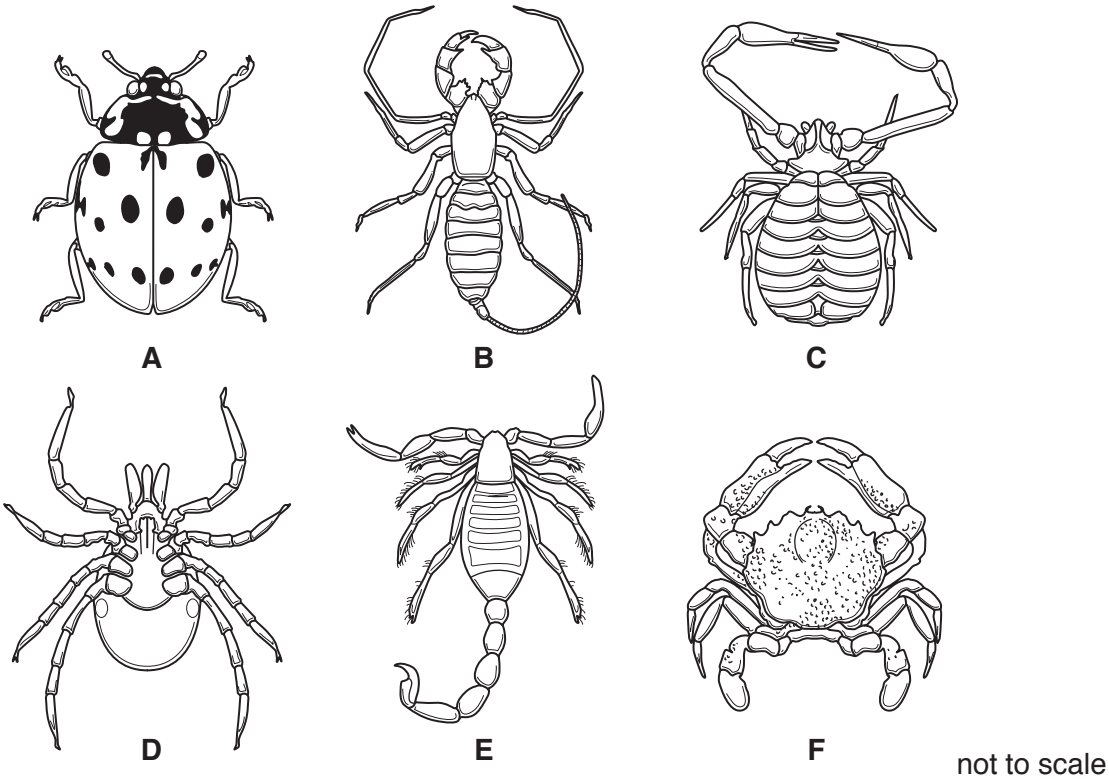


Fig. 1.2

(i) State **two** common features of all the arthropods, visible in Fig. 1.2.

1 .....

2 .....
[2]

(ii) State **two** common features of all arachnids that can be used to distinguish them from other arthropods.

1 .....

2 .....
[2]

(iii) State the letters of the **four** arachnids shown in Fig. 1.2.

..... [2]

(c) The features shown in Fig. 1.2 are morphological features. Many traditional methods of classification used morphology.

State the name of one **other** type of feature that can also be used in classification.

..... [1]

[Total: 10]

2 Plants produce glucose in leaves and convert some of it to sucrose.

(a) (i) Explain how glucose is produced in leaves.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State the name of the process that plants use to move sucrose from a source to a sink.

..... [1]

(iii) Roots can be an example of a sink.

Explain why sometimes roots act as a source rather than a sink.

.....

.....

.....

.....

..... [2]

(b) The movement of sucrose in plants can be modelled using laboratory apparatus.

Fig. 2.1 shows the apparatus used to model the movement of sucrose in a plant:

- Partially permeable bags were attached tightly to the ends of tube **Q**.
- The bag representing a **source** was filled with a coloured sucrose solution.
- The bag representing a **sink** was filled with water.
- The containers and tube **Q** and tube **S** were filled with water.

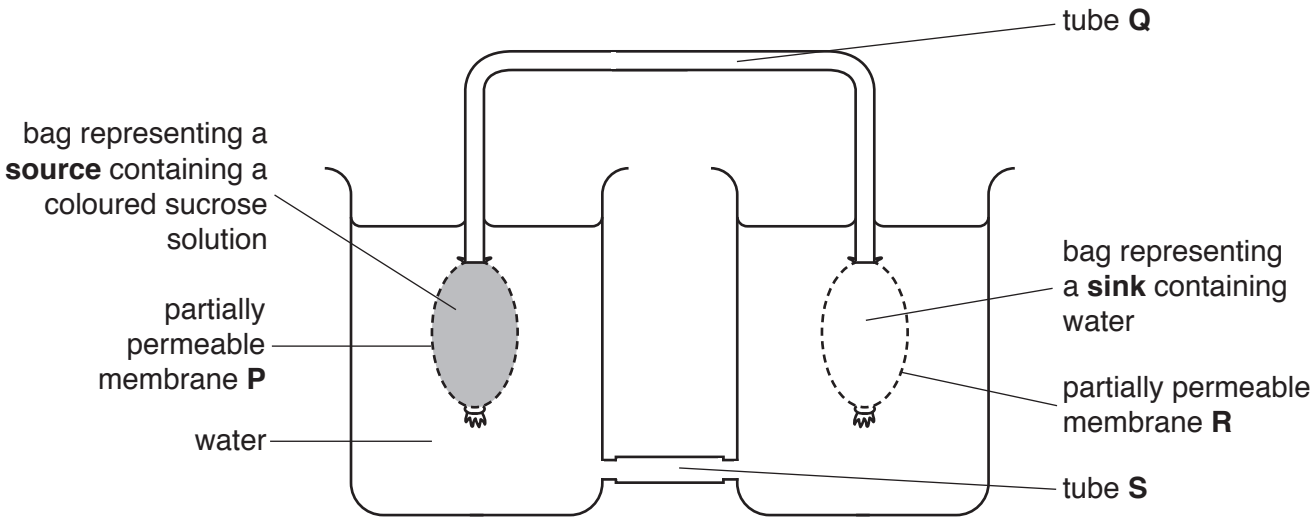


Fig. 2.1

Fig. 2.2 shows the position of the coloured sucrose solution 30 minutes after the apparatus was set up.

The arrows show the direction of the movement of the liquids.

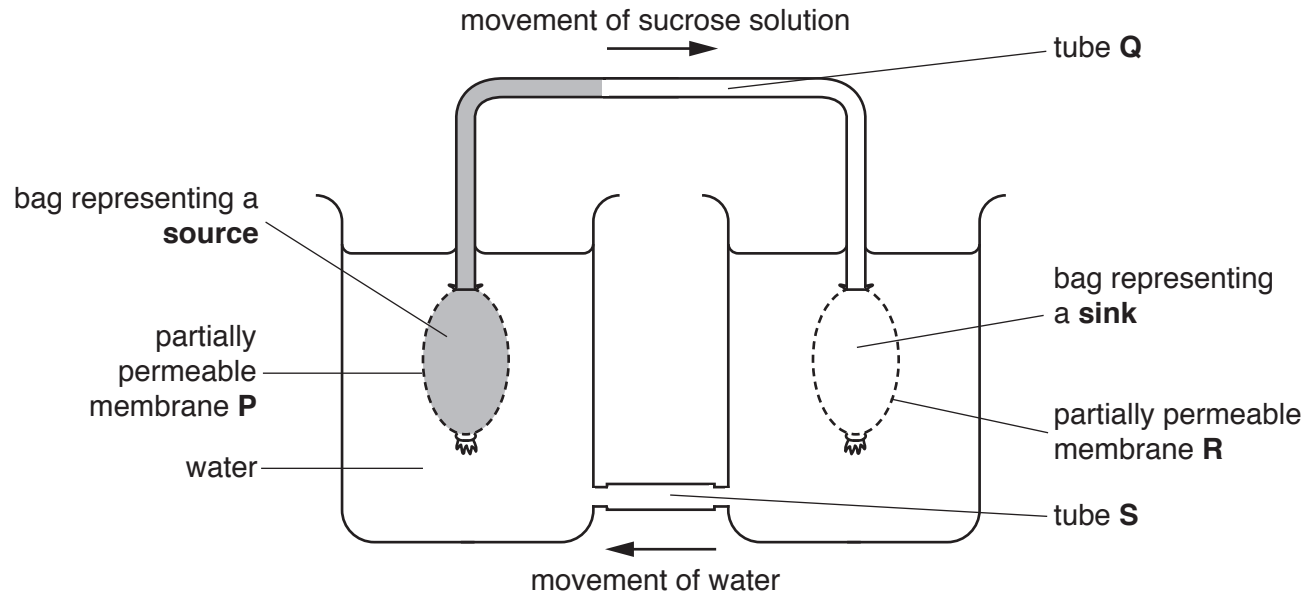


Fig. 2.2

(i) State the name of the tissue represented by tube **Q** and the name of the tissue represented by tube **S** in Fig. 2.2.

Q .....

S .....
[2]

(ii) Explain why the sucrose solution moves along tube **Q** in the model in Fig. 2.2.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) In plants the movement of sucrose is usually continuous. However, after 2 hours the movement of sucrose in tube **Q** in Fig. 2.2 stopped.

Suggest why the movement of sucrose in tube **Q** stopped.

.....

.....

..... [1]

(d) Amino acids are also transported through plants.

State the name of the mineral ion that is used to make amino acids.

..... [1]

[Total: 14]

3 Carbohydrates are an important component of a balanced diet.

The flow chart in Fig. 3.1 shows some of the processes that happen to carbohydrates in food that is eaten.

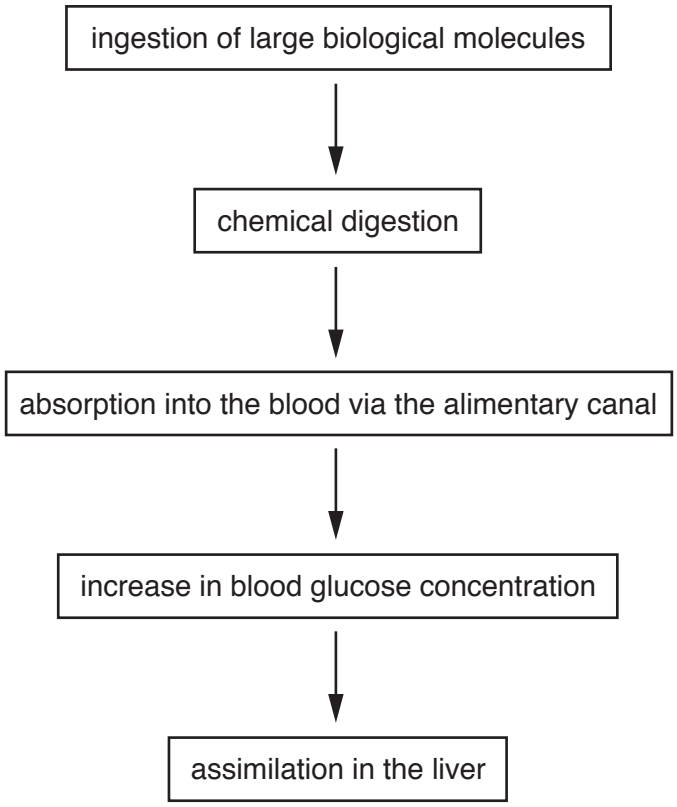


Fig. 3.1

(a) Describe what happens to carbohydrates in the human body between ingestion and assimilation in the liver.

Use the information in Fig. 3.1 as a guide.

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..... [8]

(b) Mineral salts are another important component of a balanced diet.

State the importance of calcium ions and iron ions in a balanced diet.

calcium ions .....

.....

.....

iron ions .....

.....

.....
[4]

(c) Consuming too much of some mineral salts, such as sodium chloride, increases the risk of developing coronary heart disease (CHD).

Doctors studied the effect of diet on the risk of developing CHD.

The doctors first selected volunteers who had a high salt diet.

The doctors assessed the volunteers' overall risk of developing CHD and monitored their blood pressure.

(i) List **two** factors, **other than diet and blood pressure**, that the doctors considered when assessing the overall risk of the volunteers developing CHD.

1 .....

2 .....
[2]

(ii) The doctors used urine tests to identify volunteers who had a high salt diet.

Explain why urine tests are a good indicator of how much salt has been consumed.

.....

.....

.....

.....

..... [2]

(d) The volunteers were divided into two groups.

The mass of salt consumed by **both** groups was changed every 4 weeks:
- low salt intake for 4 weeks
- medium salt intake for 4 weeks
- high salt intake for 4 weeks.

In addition, group **2** was given other changes to their diet but group **1** was not.

(i) Suggest **one** component of the diet of group **2**, **other than salt**, that the doctors changed to further reduce the risk of developing CHD.

..... [1]

The systolic blood pressure of the volunteers was measured every 4 weeks.
These results are shown in Fig. 3.2.

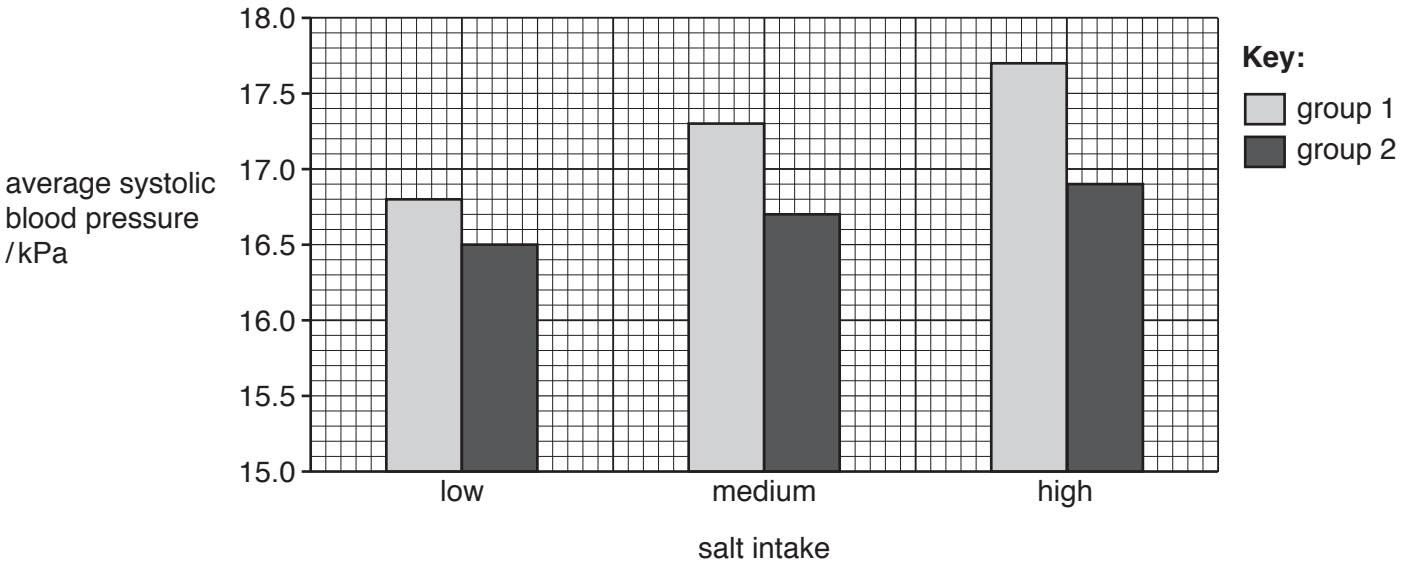

Fig. 3.2

(ii) Calculate the percentage increase in the average systolic blood pressure of the group **1** volunteers when they increased their salt intake from low to high.

low salt intake ..... kPa

high salt intake ..... kPa

Give your answer to the nearest whole number.

Space for working.

..... %
[3]

(iii) The doctors concluded that some diets reduce the risk of CHD.

Give evidence from Fig. 3.2 to support this conclusion.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 23]

1 The gas exchange system is one of the organ systems of the human body.

Fig. 1.1 shows parts of the gas exchange system during breathing in and breathing out.

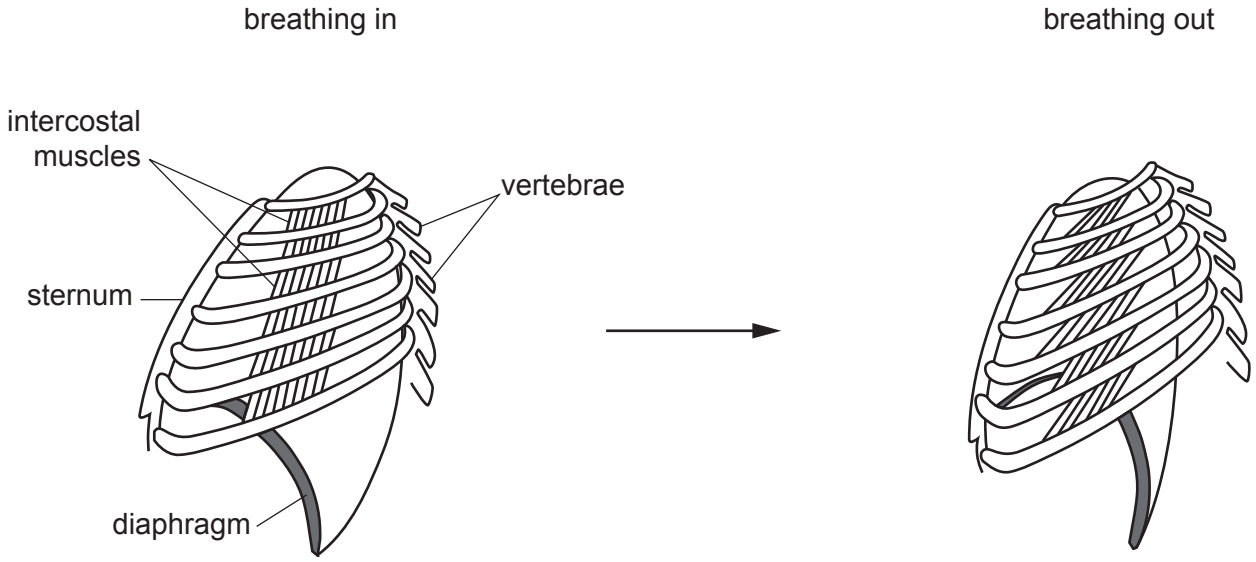

Fig. 1.1

(a) Complete Table 1.1 to show:

- the functions of the diaphragm and the intercostal muscles during breathing in and breathing out
- the pressure changes in the thorax.

Use these words:

contract
relax
increases
decreases.

Table 1.1

	diaphragm	intercostal muscles		pressure change in the thorax
		internal	external	
breathing in				
breathing out				

[4]

Fig. 1.2 shows part of the gas exchange surface of a human.

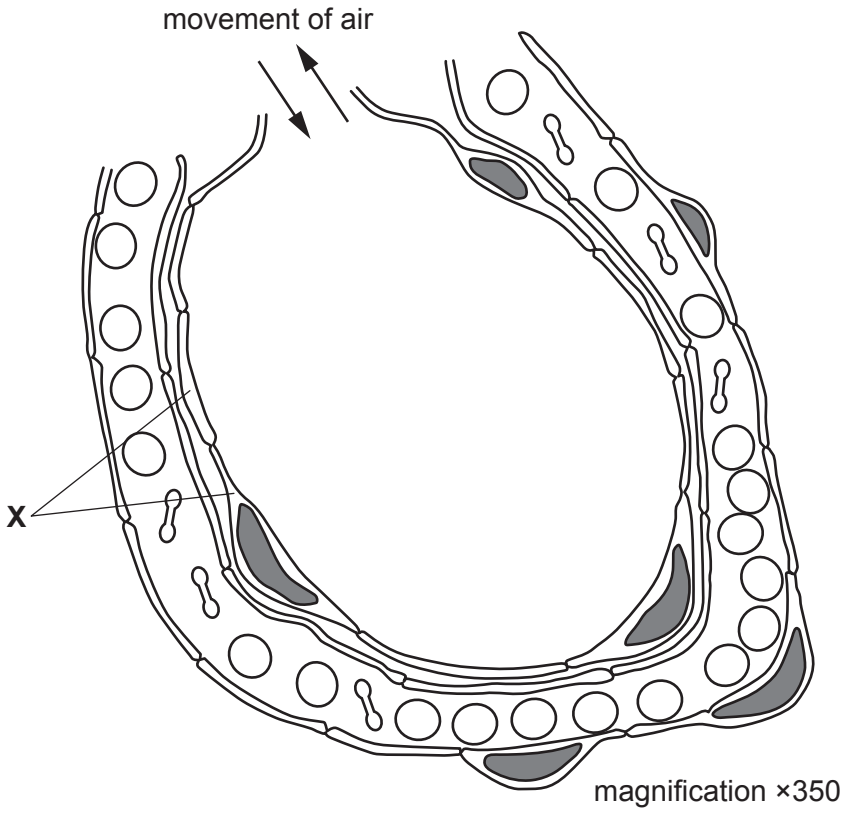

Fig. 1.2

(b) State **two** features of the gas exchange surface that are **visible** in Fig. 1.2.

1 .....

2 .....

[2]

(c) The cells labelled **X** on Fig. 1.2 form a tissue.

(i) Define the term *tissue*.

.....

.....

.....

.....

..... [2]

(ii) Cartilage is another tissue found in the gas exchange system.

State the functions of cartilage in the gas exchange system.

.....

.....

.....

.....

..... [2]

[Total: 10]

2 Biological washing powders contain enzymes that break down food stains.

(a) Complete Table 2.1 by naming the enzymes that break down three substances in food stains and by stating the product or products.

Table 2.1

substance	enzyme	product(s)
starch		
fat		
protein		

[3]

Some students compared how effective biological and non-biological washing powders are at removing stains at temperatures between 10 °C and 60 °C.

- Pieces of stained cloth were washed using two different washing powders.
- The degree of stain removal was measured by using a light meter to record the percentage of light reflected from the cloth.
- A light meter gave a value of 100% when the cloth was completely clean.
- Any stain left on the cloth reduced the percentage of light reflected.

The results of the students' investigation are shown in Fig. 2.1.

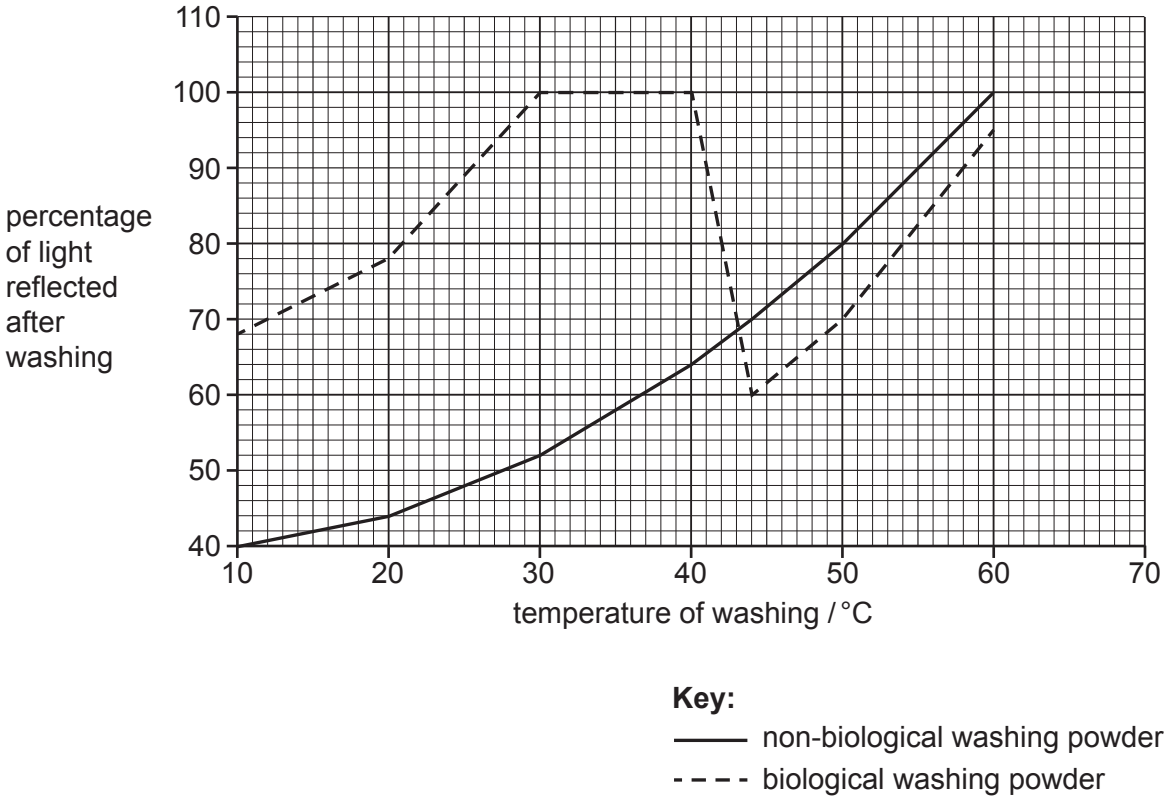

Fig. 2.1

(b) Compare the effectiveness of the two washing powders at removing stains.

Use the information in Fig. 2.1 in your answer.

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.....

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..... [4]

(c) The students suggested that the enzymes in the biological washing powder were denatured at high temperatures.

Explain why enzyme molecules do not function when they are denatured.

.....

.....

.....

.....

..... [2]

(d) Forensic scientists often try to find DNA on items of stained clothing. The DNA can be used to identify individual people.

Suggest why DNA can be used to identify individual people.

.....

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..... [2]

[Total: 11]

3 **(a)** Dialysis tubing is an artificial membrane, which is similar to the lining of the intestine.

A student investigated the diffusion of glucose through dialysis tubing by using the apparatus shown in Fig. 3.1.

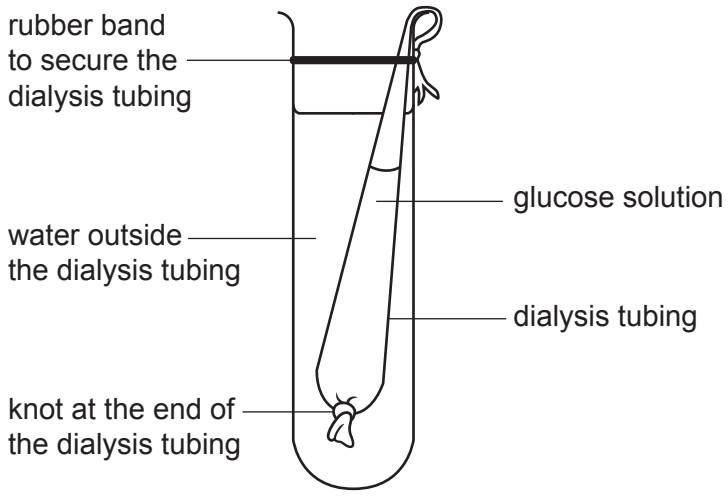

Fig. 3.1

The student took samples of the water outside the dialysis tubing at 5 minute intervals and tested the samples with Benedict's solution.

The results are shown in Table 3.1.

Table 3.1

time / minutes	results of the Benedict's tests on the water outside the dialysis tubing
0	blue
5	green
10	yellow
15	red

(i) Describe and explain the results shown in Table 3.1.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The student repeated the investigation with a higher concentration of glucose in the dialysis tubing.

Predict the results that the student would observe.

.....

.....

..... [1]

(b) Fig. 3.2 shows a drawing of a cell from the lining of the small intestine. The lumen is the space inside the intestine where food is digested.

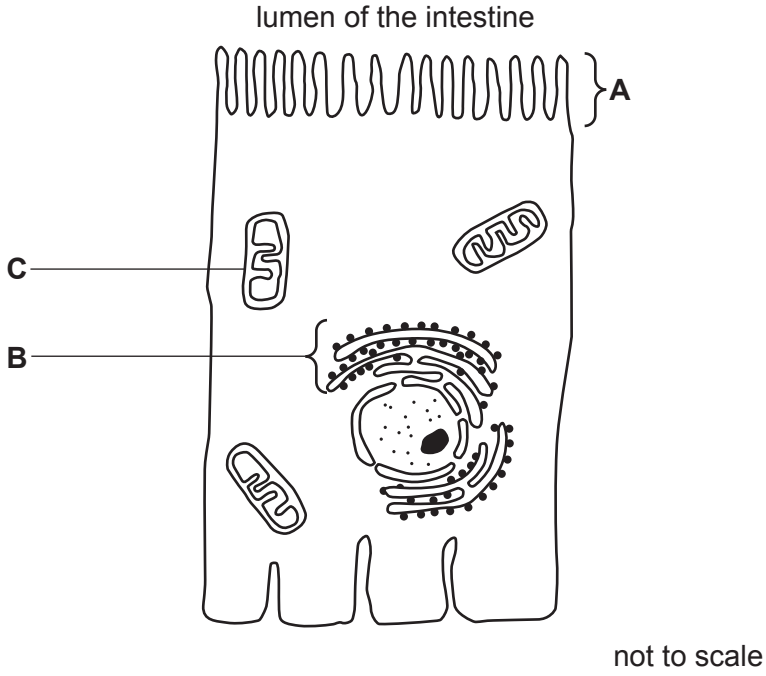

Fig. 3.2

State the names of the **three** labelled structures in Fig. 3.2 **and** describe the role of each structure in the intestinal cell.

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..... [6]

(c) The cholera bacterium can survive in the small intestine and the large intestine. The bacterium releases a toxin that interacts with receptors on the surface of cells.

Fig. 3.3 shows the effect of the toxin. The arrows indicate the direction of movement.

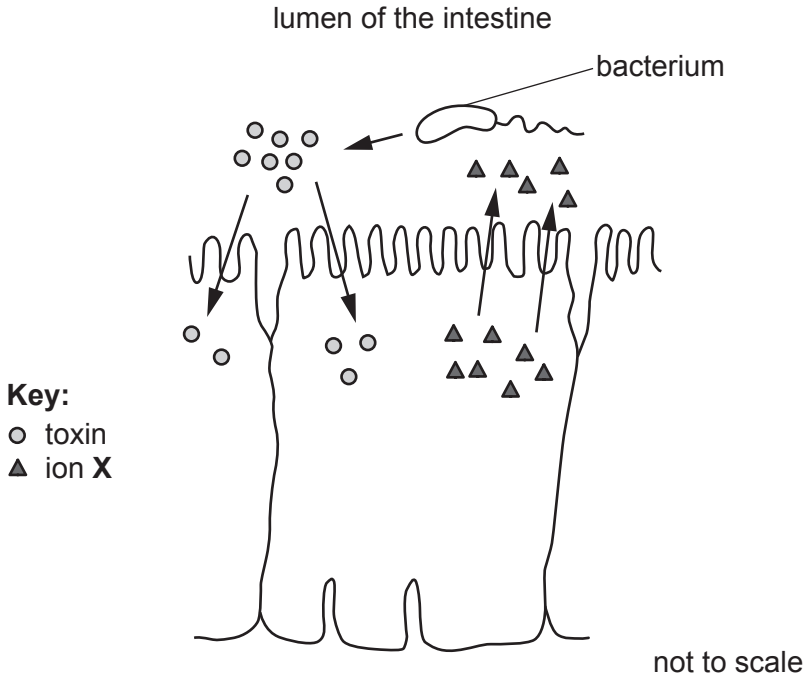

Fig. 3.3

The toxin stimulates the secretion of ion **X** out of the intestinal cell.

(i) State the name of ion **X**.

..... [1]

(ii) Describe the effects on the body of the secretion of ion **X** into the lumen of the intestine.

.....

.....

.....

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.....

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.....

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..... [4]

[Total: 15]

1 **(a)** State **three** uses of energy in the human body.

1 .....

2 .....

3 .....

[3]

(b) Fig. 1.1 shows part of the digestive system of a human.

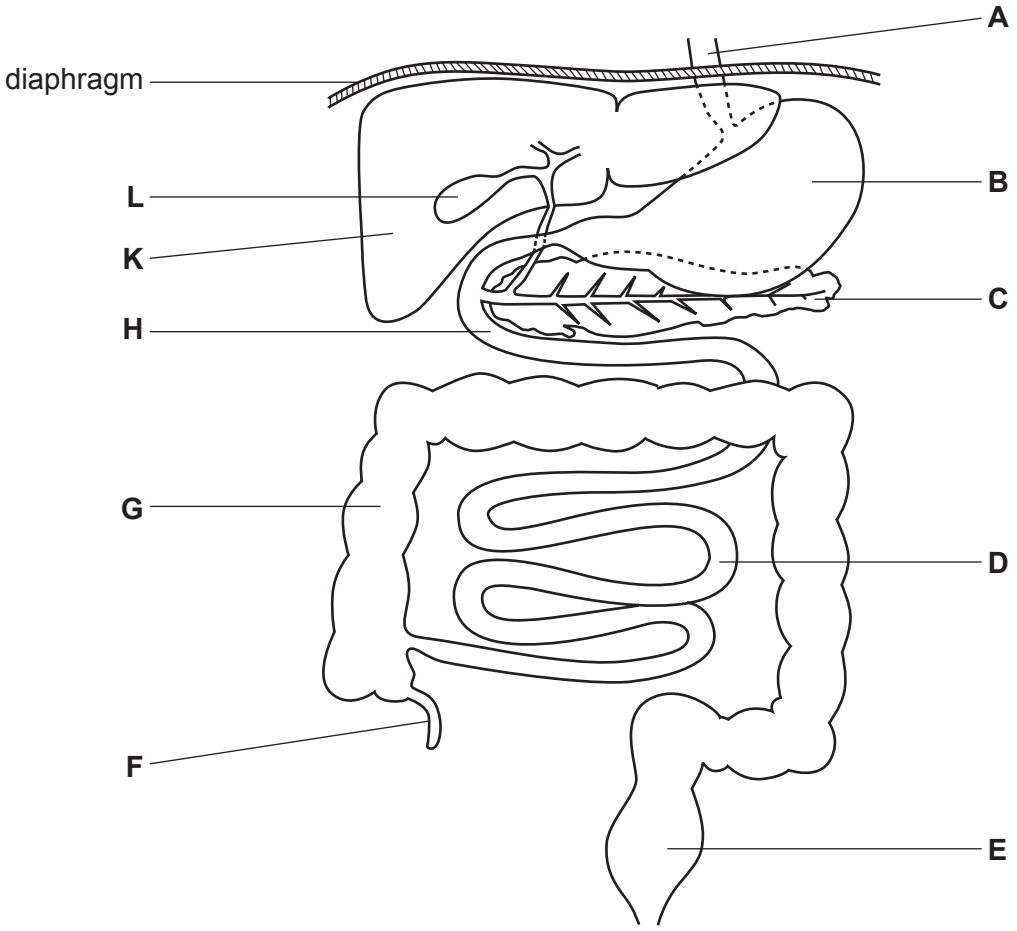

Fig. 1.1

Complete Table 1.1. One row has been done for you.

Table 1.1

function	name of structure	letter from Fig. 1.1
pushes food to the stomach	oesophagus	**A**
assimilation of amino acids to produce plasma proteins		
storage of bile		
secretion of insulin		
absorption of fatty acids and glycerol		
secretion of pepsin		
digestion of starch		

[6]

(c) Describe the role of the liver in the recovery from oxygen debt after strenuous exercise.

.....

.....

.....

.....

..... [2]

1 Water is an essential molecule for life.

(a) Complete the statements.

Water moves into and out of cells by ..... .

Water is known as a ..... because it can dissolve solutes.

[2]

(b) A leaf cell was put into a solution. The water potential of the solution was lower than the water potential of the contents of the cell.

Fig. 1.1 is a sketch of the cell after three hours in the solution.

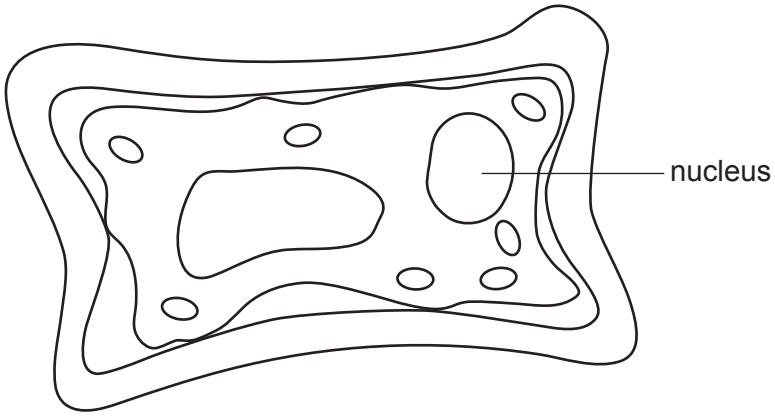

Fig. 1.1

The leaf cell was transferred into pure water.

Sketch the expected appearance of the cell after it had been in the pure water for three hours.

Draw **one** arrow on your sketch to show the direction of water movement.

[3]

(c) A plant was **not** watered for one week.

Fig. 1.2 shows a series of photographs of the plant during the week.

day 0 day 3 day 7

Fig. 1.2

Explain how the lack of water has affected the support of the leaves of the plant shown in Fig. 1.2.

Use the term *turgor pressure* in your answer.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

2 Pathogens cause disease.

(a) Fig. 2.1 shows some cells that are part of the human immune system. These cells are responding to one type of pathogen.

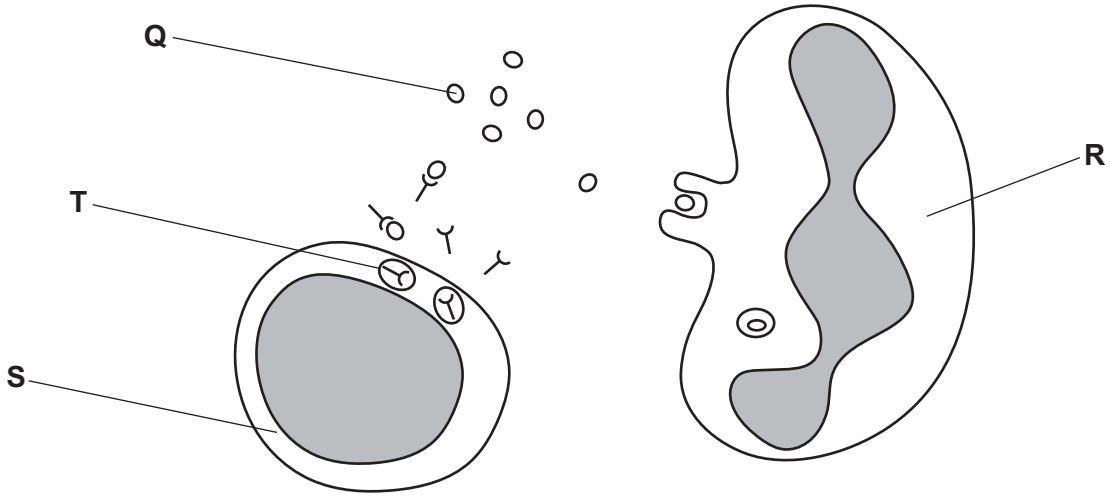

Fig. 2.1

Explain how the immune system responds to an invasion of pathogens.

Use the letters in Fig. 2.1 in your answer.

.....

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.....

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.....

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.....

.....

..... [6]

(b) A vaccine was introduced in 1942 for a particular disease.

Fig. 2.2 shows the effect of introducing the vaccine on the number of cases of the disease in one country.

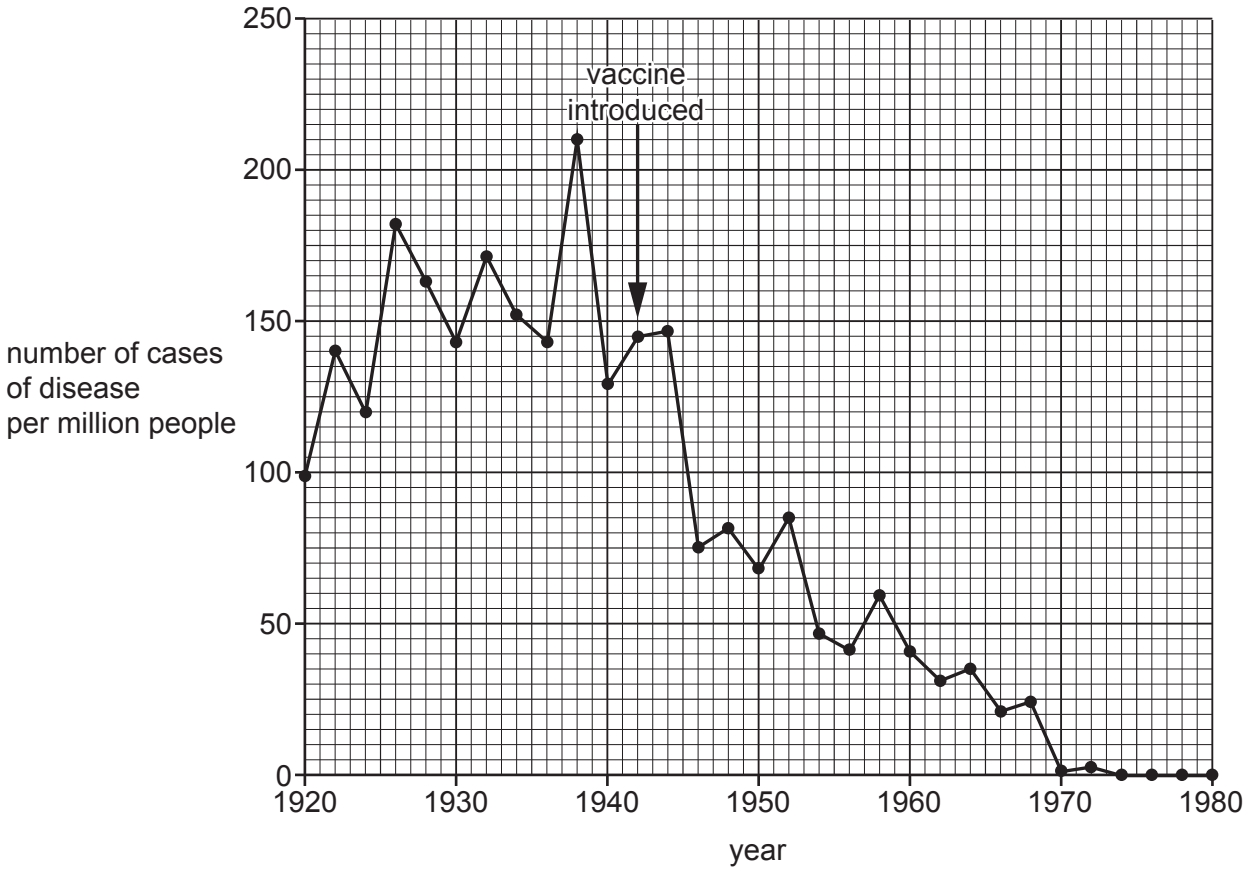

Fig. 2.2

In 1946 the government of the country concluded that the vaccine was successful.

Discuss the evidence, shown in Fig. 2.2, for **and** against this conclusion.

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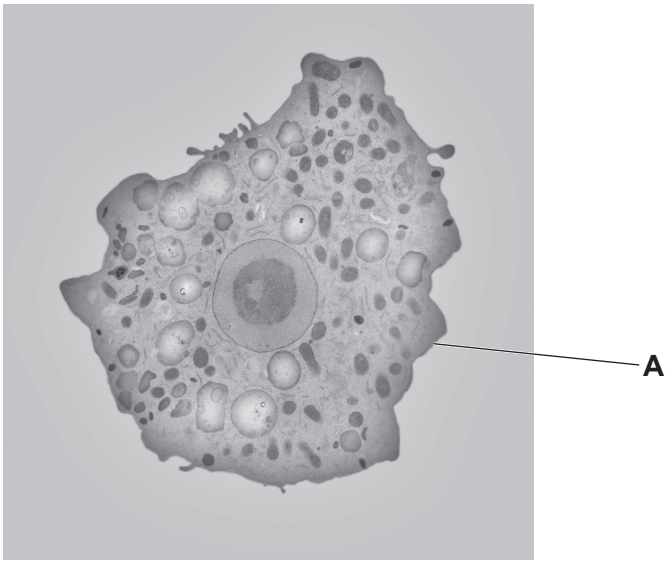
..... [4]

[Total: 10]

3 All living organisms excrete waste products.

(a) Fig. 3.1 is a photomicrograph of *Naegleria fowleri*, a single-celled protoctist that lives in watery environments.



magnification ×4000

Fig. 3.1

(i) State a feature of *N. fowleri*, visible in Fig. 3.1, that distinguishes it from prokaryotes.

..... [1]

(ii) State the name and function of structure **A**.

structure .....

function .....

.....

[2]

(iii) Suggest how *N. fowleri* excretes carbon dioxide.

.....

..... [1]

(b) Urea is a toxin that is excreted by the kidneys in humans.

Describe how **and** where in the body urea is formed.

.....

.....

.....

.....

.....

.....

..... [3]

5 Milk is a source of some of the nutrients that are part of a balanced diet.

(a) Calcium and protein are two nutrients found in milk.

Describe the importance of calcium and protein in the diet.

calcium .....

.....

.....

protein .....

.....

.....

[4]

(b) Lactose is found in cows' milk. Some people do not have the enzyme to digest lactose.

State the names of **two** organs, associated with the alimentary canal, that produce enzymes.

1 .....

2 .....

[2]

2 Fig. 2.1 is a vertical section of a human molar tooth and surrounding structures.

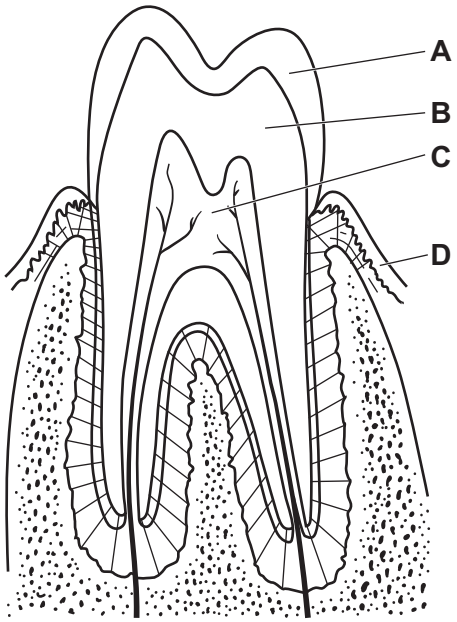


Fig. 2.1

(a) State the names of the parts labelled **A** to **D** on Fig. 2.1.

A .....

B .....

C .....

D .....

[4]

(b) Describe **and** explain the function of molar teeth.

.....

.....

.....

.....

.....

.....

..... [3]

4 **(a)** Yeast cells have many structures in common with a plant cell.

Fig. 4.1 is a drawing of a yeast cell.

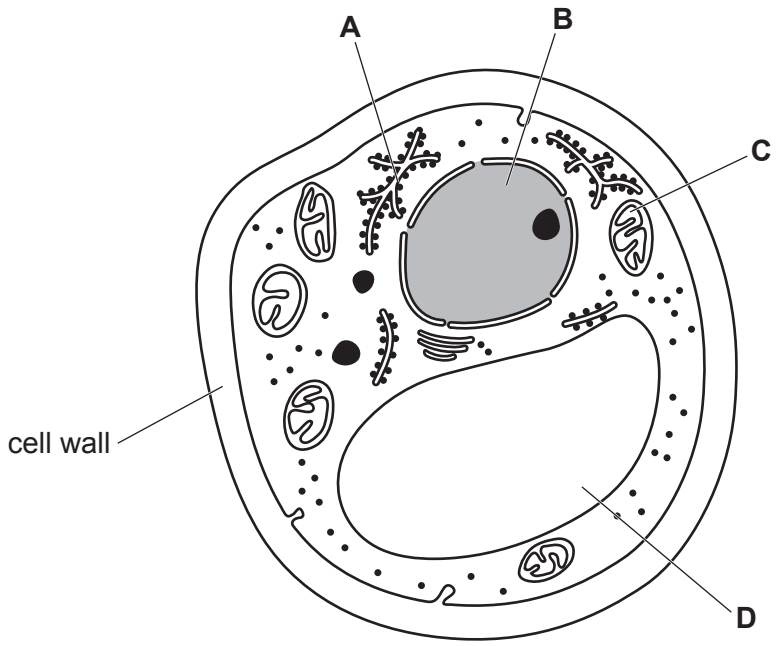


Fig. 4.1

(i) State the names of the cell structures labelled **A** and **D** on Fig. 4.1.

A .....

D .....
[2]

(ii) State the functions of the cell structures labelled **B** and **C** on Fig. 4.1.

B .....

C .....
[2]

(iii) State the name of **one** structure that is found in plant cells but is absent in yeast cells.

..... [1]

(b) Yeast is used in the production of ethanol to manufacture a type of biofuel.

Fig. 4.2 is a flow chart of the process.

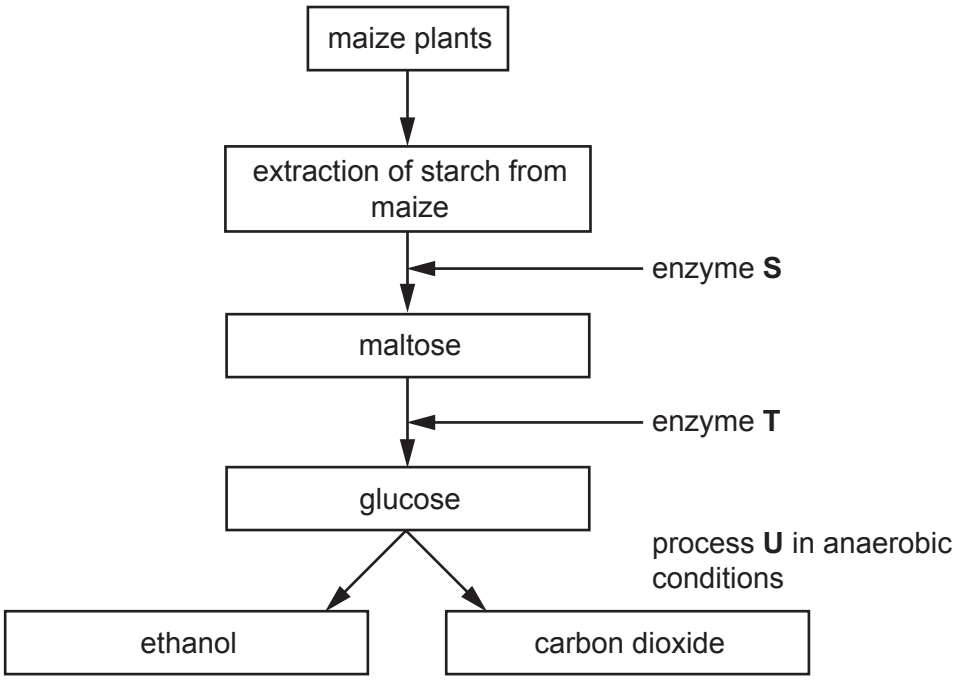


Fig. 4.2

(i) State the names of enzymes **S** and **T**.

S .....

T .....
[2]

(ii) Yeast is used in process **U**. Complete the balanced chemical equation for anaerobic respiration in yeast.

..... ⟶ .....C_2H_5OH + ...
[2]

(iii) Suggest the advantages of using biofuels instead of fossil fuels.

.....

.....

.....

.....

.....

.....

..... [3]

(iv) Carbon dioxide may be collected from process **U** and sold for use in glasshouses.

Explain why carbon dioxide is used in glasshouses.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 16]

6 Fig. 6.1 is a diagram of DNA.

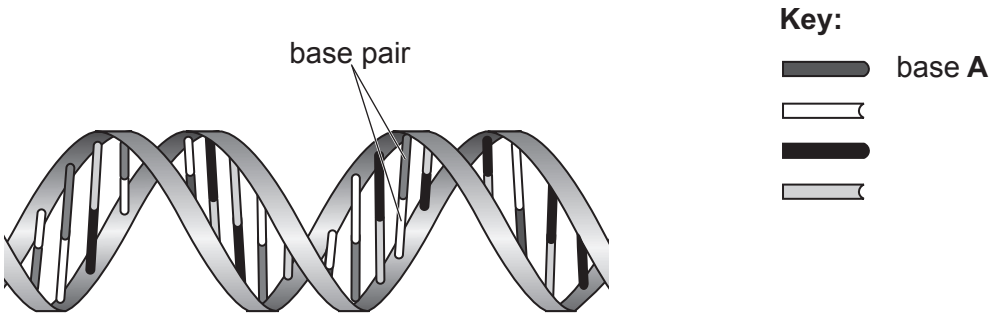


Fig. 6.1

(a) (i) State the letter of the base that pairs with **A**.

..... [1]

(ii) State the letters of the other bases in DNA.

..... [1]

(b) Outline the roles of DNA in a cell.

.....

.....

.....

.....

..... [2]