OCR GCSE GATEWAY BIOLOGY A · J247

BIOLOGY



EXAM QUESTION PACK

B2.2 THE CHALLENGES OF SIZE

SCORE	PERCENTAGE
/327	%

STEMUP

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Gateway Biology A (9-1)

The challenges of size

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **327**.
- The total number of marks may take into account some 'either/or' question choices.

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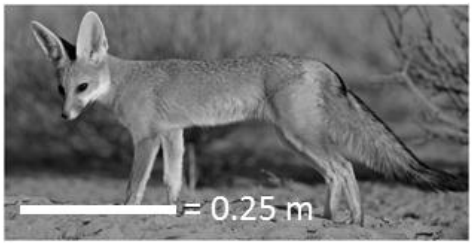
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1 The pictures show four foxes from different parts of the world.

Which fox has the largest surface area:volume ratio?

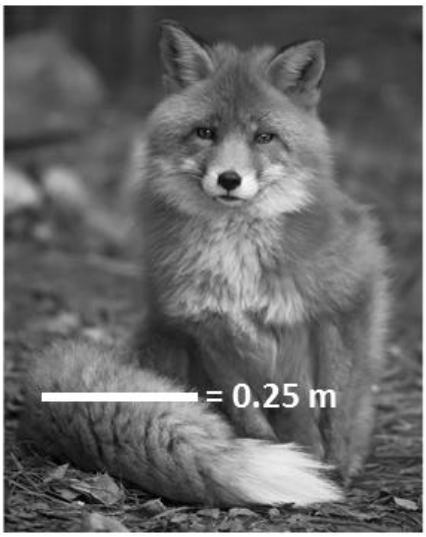
A



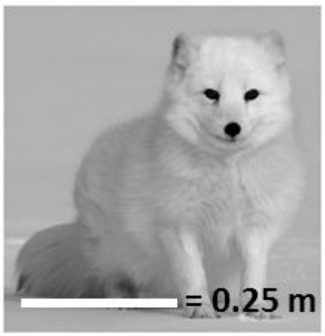
B



C



D



Your answer

[1]

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2 Through which type of cell do plants take in water?

A guard cell
B phloem cell
C root hair cell
D xylem cell

Your answer ☐

[1]

3 What is the process when water goes out of plant leaves into the air?

A osmosis
B photosynthesis
C translocation
D transpiration

Your answer ☐

[1]

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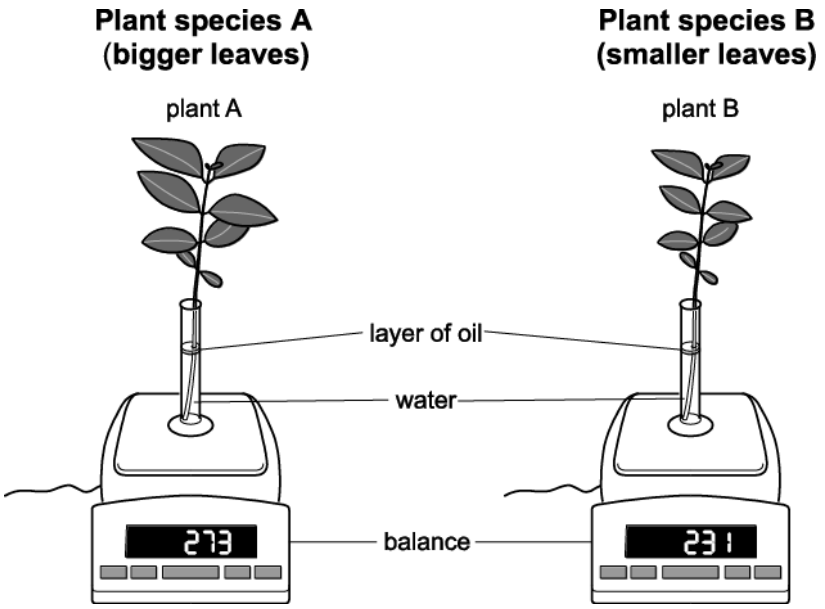
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4(a) Emma wants to compare the transpiration rates of two types of plant.

The plants have different sized leaves.

The diagram shows how she sets up her experiment.



Suggest why Emma put a layer of oil on top of the water.

---

[2]

(b) She makes sure that each plant has the same number of leaves.

Which other experimental conditions should she keep the same?

---

[3]

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(c) * The table shows Emma's results.

	Plant species A (bigger leaves)	Plant species B (smaller leaves)
mass at start (g)	261	273
mass after 24 hours (g)	228	231

Write a conclusion with an explanation about this experiment.

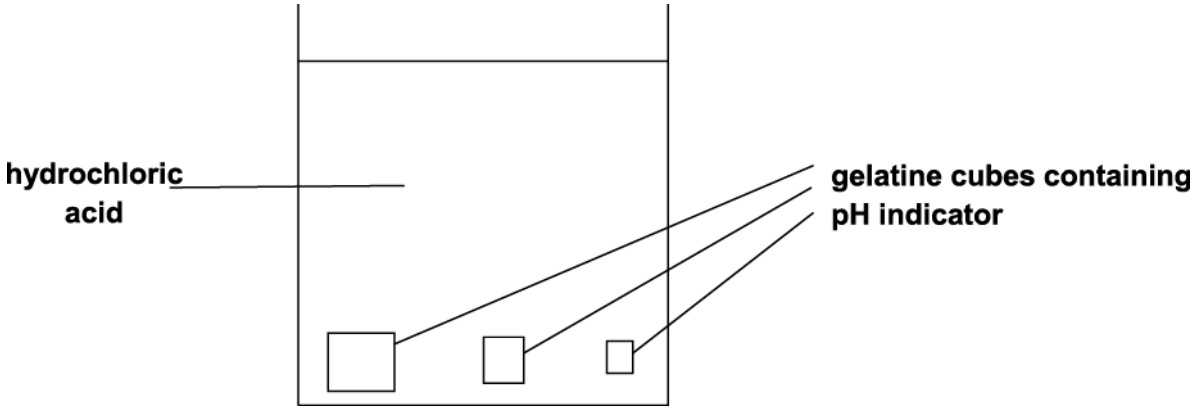
Use data / calculations in your answer.

[6]

5(a) Some students investigate the effect of the ratio of surface area:volume on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes stained blue with pH indicator.

They put different sized cubes into a beaker of hydrochloric acid and time how long it takes for the cubes to completely change colour.



The table shows their results.

length of 1 side of cube (cm)	surface area:volume ratio (cm^{-1})	time to completely change colour in seconds
1	_____	132
2	3	328
3	2	673

(i) Calculate the surface area:volume ratio for the cube with sides of 1 cm.

answer = _____ cm^{-1} [1]

(ii) Calculate the rate of colour change for each of the three cubes.

Write your answers in the table below.

Show your answers in standard form.

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length of 1 side of cube (cm)	rate of colour change (s^{-1})
1	_____
2	_____
3	_____

[2]

(iii) Use the results and your calculations in parts **(i)** and **(ii)**

Explain why most single celled organisms do **not** need a transport system (e.g. the circulatory system of multi cellular organisms).

---[2]

(b) Oxygen enters red blood cells by diffusion.

Describe and explain how red blood cells are adapted for the efficient uptake and transport of oxygen.

---[5]

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6 Rheumatic fever is a rare disease in the UK.

Look at this information.

Rheumatic fever information leaflet

Bacteria can enter the mouth and cause sore throats.

This may develop into rheumatic fever.

Rheumatic fever is much more likely if a person does not get enough food or lives in overcrowded conditions.

White blood cells in the body make protein molecules to kill these bacteria.

However, sometimes these molecules attack heart valves making them leaky.

(i) Put ticks (✓) in the **two** boxes that best describe rheumatic fever.

a communicable disease	
a disease that is caused by defective alleles	
a non-communicable disease	
a disease that is affected by lifestyle	

[1]

(ii) White blood cells make protein molecules to kill the bacteria.

What is the name of these protein molecules?

---

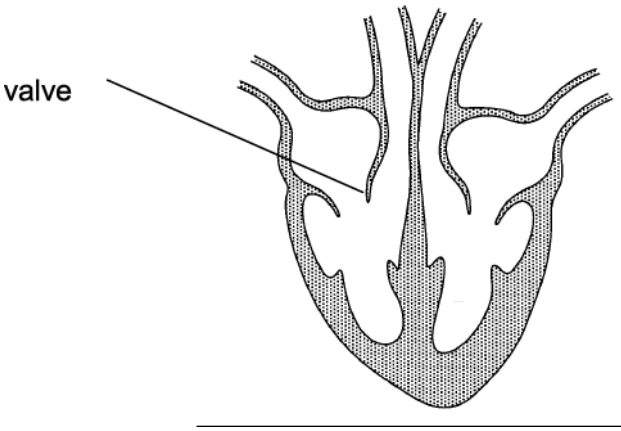
[1]

(iii) The diagram shows one of the valves that can be made leaky by rheumatic fever.

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People who have this leaky valve often have these symptoms:

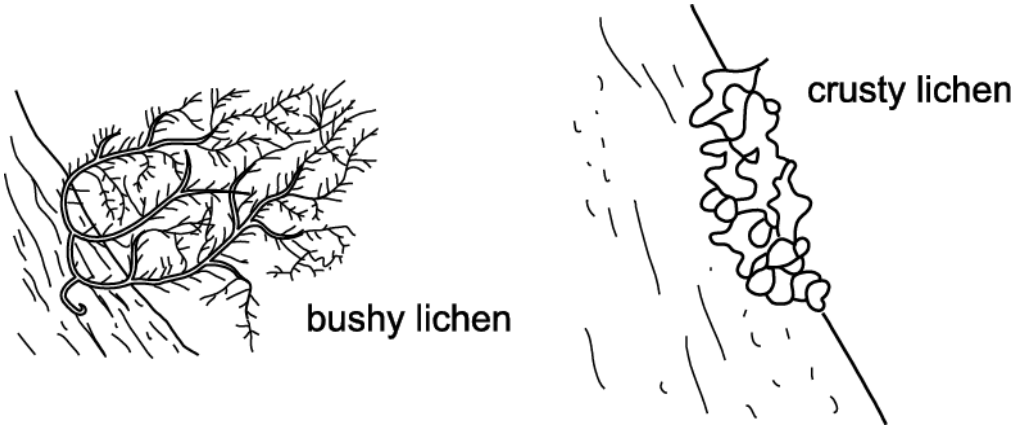
- they get out of breath easily
- they do not seem to have much energy and feel tired.

Write about the job of this valve and how damage to it may cause these symptoms.

[4]

7 Lichens are sensitive to pollution because they take up chemicals from the air.

The diagram shows a 'bushy' species of lichen and a 'crusty' species of lichen.



Bushy lichens are usually more sensitive to pollution than crusty lichens.

Use the diagrams to suggest why.

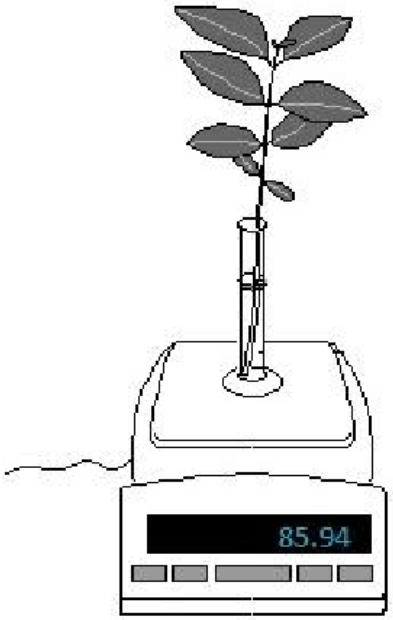
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[1]

8(a) Emma wants to investigate the effect of air movement on transpiration.

The diagram shows how she sets up her experiment.

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Emma measures the rate of transpiration by measuring the loss in mass over 3 hours.

She does this first with the fan switched off.

She then repeats this but with the fan switched on.

She keeps all other environmental conditions the same.

These are her results.

	Fan switched off	Fan switched on
Mass loss in 3 hour in g	37	144

Explain the difference in her results.

[2]

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(b) Emma kept environmental conditions like light intensity and temperature the same.

(i) Why was it important to keep the light intensity the same?

---

[2]

(ii) Why was it important to keep the temperature the same?

---

[1]

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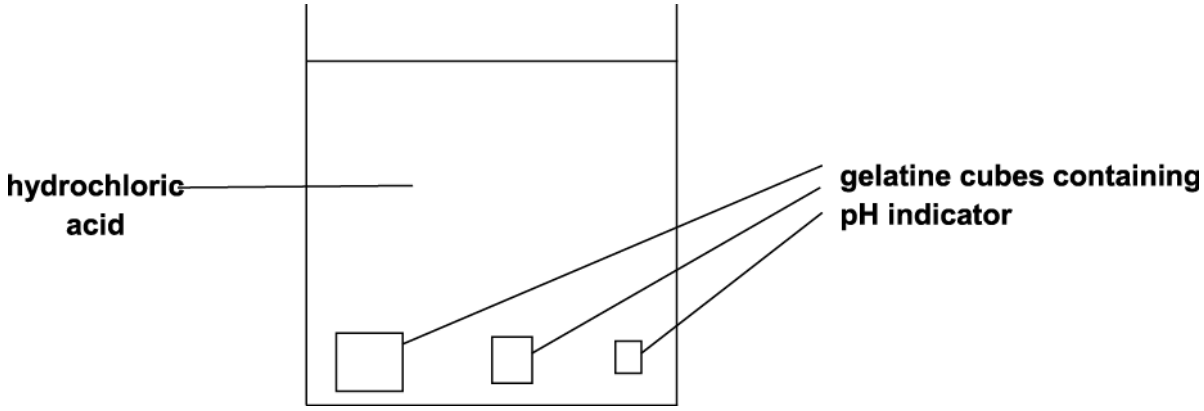
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9(a) Some students investigate the effect of the ratio of surface area:volume on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes stained blue with pH indicator.

They put different sized cubes into a beaker of hydrochloric acid and time how long it takes for the cubes to completely change colour.



The table shows their results.

length of 1 side of cube (cm)	surface area:volume ratio (cm^{-1})	time to completely change colour in seconds
1	_____	132
2	3	328
3	2	673

(i) Calculate the surface area:volume ratio for the cube with sides of 1 cm.

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answer = _____ cm^{-1} [1]

(ii) Calculate the rate of colour change for each of the three cubes.

Write your answers in the table below.

Show your answers in standard form.

length of 1 side of cube (cm)	rate of colour change (s^{-1})
1	_____
2	_____
3	_____

[2]

(iii) Use the results and your calculations in parts **(i)** and **(ii)**

Explain why most large multi cellular organisms need transport systems, such as the blood system, but most single celled organisms do **not**.

_____

_____

_____

_____ [2]

(iv) Explain why using gelatine spheres instead of cubes might be more biologically accurate but suggest why the students used cubes instead.

_____

_____

_____

_____ [2]

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(b) Oxygen enters red blood cells by diffusion.

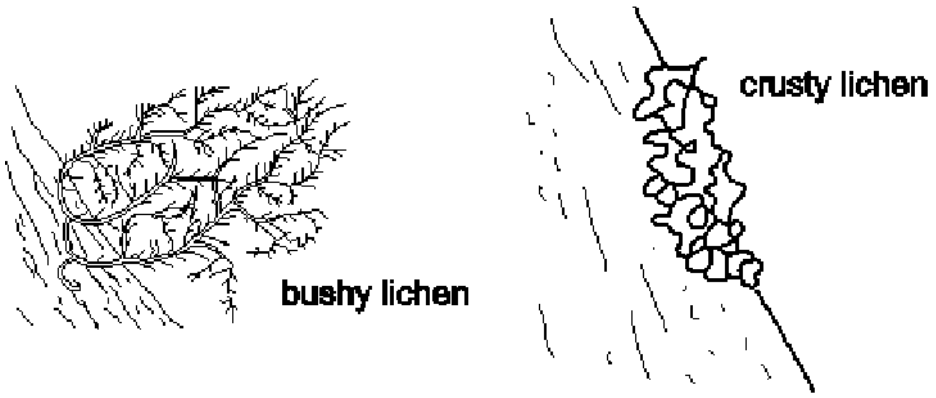
Describe and explain how red blood cells are adapted for the efficient uptake and transport of oxygen.

---

[5]

10 Lichens are sensitive to pollution because they take up chemicals from the air.

The diagram shows a 'bushy' species of lichen and a 'crusty' species of lichen.



Bushy lichens are usually more sensitive to pollution than crusty lichens.

Use the diagrams to suggest why.

---

[1]

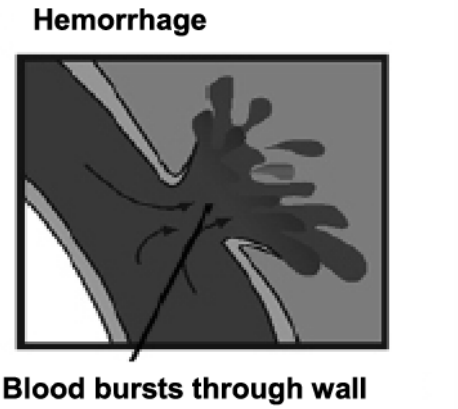
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11 Strokes are a type of cardiovascular disease.

One cause of a stroke is an artery in the brain bursting.



(i) When a person has a stroke, why are arteries more at risk of bursting than veins?

---

[1]

(ii) How are arteries adapted to try and prevent them bursting and causing a stroke?

---

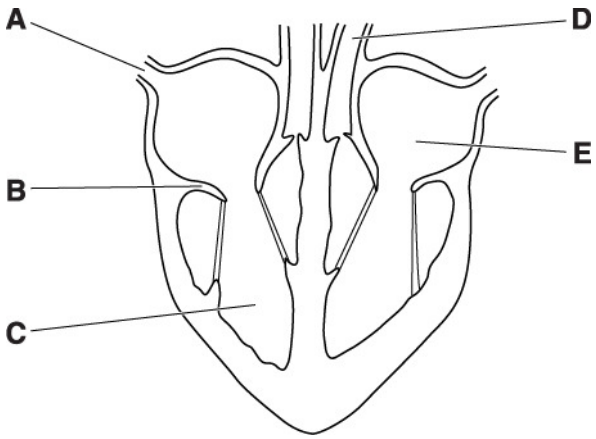
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12(a) Look at the diagram of a human heart.



Write the letter **A** to **E** next to the correct name of each part of the heart.

name of part	letter
aorta	
left atrium	
right ventricle	
tricuspid valve	
vena cava	

[2]

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(b) Blood contains cells.

One type of cell is a red blood cell.

(i) Red blood cells are adapted for their job by being very small.

Explain why this helps them do their job.

____ [1]

(ii) Haemoglobin is found in red blood cells.

Haemoglobin is a protein made in the cytoplasm.

Red blood cells start off life with a nucleus.

The gene for haemoglobin is **only** found in the nucleus.

Explain how it is possible that haemoglobin can be made in the cytoplasm.

____

____

____ [2]

(iii) Haemoglobin is important in transporting oxygen.

Describe how haemoglobin transports oxygen from the lungs to the body cells.

____

____

____ [2]

(c) Blood also contains white blood cells.

White blood cells and red blood cells are made in the bone marrow.

Why can cells in the bone marrow produce both red and white blood cells?

____

____

____ [2]

13 When an embryo grows, one of the first organs to form is the heart.

(i) What is the job of the heart?

---

[2]

(ii) The heart cells develop from stem cells by a process called cell differentiation.

What is meant by cell differentiation?

---

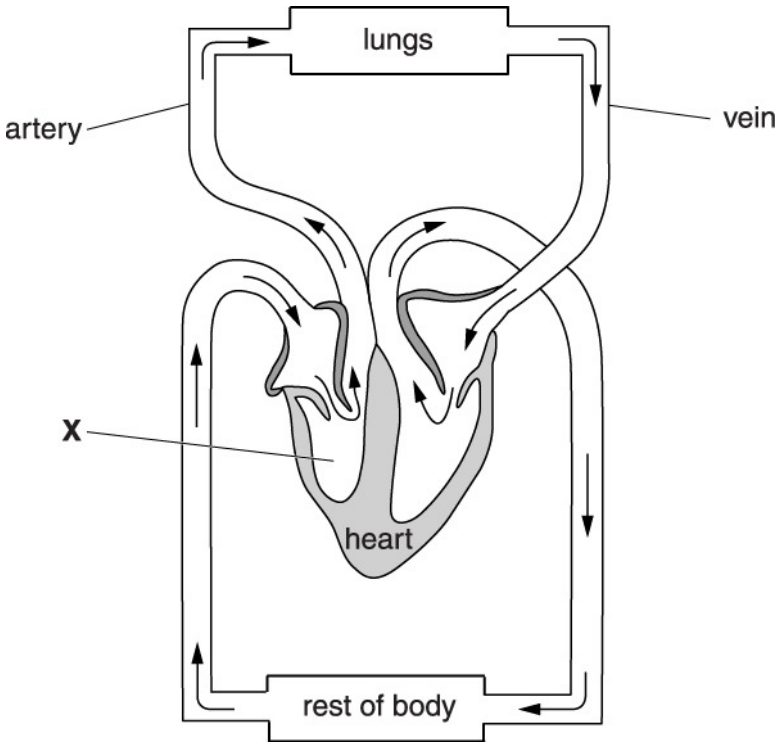
[1]

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14(a) Look at the diagram of the human circulatory system.



Complete the sentences.

Blood at **X** is travelling through the _____ side of the heart.

Blood in arteries is under higher _____ than it is in veins.

[2]

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(b) Blood contains cells.

One type of cell is a red blood cell.

(i) What is the job of a red blood cell?

---

[1]

(ii) Haemoglobin is found in red blood cells.

Which chemical codes for the production of haemoglobin?

---

[1]

(c) Blood also contains white blood cells.

White blood cells are made in bone marrow.

How can bone marrow cells make lots of white blood cells?

---

[2]

15 Mangroves are trees that grow on the coasts of many tropical countries.

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Mangroves grow in mud.

The mud is low in oxygen and nutrients.

(i) Suggest why the lack of oxygen makes the nutrient content low.

---[2]

(ii) Some mangroves grow structures from their roots to absorb oxygen from the air for respiration.

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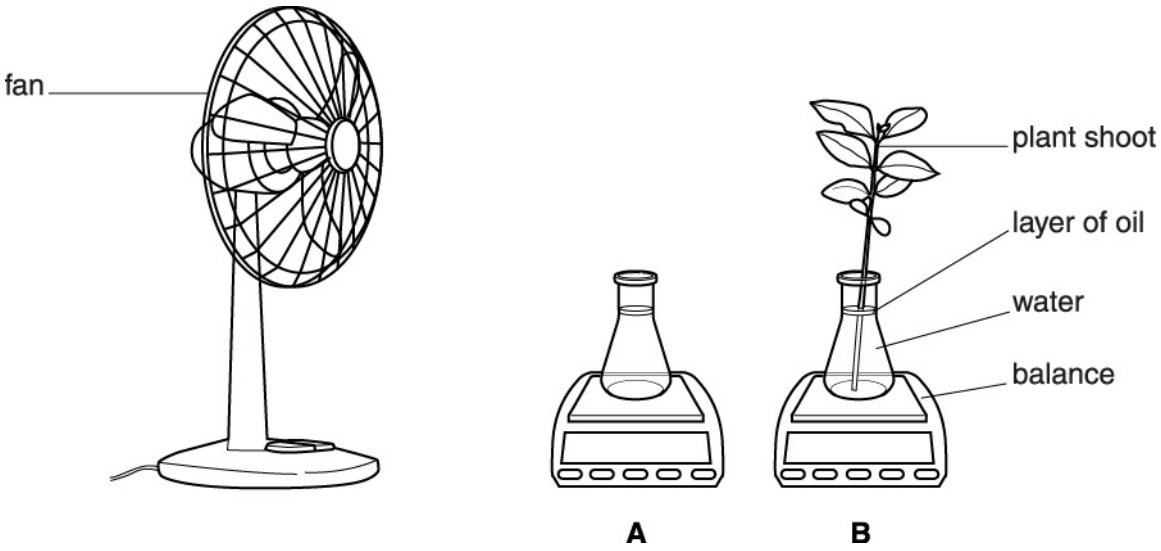
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Why do mangrove roots need to respire?

---[3]

16 Liz wants to investigate how air movement affects the rate of transpiration.



She turns the fan on and measures how the readings on the balances change every five minutes.

Describe and explain the overall expected results for **A** and **B**.

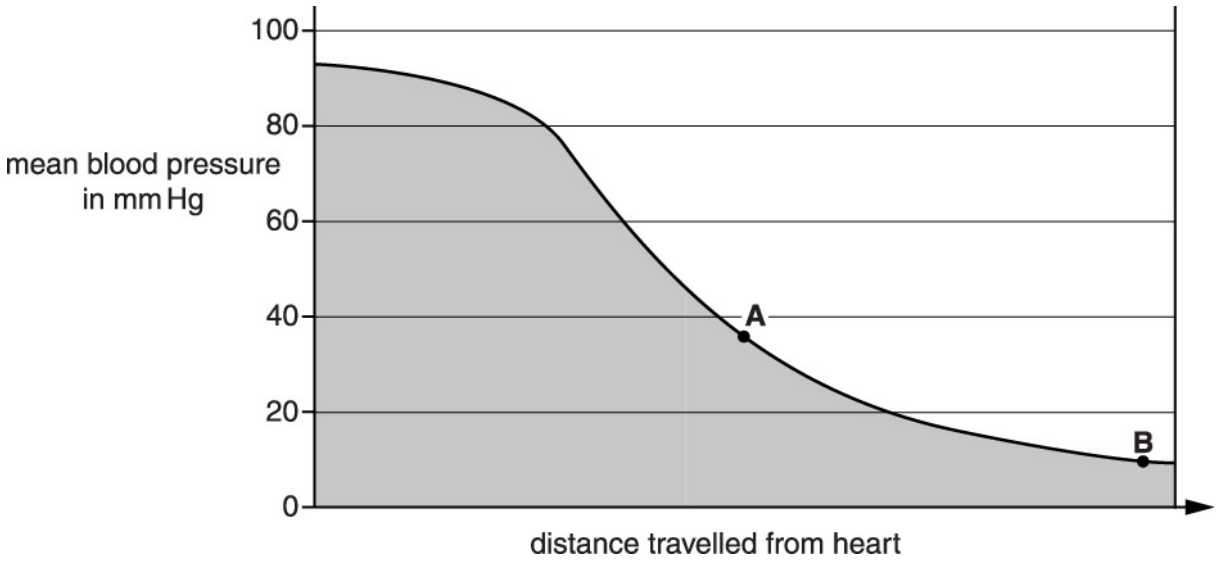
The quality of written communication will be assessed in your answer to this question.

[6]

17(a) This question is about circulation.

Look at the graph.

It shows the changes in pressure as blood leaves the heart and passes through blood vessels.



(i) Blood leaving the heart has a pressure of 93 mm Hg.

The blood pressure drops by 84 mm Hg.

Calculate the percentage drop in blood pressure.

percentage drop in blood pressure _____ %

[1]

(ii) Use the graph to name the type of blood vessels at point **A** and point **B**.

blood vessel at point **A** _____

blood vessel at point **B** _____

[2]

(b) The valves inside someone's heart can become damaged.

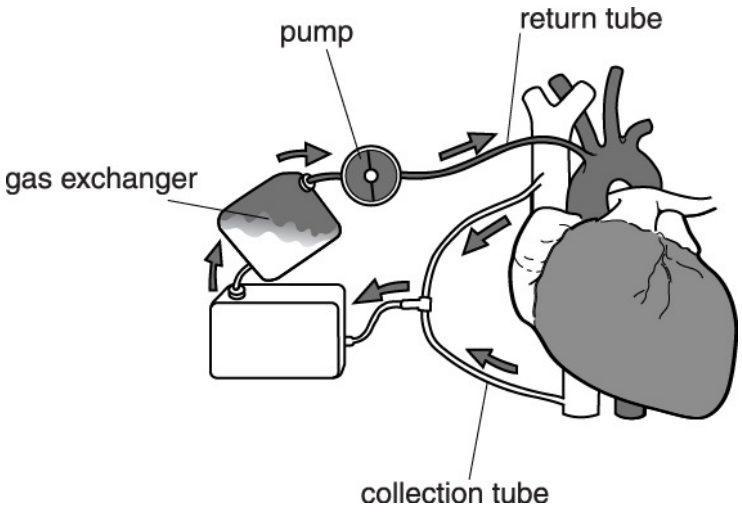
How can damaged heart valves affect a person's circulatory system?

---

[2]

18 During some operations, it is necessary to stop a patient's heart beating.

The patient is connected to a heart and lung machine.



Write about which parts of the machine do the jobs of the heart and the lungs.

--- [2]

19 In 1649 a scientist called Van Helmont wanted to find out if plants gained mass from water.

He watered the soil during the experiment.

He covered the soil so that water could not evaporate from the soil.

(i) The mass of the water that he added during the five years, was **much more** than the increase in mass of the plant.

Suggest why.

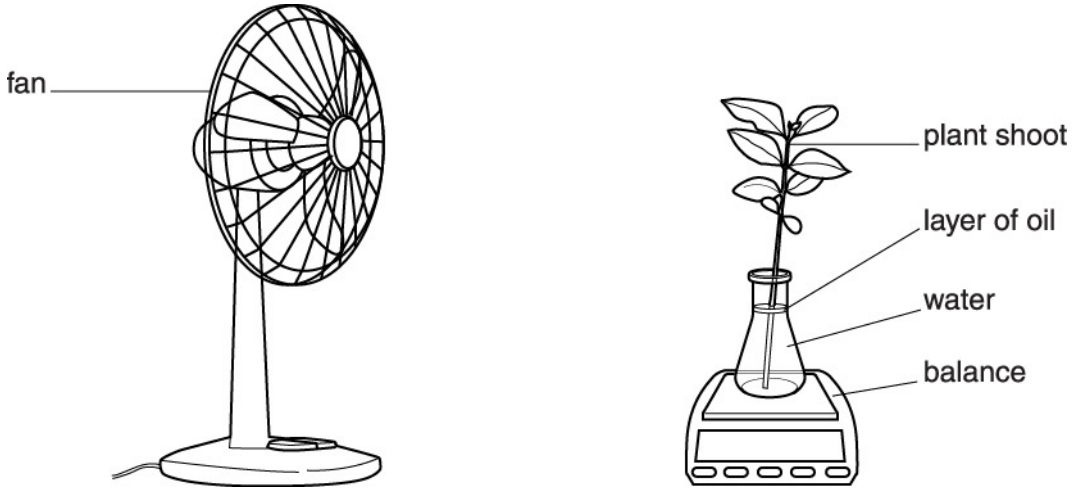
---[2]

(ii) He needed to water the soil much more on windy days.

Explain why.

---[2]

20 Liz wants to investigate how air movement affects the rate of transpiration.



Describe how Liz could do her experiment and write down the expected results.

Use the equipment shown in the diagram. You can include other equipment if you want to.

The quality of written communication will be assessed in your answer to this question.

[6]

21 This question is about circulation.

Look at the graph.

It shows the changes in pressure as blood leaves the heart and passes through blood vessels.



(i) Blood leaving the heart has a pressure of 93 mm Hg.

The blood pressure drops by 84 mm Hg.

Calculate the percentage drop in blood pressure.

percentage drop in blood pressure _____ %

[1]

(ii) Use the graph to name the type of blood vessels at point **A** and point **B**.

blood vessel at point **A** _____

blood vessel at point **B** _____

[2]

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22 Carbon dioxide and water are needed for photosynthesis.

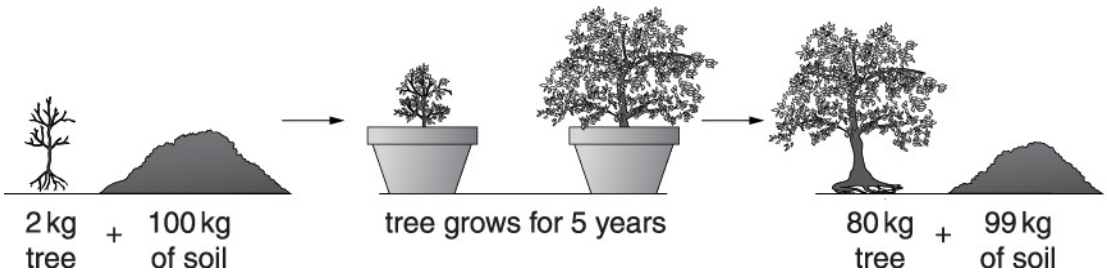
In 1649, scientists thought that plants grew by **only** taking in solid materials from the soil.

A scientist called van Helmont did an experiment to test this idea.

He grew a tree in a large pot of soil.

He measured the mass of the soil and the tree before the experiment.

He measured them again, five years later.



(i) Explain how van Helmont's experiment proved the scientists wrong.

---

[2]

(ii) During the five years, van Helmont watered the soil.

Describe how water enters the tree and what happens to the water once it has entered.

---

[3]

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23 Tim is seeing a doctor about his heart.



The doctor says that Tim's heart muscle is not getting enough blood.

This is because he has a blockage in one of his coronary arteries.

The doctor tells Tim that he needs an operation.

Put a tick (✓) next to the type of surgery that can treat this problem.

a by-pass operation	☐
a valve replacement	☐
inserting a pacemaker	☐
inserting a 'heart assist' device	☐

24(a) Bristlecone pine trees are among the longest living things on Earth.

One of them, called Methuselah, is in California and is over 4 800 years old.



Methuselah

Bristlecone pine trees live high up in the mountains.

The low temperature, dry soil and strong wind make the trees grow very slowly.

This is because these conditions affect both transpiration and photosynthesis.

Explain how and why these conditions affect both transpiration and photosynthesis.



The quality of written communication will be assessed in your answer to this question.

[6]

(b) As a bristlecone pine tree gets older, much of its wood dies.

In old trees only a narrow strip of functioning tissue transports substances between the roots and the leaves.

What types of cells will be in this tissue?

Write down the names of these types of cells and what substances each type of cell transports.

---

[4]

25 Jo buys an apple tree and plants it in her garden.

Jo waters the tree and then gives it some fertiliser.

The tree roots absorb the minerals in the fertiliser by **active transport**.

Explain what active transport is.

---

[2]

26 About 1 in 10 000 people has a condition called situs inversus.

People with this condition have **their organs reversed** so they are a '**mirror image**' of the usual arrangement.

For most people with situs inversus, there are no harmful effects on their health.

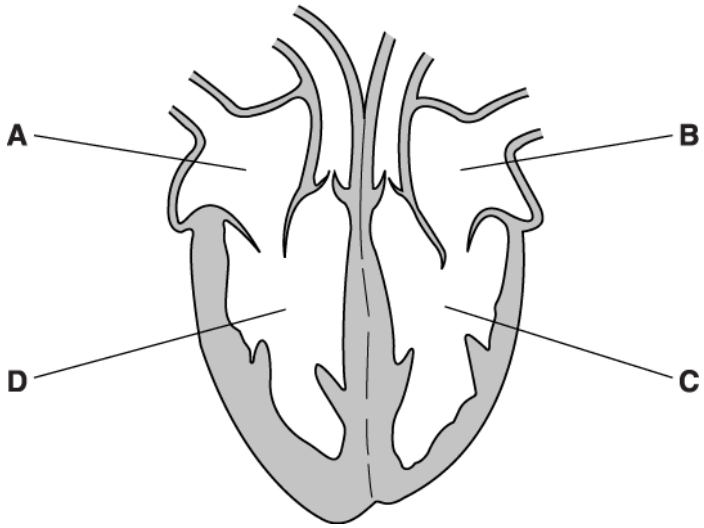
However, doctors need to know if someone has the condition if they are going to successfully treat them if they are ill or injured.

The diagram shows the heart from someone with situs inversus, viewed from the front.

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(i) Look at the diagram of the heart. Which part pumps blood **around the body**?

Choose from **A**, **B**, **C** or **D**, and explain your choice.

---

[2]

(ii) If someone with situs inversus needs a heart transplant, then a normal heart can be used.

The procedure will be very similar to a normal heart transplant but there will need to be some differences.

Suggest how the procedure will be different.

Explain your answer.

---

[2]

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27 Two athletes run in a long race.

During the race both athletes made more carbon dioxide than normal.

Why is more carbon dioxide made and why must it be removed from the body?

---

[2]

28 Tim is seeing a doctor about his heart.



The doctor says that the muscle in Tim's heart is not getting enough blood.

(i) Which substances does heart muscle get from the blood?

Put ticks (✓) next to the **two** substances in this list.

carbon dioxide	☐
glucose	☐
oxygen	☐
urea	☐

[1]

(ii) Which blood vessel supplies the heart muscle with blood?

Choose your answer from this list.

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coronary artery

coronary vein

pulmonary artery

pulmonary vein

vena cava

[1]

29 Bristlecone pine trees are among the longest living things on Earth.

One of them, called Methuselah, is in California and is over 4 800 years old.



Methuselah

Bristlecone pine trees live high up in the mountains.

The temperature, dry soil and strong wind make them grow very slowly.

Explain why these extreme conditions make the bristlecone pine trees grow very slowly.

The quality of written communication will be assessed in your answer to this question.

[6]

30(a) Jo buys an apple tree and plants it in the middle of her garden.

She does **not** do anything else to it and leaves it for a month.

The first picture shows the tree when she first plants it.

The second picture shows the tree a month later.



apple tree when first planted



apple tree one month later

(i) Describe what happened to the tree a month after planting.

---

[1]

(ii) Describe what she should do to help the tree recover.

---

[1]

(b) Jo planted the tree away from the house so it was **not** in the shade.

Explain why this is important for the tree.

---

[2]

31 Substances enter plants in different places.

Draw a straight line from each **substance** to the **place it enters a plant**.

You can use each place **once, more than once, or not at all.**

substance	place it enters a plant
carbon dioxide	phloem
oxygen	root hairs
water	stomata
	xylem

[3]

32 About 1 in 10 000 people has a condition called situs inversus.

People with this condition have **their organs reversed** so they are a '**mirror image**' of the usual arrangement.

For most people with situs inversus, there are no harmful effects on their health.

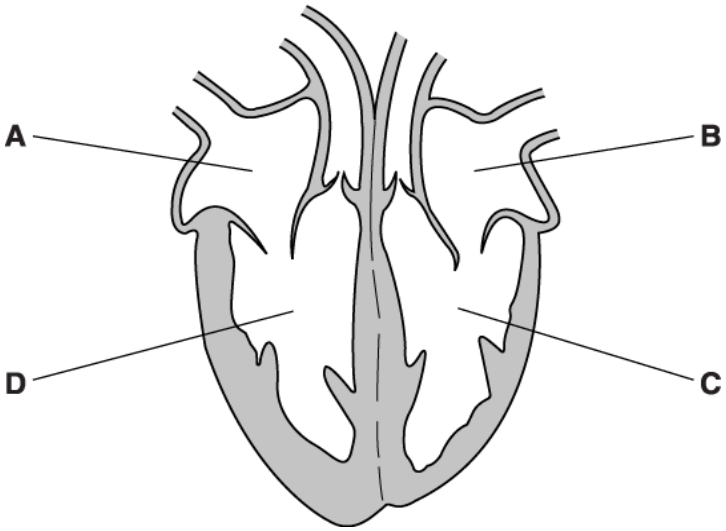
However, doctors need to know if someone has the condition if they are going to successfully treat them if they are ill or injured.

The diagram shows the heart from someone with situs inversus, viewed from the front.

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(i) Look at the diagram of the heart. Which part pumps blood **around the body**?

Choose from **A**, **B**, **C** or **D**, and explain your choice.

---

[2]

(ii) If someone with situs inversus needs a heart transplant, then a normal heart can be used.

The procedure will be very similar to a normal heart transplant but there will need to be some differences.

Suggest how the procedure will be different.

Explain your answer.

---

[2]

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33 When border collies run, their breathing and pulse rates have to increase.

Explain why they have to increase.

---

[3]

34

(i) Insecticides are a type of pesticide.

Some insecticides are used in liquid form.

They are poured onto the soil around a plant.

They are absorbed by the plant and transported to the leaves to kill insects feeding there.

Suggest which part of a plant absorbs the insecticide and which part transports the insecticide to the leaves.

---

[2]

(ii) Herbicides are another type of pesticide.

What do herbicides kill?

---

[1]

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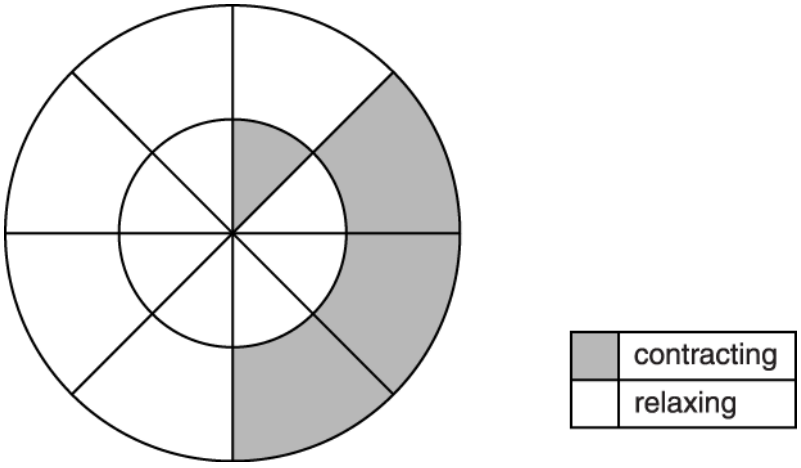
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35 Dicky is visiting the hospital to have his heart checked.

The doctor produces this diagram showing one complete cycle of Dicky's heart.

The inner circle shows what is happening in the atria and the outer circle shows what is happening in the ventricles.

The whole cycle lasts for 0.64 seconds.



(i) For how long do the atria contract during one cycle of Dicky's heart?

answer _____ seconds **[1]**

(ii) The longer a contraction lasts, the greater the pressure that can be generated by the heart.

Explain how and why the contraction time of the ventricles is different from the contraction time for the atria.

_____

_____

_____ **[2]**

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36 Pesticides can be used to kill pests, such as insects, that damage plants.

Some pesticides are dissolved in water and can be poured onto soil. They are absorbed by plant roots and transported to the leaves to kill insects feeding there.

These pesticides move through plants more quickly on warm sunny days.

Use this information to suggest what part of the plant transports these pesticides to the leaves, and why this happens more quickly on warm sunny days.

The quality of written communication will be assessed in your answer to this question.

[6]

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37 During exercise, the rate of blood flow to different parts of the body changes.

Look at the table.

	Rate of blood flow in ml per minute	
Part of body	**At rest**	**During exercise**
digestive system	1350	600
kidneys	1100	600
muscles	1000	12500
brain	700	750
skin	300	1900
heart muscle	200	750
other	350	400
Total blood flow to the body	5000	17500

The rate of blood flow to the lungs is always the same as the total rate of blood flow shown in the table. Suggest why.

---

[1]

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38 During exercise, the rate of blood flow to different parts of the body changes.

Look at the table.

	Rate of blood flow in ml per minute	
Part of body	**At rest**	**During exercise**
digestive system	1350	600
kidneys	1100	600
muscles	1000	12500
brain	700	750
skin	300	1900
heart muscle	200	750
other	350	400
Total blood flow to the body	5000	_____

Look at the table.

(i) Calculate the total rate of blood flow during exercise.

_____ ml per minute

[1]

(ii) The total rate of blood flow around the body changes during exercise.

What organ makes the rate of blood flow change and how does it do this?

_____

_____ **[2]**

39 Amir is in hospital.

A nurse measures Amir's blood pressure.

Explain why blood in the arteries is under pressure.

---

[2]

40(a)

The table shows two components of blood.

Component	Job
red blood cells	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
platelets	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Complete the table by writing the jobs in the empty boxes. [2]

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(b) Camels are animals that live in hot deserts.

The table shows some differences between camel blood and human blood.

Animal	Number of red blood cells per mm^3 of blood	Volume of one red blood cell in arbitrary units
Camel	7	40
Human	5	90

(i) Use the table to put ring around the words in bold that best complete these sentences.

In 1 mm^3 of camel's blood there are **equal numbers of / fewer / more** red blood cells compared to 1 mm^3 of human blood.

Each camel red blood cell is **larger than / smaller than / the same size as** a human red blood cell.

[2]

(ii) The percentage of blood that is red blood cells can be calculated using this formula.

$$\% \text{ of blood} = \frac{\text{number of red blood cells per mm}^3 \text{ of blood} \times \text{volume of one red blood cell}}{10}$$

Calculate the percentage of **camel blood** that is red blood cells.

Use the figures in the table and the formula.

answer = _____ %

[2]

(iii) Human blood is **45%** red blood cells.

If an animal does not drink for some time the percentage of red blood cells in the blood can increase.

This can be dangerous.

Camels and humans have a different percentage of red blood cells in their blood.

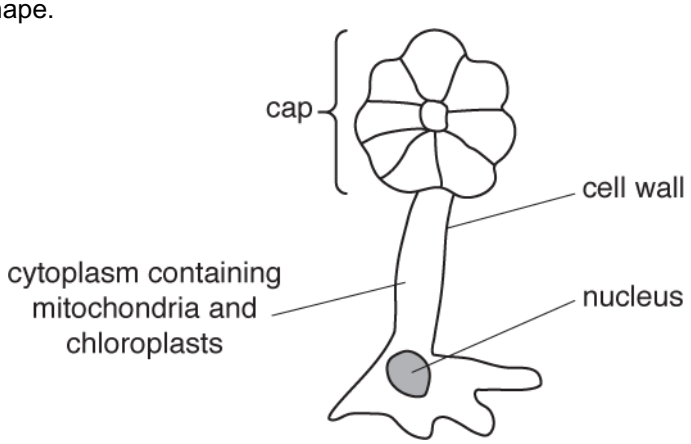
Suggest why.

---

[1]

41 *Acetabularia* is a unicellular organism that lives in the sea.

It has rather an unusual shape.



(i) Write down **two** features shown in the diagram of *Acetabularia* that tell you that it is **not** a bacterium.

1 ---

2 ---

[2]

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(ii) *Acetabularia* is one of the largest unicellular organisms.

To be larger, organisms need to be multicellular.

What is an advantage of being larger and multicellular?

Put a tick (✓) next to the **correct** answer.

Some genes can be lost from some cells. ☐

Both aerobic and anaerobic respiration can occur. ☐

Cells are able to differentiate and specialise. ☐

Organisms are able to clone themselves. ☐

[1]

(iii) To become multicellular, specialised organ systems may be needed.

Write down **one** of these systems and explain why it is needed.

---

[1]

42 The table shows some information about three types of mammal.

Mammal	Metabolic rate	Surface area of one red blood cell in arbitrary units	Volume of one red blood cell in arbitrary units	Surface area to volume ratio of red blood cells
Mouse	1.0	91	52	1.75
Rabbit	1.5	114	70	1.63
Shrew	7.5	60	24	

(i) Calculate the surface area to volume ratio of red blood cells for the shrew.

answer = _____

[1]

(ii) Explain how the shrew manages to maintain its metabolic rate.

Use your calculation in part **(b)(i)** and information from the table in your answer.

---

[3]

43 Carbon dioxide and water enter a plant at different points.

Finish these sentences to show where water and carbon dioxide enter plants.

Water enters a plant through the _____

Carbon dioxide enters a plant through the _____ [2]

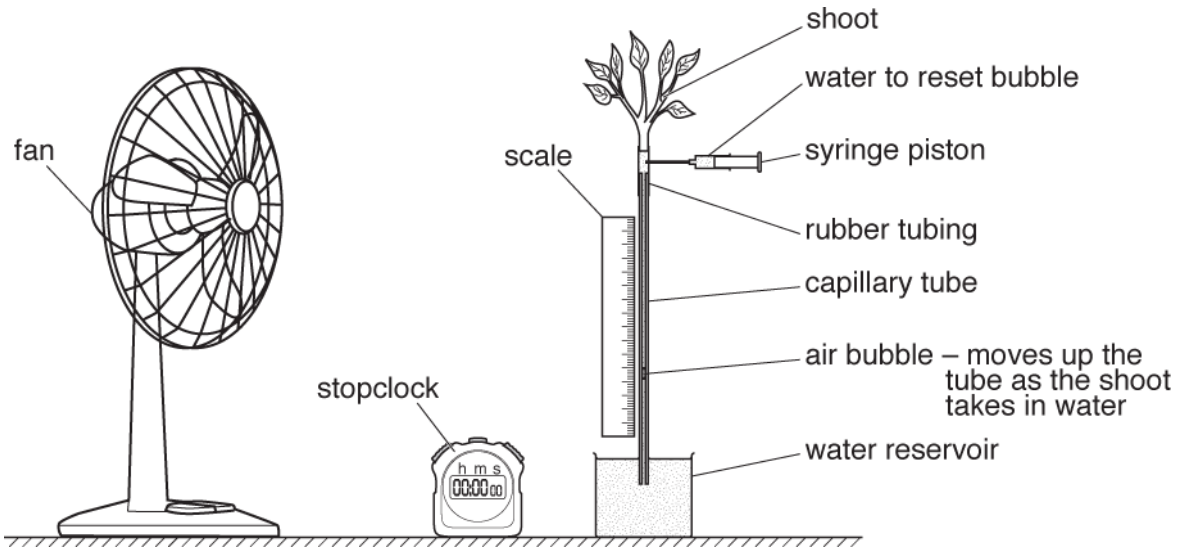
44 Transpiration is the loss of water from the leaves of a plant.
Look at the apparatus in the diagram.

The apparatus is used to measure the effect of air movement on the rate of transpiration.

The distance the air bubble moves in 5 minutes is measured.

The fan is used to change the amount of air movement around the leaves.

The method is repeated 3 times for each fan speed.



Here are the results.

Conditions	Distance air bubble moves in 5 minutes in mm

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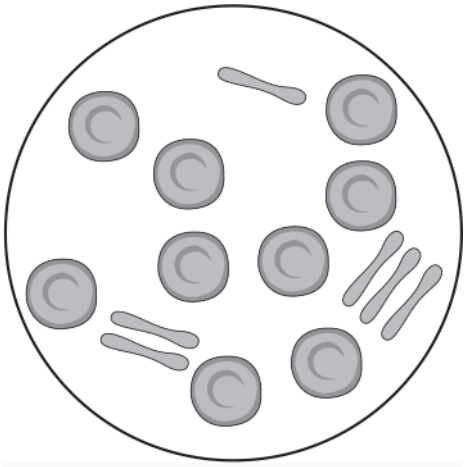
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	repeat 1	repeat 2	repeat 3
no fan	4	3	4
fan on slow speed	13	12	10
fan on medium speed	47	44	46
fan on fast speed	45	46	48

Explain the **complete** pattern in the results.

[3]

45 Which type of human cell is shown in this diagram?



A Egg cells

B Red blood cells

C Sperm cells

D White blood cells

Your answer [1]

46 Transpiration has a cooling effect on the leaves of plants.

Which statement **best** describes how this happens?

A Evaporation of water from the leaf removes heat energy.

B Water entering the stomata takes heat energy from the leaf surface.

C Water dripping off the leaf causes heat energy to be lost.

D Water falling on the leaf removes heat energy.

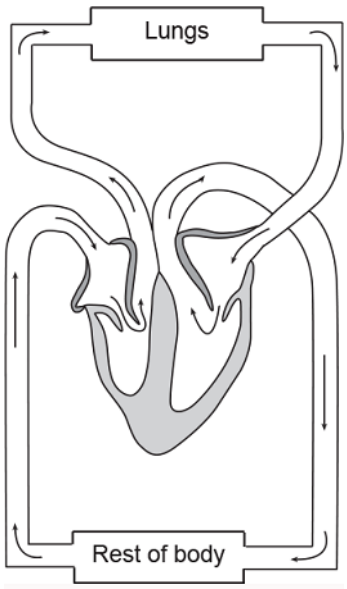
Your answer [1]

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47(a) Look at the diagram of the human circulatory system.



(i) Write the letter **X** on the diagram to show the position of the left ventricle. **[1]**

(ii) Complete the sequence to show the flow of blood through the circulatory system.

Left side of heart ↓
.....
Rest of body ↓
Veins ↓
Right side of heart ↓
Artery ↓
.....
Vein ↓
Left side of heart ↓

[2]

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(b) The blood travels through the heart twice on one complete circuit of the body.

(a) What is the name of this type of circulation?

---------- [1]

(b) Suggest **two** advantages of blood travelling through the heart twice in each complete circuit of the body.

1 ----------

----

2 ----------

---------- [2]

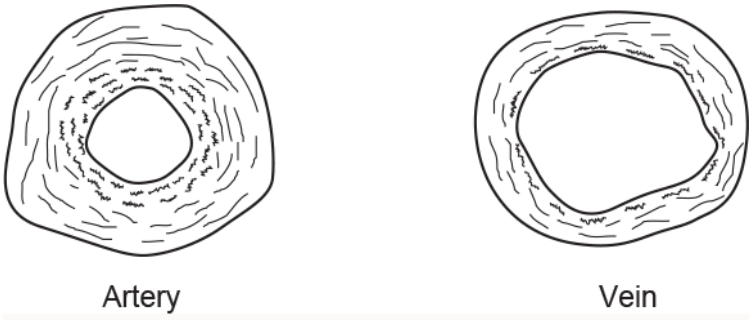
(c) How is the **thickness** of the heart wall on the left side different to the right side?

Write down **two** reasons for the difference.

---------- [2]

(d) Look at the diagram.

It shows a section of an artery and a vein.



(i) Describe **two** differences in structure between the artery and the vein shown in the diagram.

1 ----------

---

2 ----------

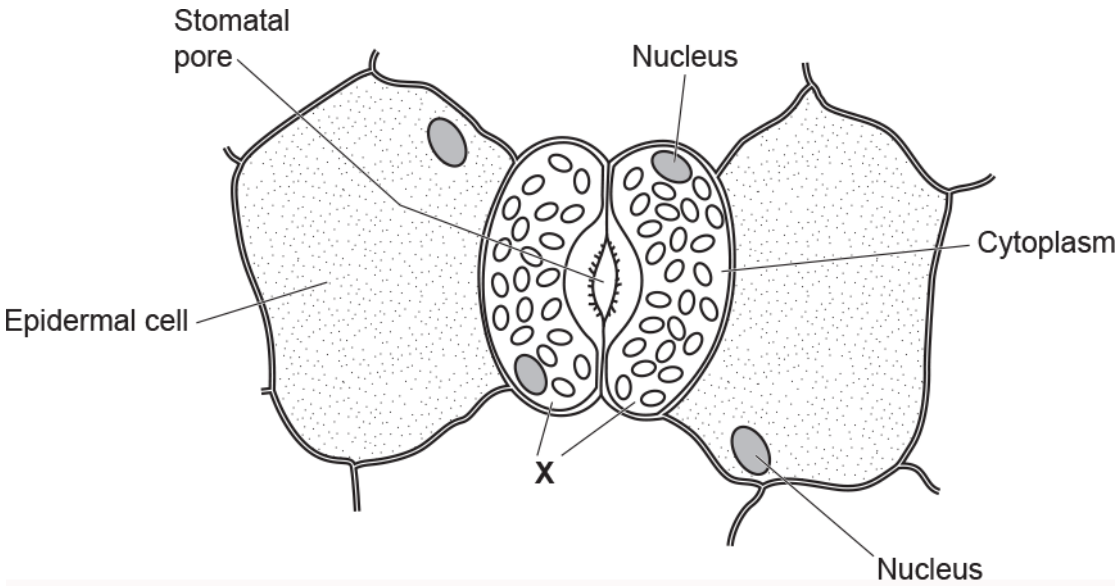
---[2]

(ii) Write down **one** difference between arteries and veins that is **not** shown in the diagram.

---[1]

48 Stomata are found on the surface of leaves.

The diagram shows some of the surface cells of a leaf.



(i) Write down the name of the cell labelled **X**.

---

[1]

(ii) Describe **two** functions of stomata.

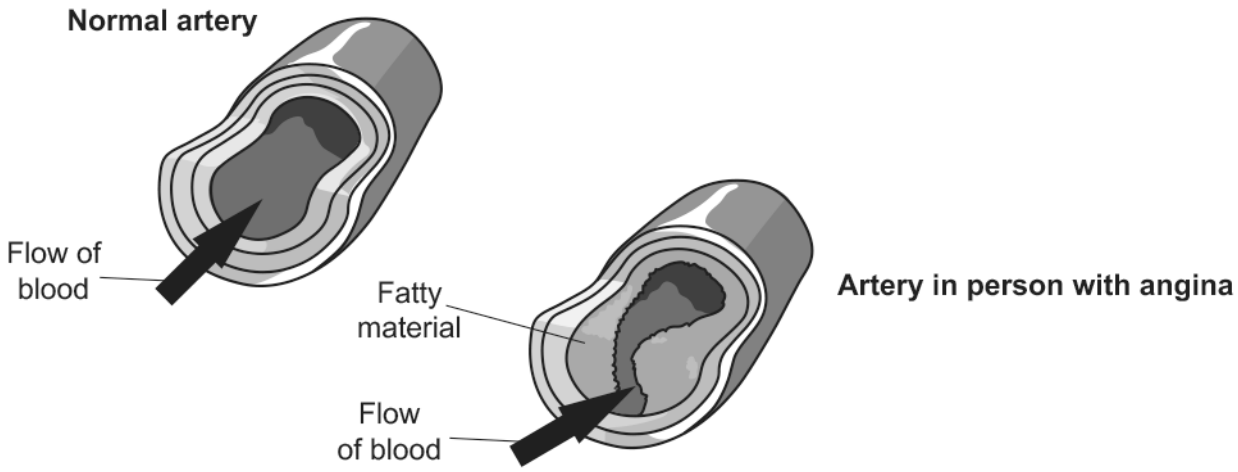
---

[2]

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49(a) Angina is caused by a problem in the arteries that supply the heart muscle.

Fatty material (cholesterol) builds up in these arteries.



In angina the heart muscle starts to carry out anaerobic respiration.

Explain why this happens.

Use the information in the diagram and your biological knowledge.

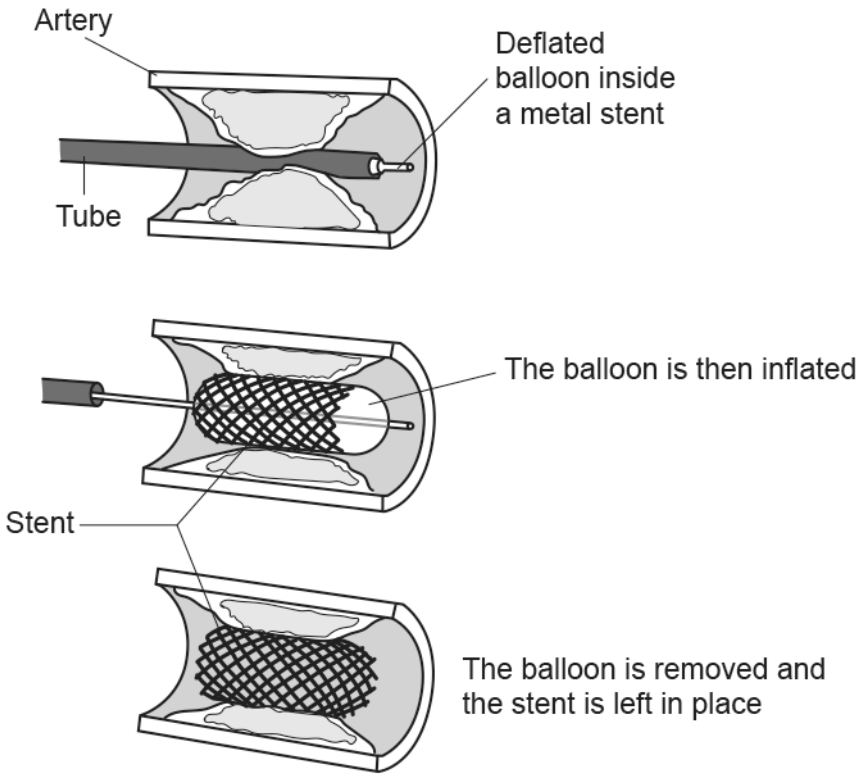
[3]

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(b) There are several treatments for coronary heart disease (CHD).

One of these is an operation.

In this operation, doctors insert a metal grid called a stent into the artery.



(i) Look at the diagram.

Why does using a stent help treat CHD?

---

[2]

(ii) Taking a drug called statins is a treatment for CHD.

The drug is taken every day and lowers the level of cholesterol in a person's blood.

Suggest one **advantage** and one **disadvantage** of taking statins.

Advantage ----------

Disadvantage ----------

---

[2]

50 A student uses a simple potometer to study the effect of different temperatures on the cut shoot of a plant.

What does the potometer actually measure?

A Volume of water evaporating from the leaves of the shoot

B Volume of water produced by respiration in the shoot

C Volume of water taken up by the shoot

D Volume of water used in photosynthesis in the shoot

Your answer ☐ **[1]**

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51 The surface area of a single red blood cell is 1.5×10^{-4} mm^2.

The volume is 1×10^{-7} mm^3.

What is the surface area to volume ratio of a red blood cell?

A 0.0015 : 1

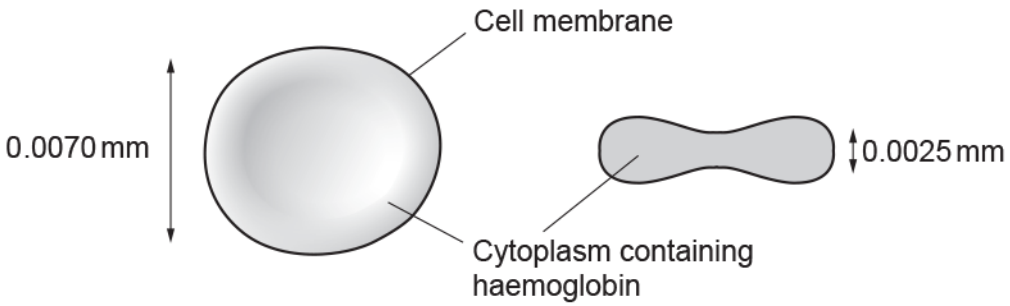
B 0.7 : 1

C 1.5 : 1

D 1500 : 1

Your answer [ ] **[1]**

52 The diagram shows a red blood cell.



	Distance oxygen travels to get to haemoglobin from blood plasma	Surface area to volume ratio	Nucleus present
A	Large	Small	Yes
B	Short	Large	Yes
C	Short	Large	No
D	Large	Large	No

Which row in the table shows how red blood cells are adapted for transport of oxygen?

Your answer [1]

53 Sieve plates are structures found in plants.

What is their location and function?

A Found in phloem and allow movement of sucrose

B Found in phloem and allow movement of water

C Found in xylem and allow movement of sucrose

D Found in xylem and allow movement of water

Your answer [1]

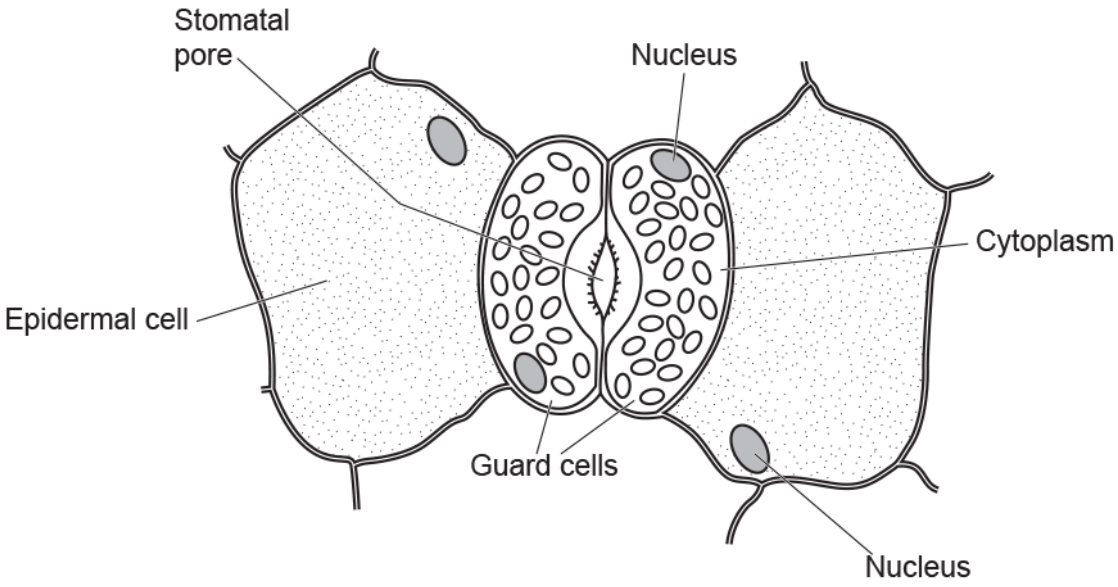
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54(a)

The diagram shows structures on the surface of a leaf.



(i) Photosynthesis occurs in the guard cells but not the epidermal cells.

Explain why this is important in the control of the rate of transpiration in the plant.

---

[4]

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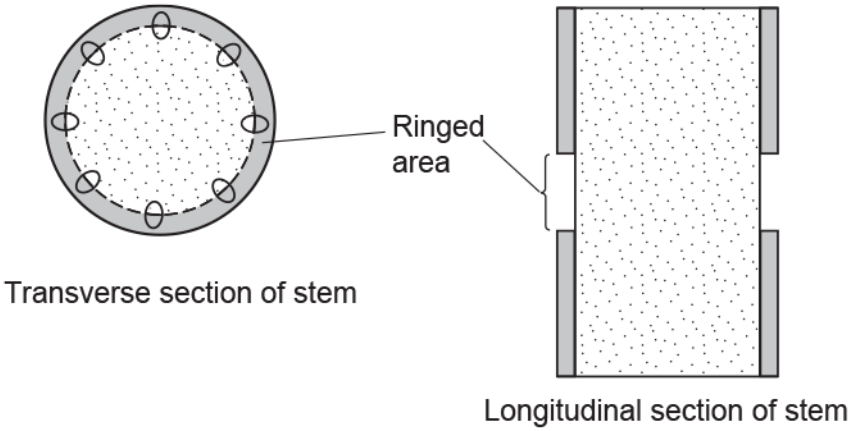
(ii) Explain why guard cells are an example of specialised cells.

---

[2]

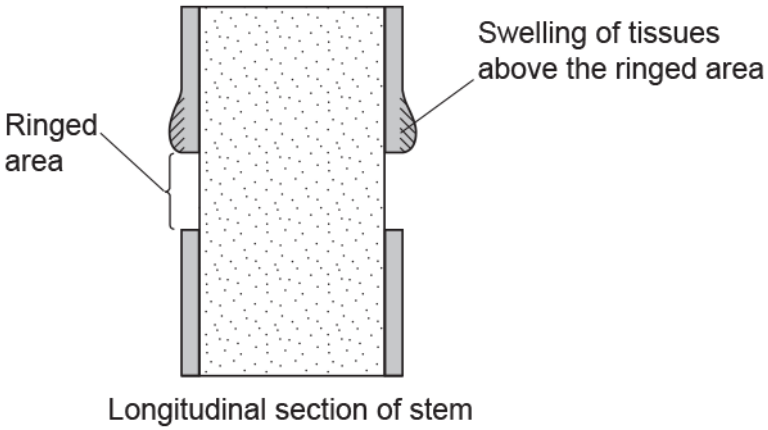
(b) An experiment was done to look at the effect of ringing on a tree trunk. Ringing removes a strip of plant tissue from around the stem of the tree.

The diagram shows where the stem is ringed.



The results were recorded after one week.

The diagram shows the results.



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What conclusions can be made about the results?

---

[3]

55 A cube of potato is used to investigate the effect of surface area on osmosis.

The cube is 3 × 3 × 3 cm.

What is the surface area to volume ratio of the cube?

A 1 : 2
B 2 : 1
C 6 : 1
D 1 : 6

Your answer ☐ [1]

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56(a) The diagram shows cells that are important in the process of **transpiration** in plants.



What is the name of plant cell **X**?

Tick (✓) **one** box.

Phloem cell ☐

Root hair cell ☐

Xylem cell ☐

[1]

(b) State **two** ways that cell **X** is adapted to its function in a plant.

1 _____

2 _____

[2]

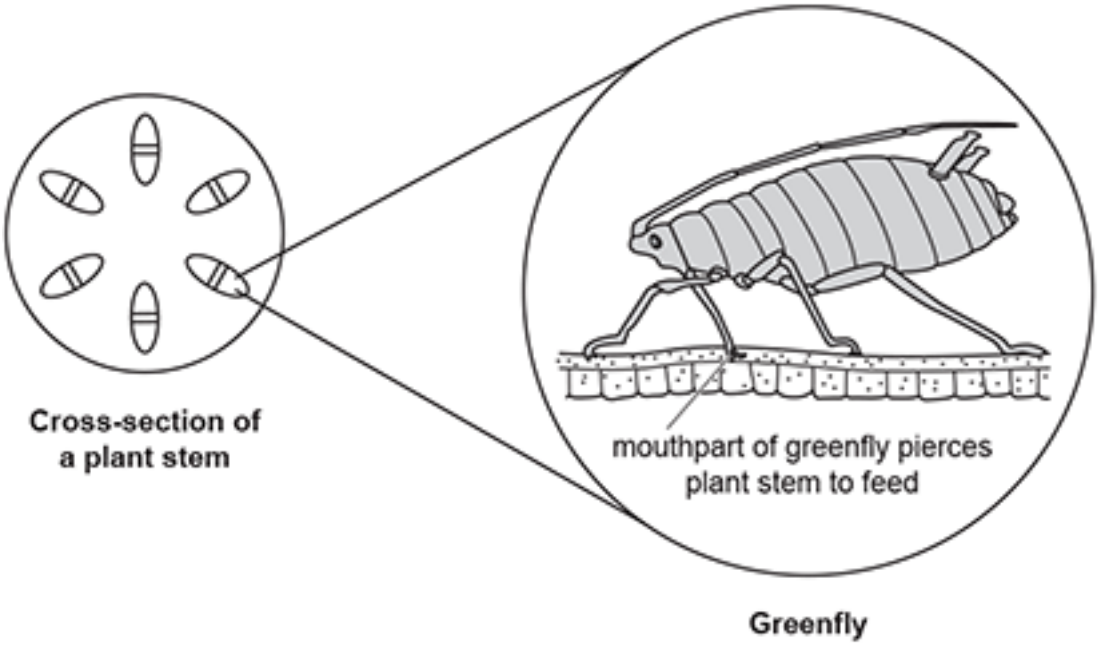
57(a) The diagram shows a cross-section of a plant stem.

A greenfly feeds on the plant by piercing through to the tissue shown in the cross-section of a plant stem.

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(i) What is the name of the tissue in the stem that the greenfly is trying to reach with its mouthpart?

Tick (✓) **one** box.

Phloem ☐

Root hair ☐

Xylem ☐

[1]

(ii) Explain why plants infested with greenfly have very poor growth.

---

[2]

(b) Fifty years ago scientists experimenting on plants had to inject dyes to measure water flow.

Now they can use modern methods such as MRI and X-ray imaging.

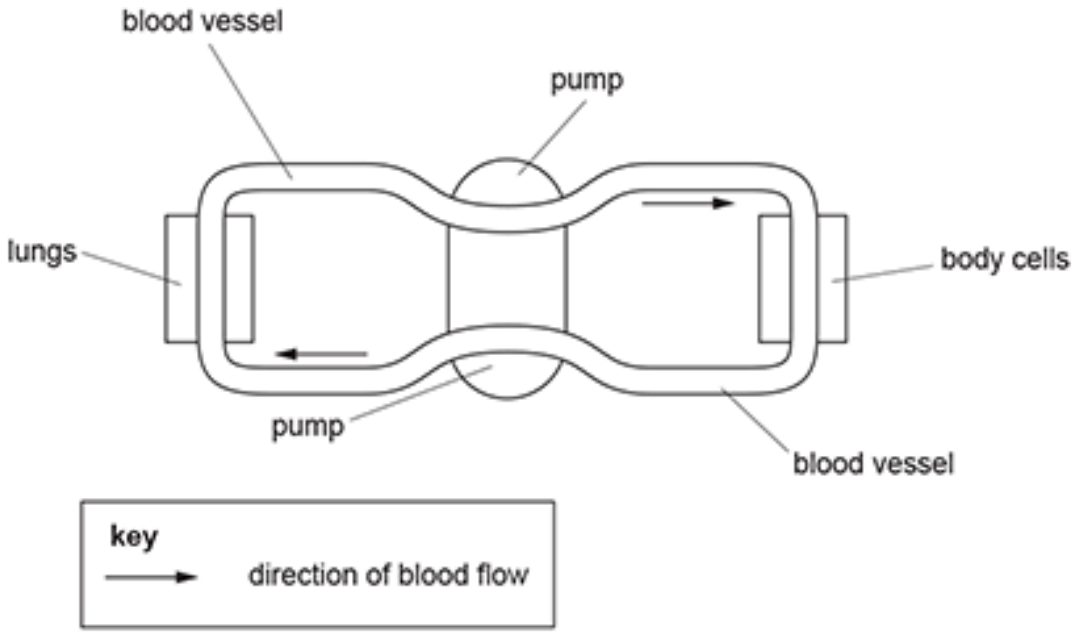
Scientists are now developing new ideas on how water flows through a plant that are different from theories developed fifty years ago.

Explain why.

[2]

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58(a) Look at the diagram. It represents the human circulatory system.

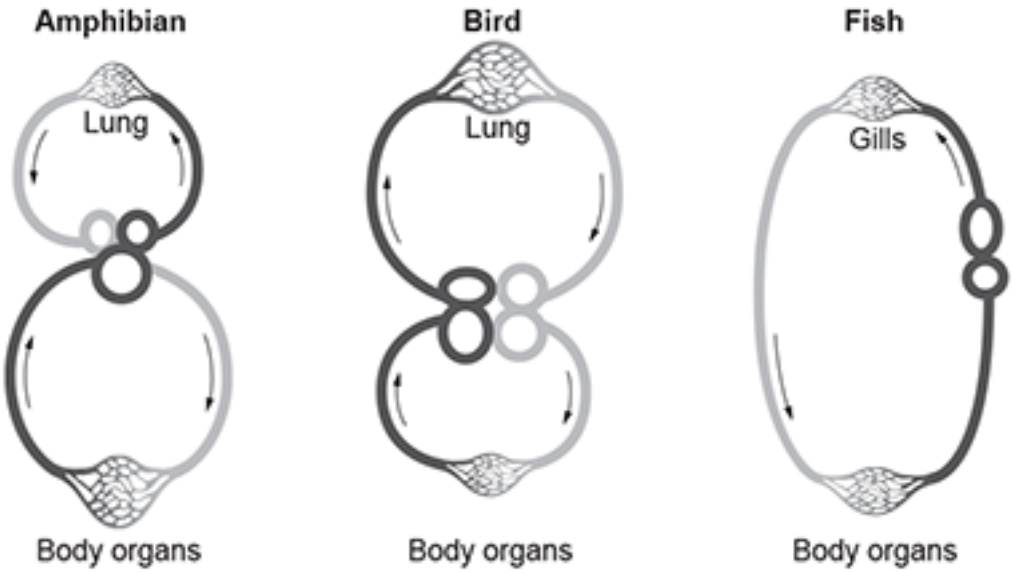


Describe how the diagram shows that humans have a double circulatory system.

---

[2]

(b) Look at the diagrams of the circulation systems in an amphibian, bird and fish.



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Which of these has a circulatory system most similar to humans?

Tick (✓) **one** box.

Amphibian ☐

Bird ☐

Fish ☐

Explain your choice.

---

[3]

(c) Scientists investigate how exercise affects blood flow to different organs in the body.

This is their method.

- Ask a healthy person to sit in a room at 20 °C
- Measure the blood flow to different organs in the person's body
- Repeat this with the person exercising at a constant speed on a treadmill in the same room.

The table shows the scientists' results.

Organ	Rate of blood flow (ml per minute)	
	Sitting	Doing exercise
Brain	750	750
Heart muscle	250	1000

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Muscles	1200	22 000
Skin	500	600
Other organs	3100	650
Total	**5800**	**25 000**

(i) By how many times has the **total** blood flow increased by doing exercise?

Give your answer to the **nearest whole number**.

Number of times the total blood flow has increased = ... **[2]**

(ii) The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

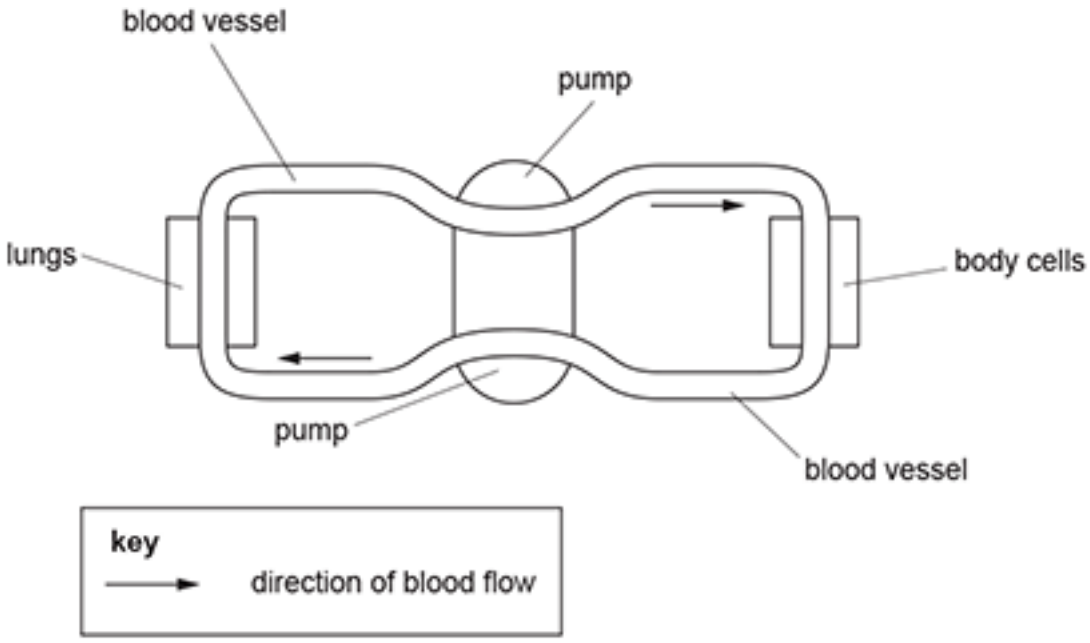
The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

---

[2]

59(a) Look at the diagram. It represents the human circulatory system.



Describe how the diagram shows that humans have a double circulatory system.

---

[2]

(b) Scientists investigate how exercise affects blood flow to different organs in the body.

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Skin	500	600
Other organs	3100	650

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Total	5800	25 000

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Number of times the total blood flow has increased = _____ [2]

(ii) The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

_____

_____

_____

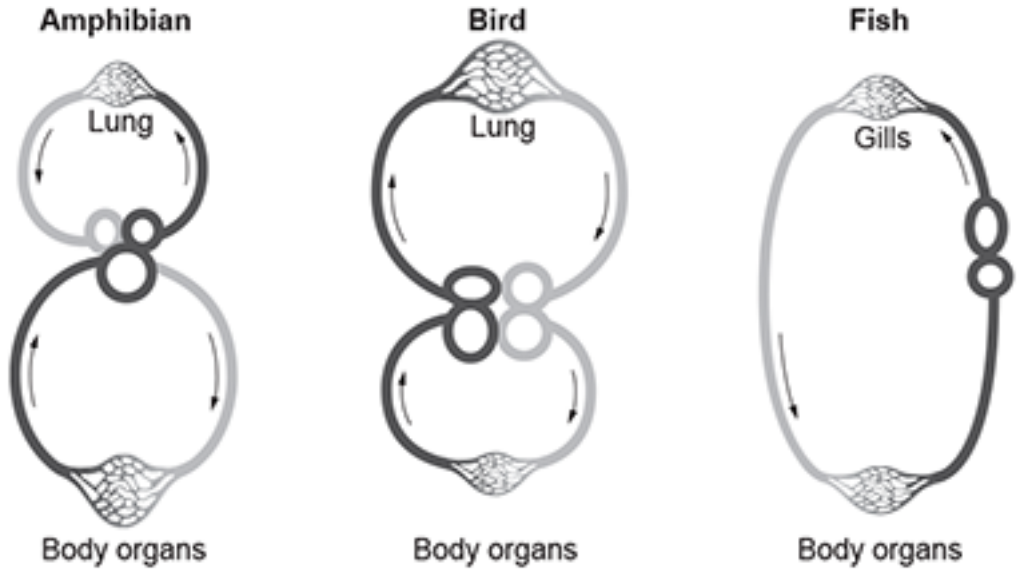
_____ [2]

(c) Look at the diagrams of the circulation systems in an amphibian, bird and fish.

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Which of these has a circulatory system most similar to humans?

Tick (✓) **one** box.

Amphibian ☐

Bird ☐

Fish ☐

Explain your choice.

---

[3]

60(a) Rats are a major pest in many areas of the world. They can reduce food security and spread diseases.



Warfarin is a chemical that is used as a rat poison. It stops platelets working in the blood.

Describe the function of platelets in the blood.

---

[2]

(b) Some rats are resistant to warfarin. When fed with large amounts of warfarin the rats do not die.

Scientists found that the resistance is due to the dominant allele **R**.

Two resistant rats (**Rr**) mate.

Complete this genetic diagram to find the ratio of resistant rats to non-resistant rats that would be expected to be produced.

		Rr	
		.....	.....
Rr	R	.....	.....
	r	.....	.....

Ratio = ... [3]

(c) After several years, the percentage of resistant rats in the population had increased.

Use Darwin's theory of natural selection to explain this observation.

[3]

(d) Scientists are now trying to find another poison to use on rats.

They have introduced a chemical called phosphine. This blocks the action of mitochondria in rat cells.

Explain why this might kill rats.

[3]

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61(a) Rats are a major pest in many areas of the world. They can reduce food security and spread diseases.



Warfarin is a chemical that is used as a rat poison. It stops the correct functioning of platelets in the blood.

Explain why warfarin can be used as a rat poison.

---

[2]

(b) In 1958, some rats were found that were resistant to warfarin. They did not die, even when fed with large amounts of the poison. Scientists found that the resistance was due to dominant allele **R**.

Two resistant rats can mate and produce non-resistant rats.

Draw a genetic diagram below to show how these non-resistant rats can be produced.

[3]

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(c) When scientists studied the resistant rats they found that there were two different types.

Homozygous rats are resistant to warfarin but need to eat 20 times more vitamin K.

Heterozygous rats are resistant to warfarin but only need slightly increased amounts of vitamin K.

The scientists found that the non-resistant rats never died out completely.

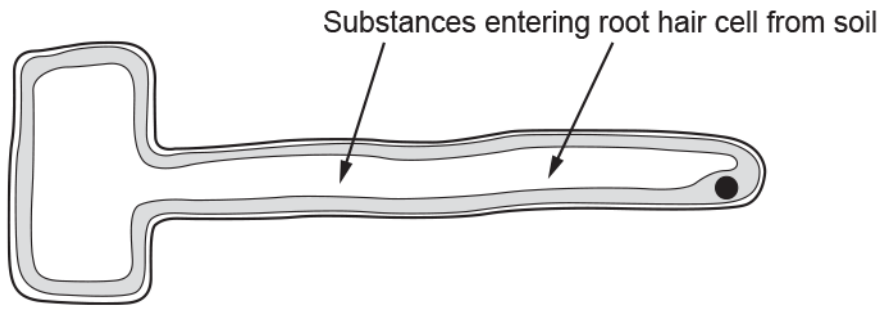
Explain why.

---

[2]

---

62 Which substances are absorbed from the soil by the root hair cell?



A Carbohydrates and proteins

B Carbon dioxide and nitrogen

C Proteins and vitamins

D Water and mineral ions

Your answer ☐ [1]

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63 Which process moves food around in plants?

A Osmosis
B Respiration
C Translocation
D Transpiration

Your answer [ ] [1]

64 Some plants can wilt if they lose more water than they take up.

Which conditions make a plant **most** likely to wilt?

A Higher wind speed and lower temperature
B Lower wind speed and lower temperature
C Lower wind speed and higher temperature
D Higher wind speed and higher temperature

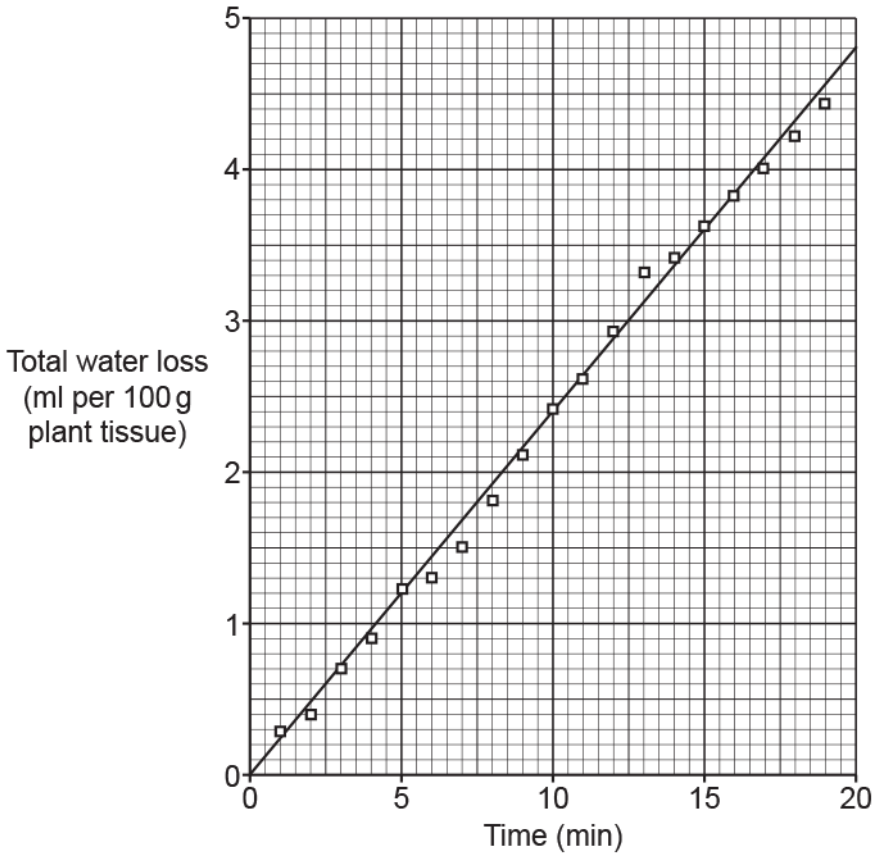
Your answer [ ] [1]

65 The graph shows total water loss from a plant.

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Calculate the water lost between 5 and 15 minutes using the line of best fit.

A 2.2 ml per 100 g

B 2.4 ml per 100 g

C 2.6 ml per 100 g

D 2.8 ml per 100 g

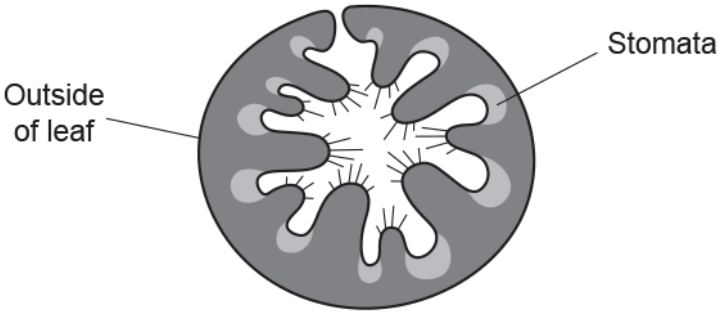
Your answer ☐ **[1]**

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66 Marram grass grows on sand dunes with very little water available. It has a leaf that is curled in on itself so that the stomata are hidden on the inside, as shown in the diagram.



Why does this adaptation help the plant to survive on sand dunes?

A Increases gas exchange from the stomata.

B Reduces air movement around the stomata.

C Increases photosynthesis by the leaf.

D Increases water uptake by the leaf.

Your answer ☐ **[1]**

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67(a) Some students investigate the effect of the surface area : volume ratio on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes that have been stained blue using a pH indicator solution. The indicator will turn red in acidic conditions.

They put different sized cubes into 3 different test tubes of hydrochloric acid and time how long it takes for the cubes to completely change to red.

Fig. 21.1 shows the apparatus they use.

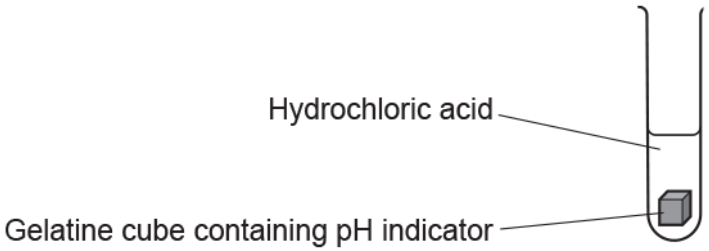


Fig. 21.1

The table shows the students' results.

Length of each side of the cube (mm)	surface area : volume ratio	Time to completely change colour (seconds)
2	.....	32
4	3 : 2	61
6	1 : 1	170

(i) Calculate the surface area : volume ratio for the cube with sides of 2 mm.

surface area : volume ratio = ... **[2]**

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(ii) What conclusion can be made about the effect of surface area : volume ratio on the rate of diffusion?

[1]

(iii) Emphysema causes some of the walls of alveoli in the lungs to break down. This produces a smaller number of larger air sacs.

Use the results to explain the effect of emphysema on oxygen diffusing into the blood.

[2]

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(b) In a condition called sickle cell anaemia, the red blood cells can change shape. This reduces the amount of oxygen getting to cells in the body.

Fig. 21.2 shows a red blood cell and a sickled red blood cell.



Fig. 21.2

Explain why sickle cell anaemia reduces the amount of oxygen getting to cells in the body.

---

[2]

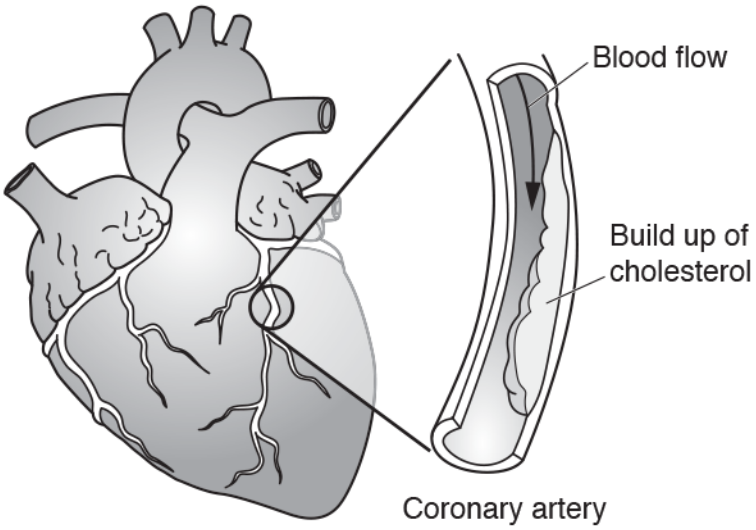
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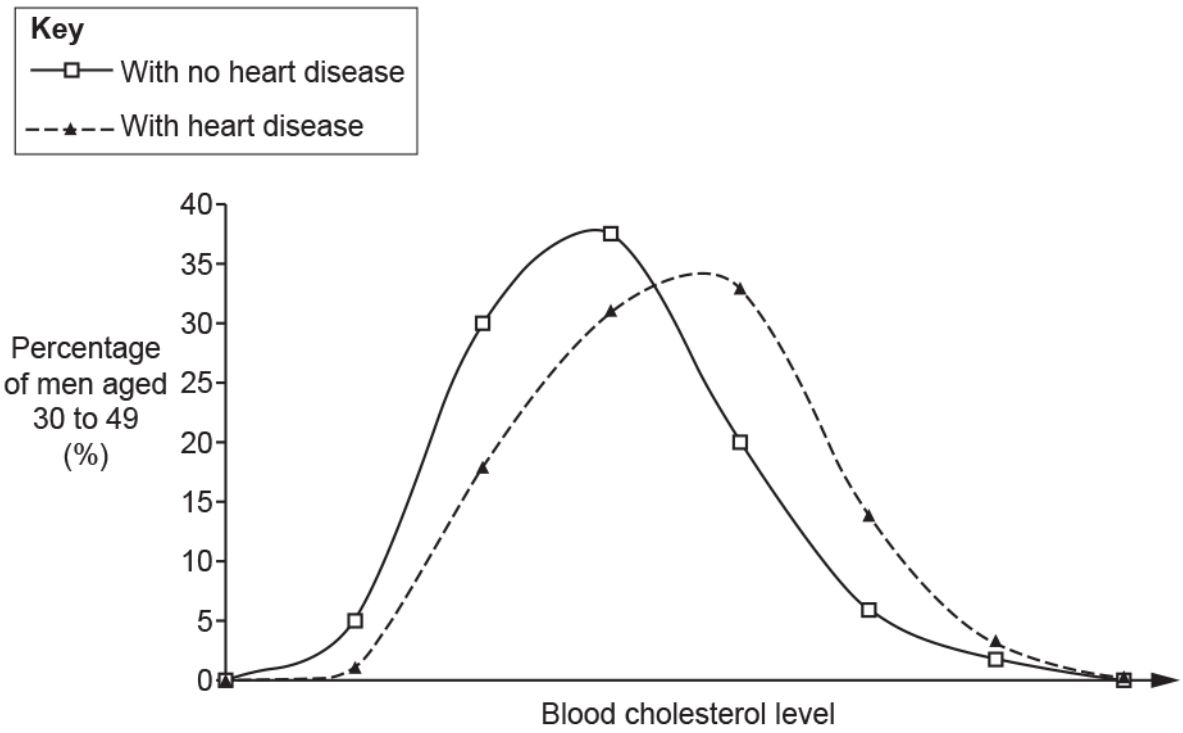
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68 Hypercholesterolemia (HC) is caused by a dominant allele on chromosome 19. This allele has mutations which cause a change in the order of DNA nucleotides.

* People with HC are more likely to get heart disease. The diagram shows the heart of a person who has heart disease.



The graph shows the results of a study of men aged 30 to 49. The study measured the cholesterol levels in the blood of the men. It also recorded if the men developed signs of heart disease.



Explain the possible link between cholesterol and heart disease and if this link is supported by the graph.

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Use evidence from the diagram and the graph in your answer.

[6]

69 Which row shows the correct direction of blood flow through a double circulatory system?

A	left side of heart	→	body organs	→	right side of heart	→	lungs
B	left side of heart	→	lungs	→	right side of heart	→	body organs
C	right side of heart	→	body organs	→	lungs	→	left side of heart
D	right side of heart	→	lungs	→	body	→	left side of heart

Your answer ☐ [1]

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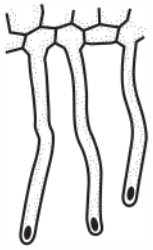
70 How is sugar transported around a plant?

A Upwards in phloem
B Upwards in xylem
C Upwards and downwards in phloem
D Upwards and downwards in xylem

Your answer ☐ [1]

71 Which diagram shows cells that swell, creating an opening during daylight conditions?

A



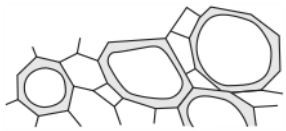
B



C



D



Your answer ☐ [1]

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72(a) Some students investigate the effect of the surface area : volume ratio on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes that have been stained blue using a pH indicator solution. The indicator will turn red in acidic conditions.

They put different sized cubes into 3 different test tubes of hydrochloric acid and time how long it takes for the cubes to completely change to red.

Fig. 16.1 shows the apparatus they use.

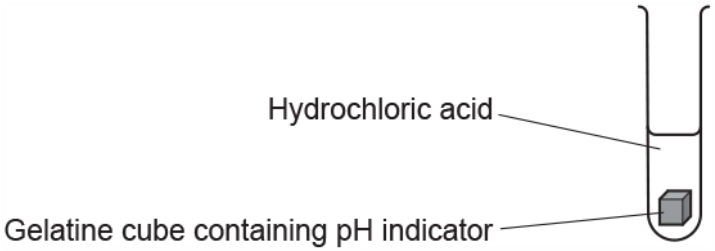


Fig. 16.1

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(i) Calculate the surface area : volume ratio for the cube with sides of 2 mm.

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surface area : volume ratio = ... [2]

(ii) What conclusion can be made about the effect of surface area : volume ratio on the rate of diffusion?

---

[1]

(iii) Emphysema causes some of the walls of alveoli in the lungs to break down. This produces a smaller number of larger air sacs.

Use the results to explain the effect of emphysema on oxygen diffusing into the blood.

---

[2]

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(b) In a condition called sickle cell anaemia, the red blood cells can change shape. This reduces the amount of oxygen getting to cells in the body.

Fig. 16.2 shows a red blood cell and a sickled red blood cell.



Fig. 16.2

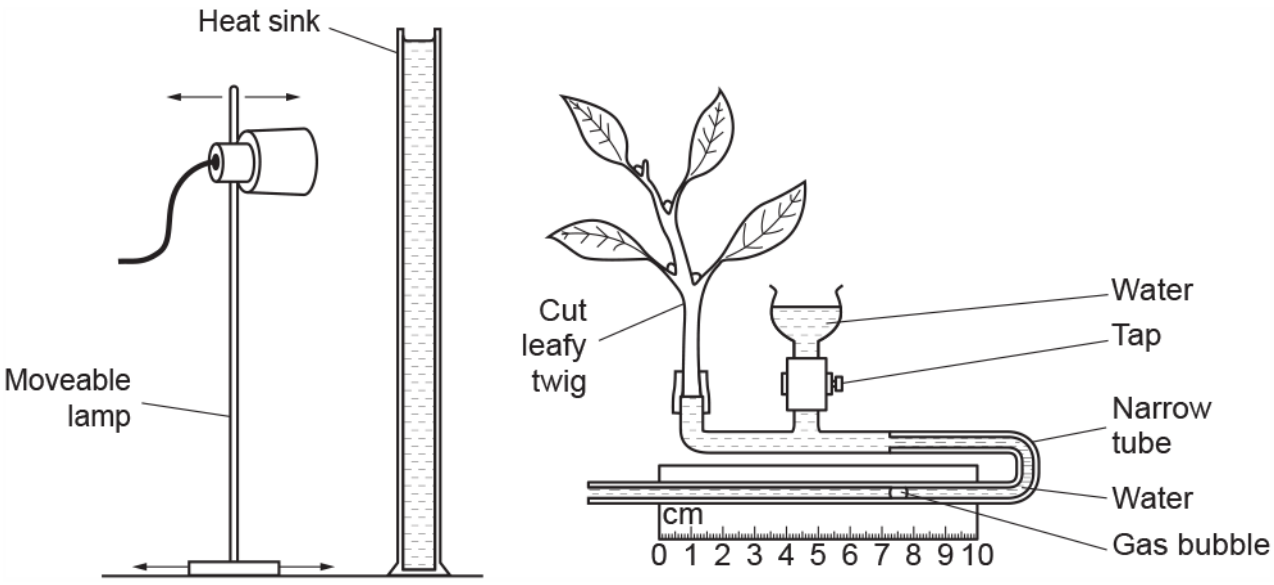
Explain why sickle cell anaemia reduces the amount of oxygen getting to cells in the body.

---

[2]

73(a) The diagram shows a simple potometer.

The apparatus can be used to investigate the effect of light intensity on transpiration rates.



(i) Describe what happens during transpiration.

---

[2]

(ii) Describe how the apparatus can be used to investigate the effect of light on transpiration rates.

---

[3]

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(iii) The heat sink is a transparent tube of cold water.

Explain why a heat sink is used in this experiment.

---

[2]

(b) The table shows the results from using the potometer.

Distance of potometer from the light (cm)	Distance gas bubble moved in one minute (mm)		
	Trial 1	Trial 2	Trial 3
10	70	74	72
20	73	75	71
30	52	49	51
40	42	30	31
50	12	14	13

(i) The mean distance the gas bubble moved along the tube at 10 cm from the light was 72 mm.

The diameter of the narrow tube was 1 mm.

Calculate the volume of water taken up by the plant.

Use the equation: volume = $\pi r^2 l$
where r is the radius of the tube and l is the distance the bubble moves
$\pi = 3.14$

Give your answer to **2** significant figures.

Volume of water = ... mm^3 / minute **[3]**

(ii) Identify the anomalous reading in their recorded results and suggest a possible reason for this.

---

[2]

(iii) How should the scientists deal with this anomalous reading when they process the data?

---

[1]

(iv) The scientists described their results for **20 cm** as 73 ± 2.
Explain why they did this.

---

[2]

74(a) Fanconi anaemia is a genetic disorder. It results in the bone marrow being destroyed.
This causes a decrease in the numbers of red blood cells, white blood cells and platelets.

Explain **two** possible symptoms of Fanconi anaemia.

1 ---

---

2 ---

---

[2]

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(b) **Table 19.1** shows normal ranges for blood components in people **without** Fanconi anaemia.

Blood component	Number per mm^3
red blood cell	$4.5 – 6.5 \times 10^6$
white blood cell	$6.0 – 16.0 \times 10^3$
platelet	$1.5 – 4.0 \times 10^5$

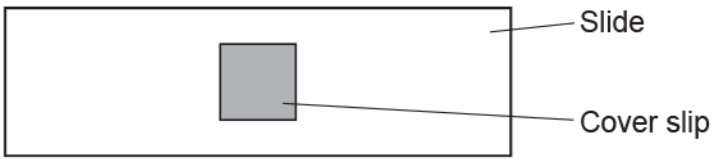
Table 19.1

(i) Suggest why there is such a wide range of white blood cell numbers.

---

[2]

(ii) The diagram shows a microscope slide containing blood from a patient.



The square cover slip is 10 mm wide and the thickness of the blood underneath is 0.001 mm.

Calculate the volume of blood under the cover slip.

Volume of blood = ... mm^3 **[1]**

(iii) Under the cover slip are 1000 white blood cells.

Does the blood sample provide evidence that the patient has Fanconi anaemia?

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Use **Table 19.1** and your answer to part **(ii)** to justify your answer.

---

[3]

(c) There are many different genetic disorders that can affect blood cells. Details of three of these are found in **Table 19.2**.

Name of disorder	Cause of disorder	Symptom
D-B anaemia	dominant allele	low red blood cell numbers
S-D syndrome	recessive allele	low white blood cell numbers
Fanconi anaemia	recessive allele	small numbers of all blood cells

Table 19.2

A blood smear from another patient shows that he has 3×10^6 red blood cells per mm^3 of blood. Neither of his parents have a blood disorder.

Use **Table 19.1** and **Table 19.2** to explain which blood disorder the patient could have.

Name of disorder ---

Explanation ---

---

[3]

75 Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

People with HC are more likely to develop heart disease. **Fig. 21.1** shows the heart of a person who has heart disease.

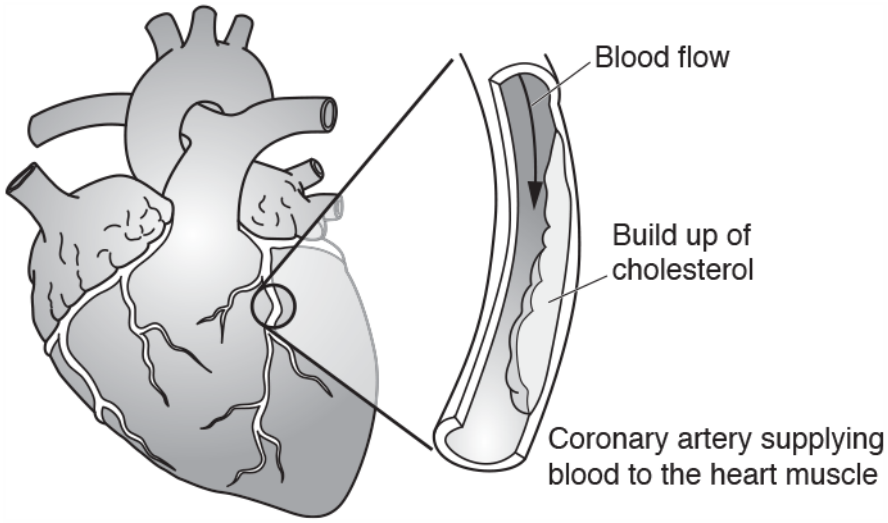


Fig. 21.1

The LDL receptor protein is found on the cell membrane of liver cells. The receptor picks up cholesterol from the blood and transports it into the liver cell. Inside the liver cell the cholesterol is broken down or used.

Explain why people who have the mutation in the allele for the LDL receptor are much more likely to develop heart disease.

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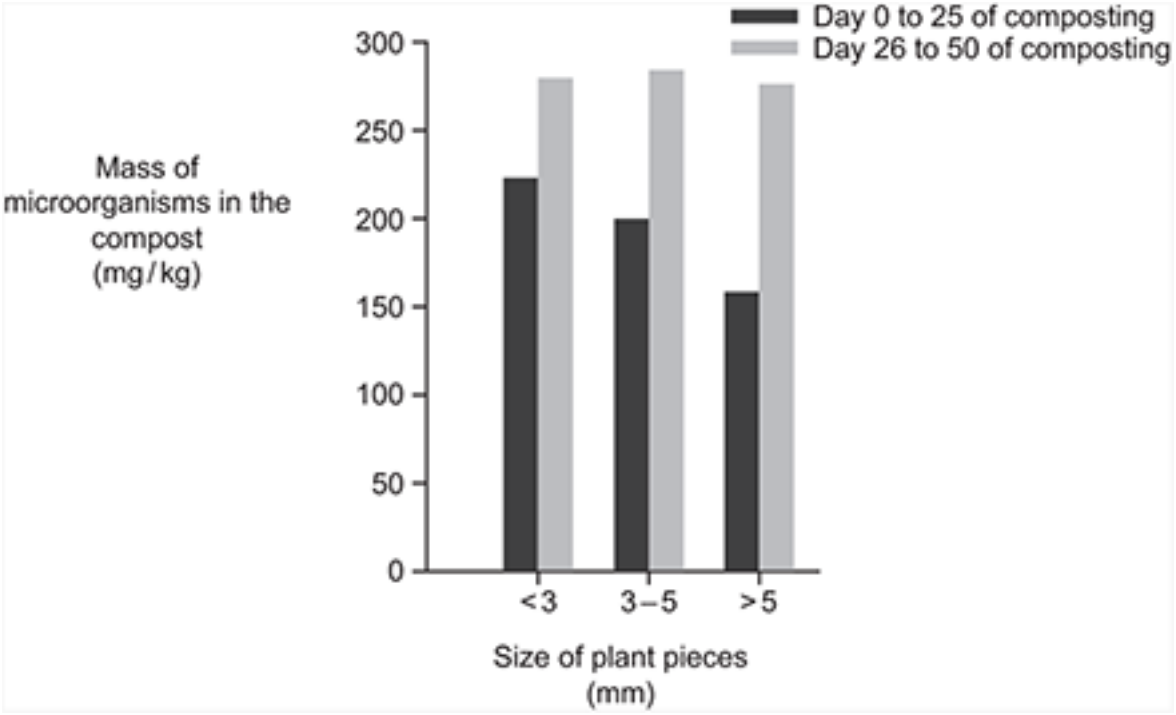
[6]

76 This machine helps shred plants for a compost heap.



The machine can shred plants into three different sizes.

This graph is in the instruction booklet for the machine.



The size of the plant pieces has an effect on the number of microorganisms in the compost.

Suggest why.

---

[2]

END OF QUESTION PAPER